A Default Logic Approach to the Derivation of Natural Language Presuppositions

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Abstract

A hearer's interpretation of the meaning of an utterance consists of more than what is conveyed by just the sentence itself. Other parts of the meaning are produced as inferences from three knowledge sources: the sentence itself, knowledge about the world, and knowledge about language use. One inference of this type is the *natural language presupposition.* This category of inference is distinguished by a number of features: the inferences are generated only, but not necessarily, if certain lexical or syntactic environments are present in the uttered sentence; normal interpretations of these presuppositional environments in the scope of a negation in a simple sentence produce the same inferences as the unnegated environment; and the inference can be cancelled by information in the conversational context.

We propose a method for deriving presuppositions of natural language sentences that has its foundations in an inference–based concept of meaning. Whereas standard (monotonic) forms of reasoning are able to capture portions of a sentence's meaning, such as its entailments, non–monotonic forms of reasoning are required to derive its presuppositions. Gazdar's idea of presuppositions being consistent with the context, and the usual connection of presuppositions with lexical and syntactic environments motivates the use of Default Logic as the formal non–monotonic reasoning system. Not only does the default logic approach provide a natural means to represent presuppositions, but also a single (slightly restricted) default proof procedure is all that is required to generate the presuppositions. The naturalness and simplicity of this method contrasts with the traditional projection methods. Also available to the logical approach is the proper treatment of '*or*' and '*if* ... *then* ...' which is not available to any of the projection methods.

The default logic approach is compared with four others, three projection methods and one non–projection method. As well as serving the function of demonstrating empirical and methodological difficulties with the other methods, the detailed investigation also provides the motivation for the topics discussed in connection with default logic approach. Some of the difficulties have been solved using the default logic method, while possible solutions for others have only been sketched.

A brief discussion of a new method for providing corrective answers to questions is presented. The novelty of this method is that the corrective answers are viewed as correcting presuppositions of the answer rather than of the question.

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To the memory of my dad

Chapter 1

Introduction

1.1 Overview

A hearer's interpretation of the meaning of an utterance consists of more than what is conveyed by just the sentence itself. Other parts of the meaning are produced as inferences from three knowledge sources: the sentence itself, knowledge about the world, and knowledge about language use. One inference of this type is the ***natural language presupposition.*** This category of inference is distinguished by a number of features: the inferences are generated only, but not necessarily, if certain lexical or syntactic environments are present in the uttered sentence; normal interpretations of these presuppositional environments in the scope of a negation in a simple sentence produce the same inferences as the unnegated environment; and the inference can be cancelled by information in the conversational context.

Because a precise definition requires a great deal of development, the discussion below will necessarily be carried via examples. A definition of presupposition is given in Chapter 3. (1.1)–(1.5) show some prototypical examples of presuppositions produced by the following presuppositional environments: noun phrases, possessives, factive verbs, certain aspectuals, and definitions of words, respectively. In each of these examples the affirmative (a)–sentence entails and the negative (b)–sentence presupposes the (d)–sentence. The difference between entailment and presupposition is a technical one; for instance entailments cannot be cancelled. (Most definitions of presupposition conflate the two forms of inference in affirmative sentences.) The cancelability of the presuppositional inference is demonstrated by the (c)–sentence in each case. No reasonable interpretation of the (c)–sentence would infer the (d)–sentence.

(a) The present king of Buganda is bald.

(b) The present king of Buganda is not bald.

(c) The present king of Buganda is not bald, because Buganda has no king. (1.1)

(d) There presently exists a king of Buganda.

(a) Jack's children are bald.

(b) Jack's children are not bald.

(c) Jack's children are not bald; Jack doesn't have any. (1.2)

(d) Jack has children.

(a) Mary is surprised that Fred left.

(b) Mary is not surprised that Fred left.

(c) Mary is not surprised that Fred left, because he is still here. (1.3)

(d) Fred left.

(a) John stopped beating the rug.

(b) John did not stop beating the rug.

(c) John did not stop beating the rug, he hasn't even started. (1.4)

(d) John has been beating the rug.

(a) My cousin is a bachelor.

(b) My cousin is not a bachelor.

(c) My cousin is not a bachelor; she is a spinster. (1.5)

(d) My cousin is a male adult.

The notion of presupposition has had quite a long history. Beginning with Frege (1892), and having been resurrected by Strawson (1950), it finally landed in the linguistic arena in the late 1960's (Kiparsky and Kiparsky (1970) which in an earlier form was first presented in 1967, and

Langendoen and Savin (1971) which was first read in 1969). Two themes that have persisted in various forms since these early writings are that presuppositions are entailments of the sentence (and the pragmatic context in those definitions that allow a pragmatic component) and that sentences inherit some subset of the presuppositions possessed by the subordinate clauses.

The position held in the first theme has been attacked by Kempson and Wilson who both propose that sentences that contain presuppositional environments have a disjunctive representation (Kempson (1975) and Wilson (1975)). Gazdar has also suggested an alternative to the entailment hypothesis (Gazdar (1979)). He argues that presuppositions should be defined in terms of consistency rather than entailment. In addition to this paradigm shift, he also proposes an algorithm to derive[1] the presuppositions of sentences based on this idea of consistency.

Although the idea that presupposing is a form of entailing has, I believe, been laid to rest, the other theme persists. The *projection problem* — which of the clausal presuppositions are inherited by the sentence — has been given various solutions based on a variety of *projection methods.* One of the aims of this thesis is to represent presuppositions in a formal system that not only captures the idea of consistency as expounded by Gazdar, but that also provides a means to derive the presuppositions of sentences without recourse to a projection method.

This thesis proposes a major paradigm shift. Moving away from the standard linguistic notions of meaning based on compositionality, I propose a method for deriving presuppositions of natural language sentences that has its roots in an inference–based concept of meaning. Whereas standard (monotonic) forms of reasoning are able to capture portions of a sentence's meaning, such as its entailments, non–monotonic forms of reasoning are required to derive its presuppositions. Kempson and Wilson's disjunctive representation for presuppositional environments in the scope of a negation and the need to make non–disjunctive inferences from this representation is a linguistic situation which can be modelled by non–monotonic inferencing from incomplete knowledge bases. Gazdar's idea of presuppositions being consistent with the context, and the usual connection of presuppositions with lexical and syntactic environments was the motivation for using Default Logic as the formal non–monotonic reasoning system.

Three issues are introduced and investigated in Chapter 2: the linguistic context and the motivation for considering it as a logical theory; implicatures, which are inferences derived from

[1]It should be noted that throughout this thesis the term *derive* is not used in its classical logical sense. Classically, a method of derivation can enumerate all theorems. As soon as the notion of consistency is added to the derivation procedure, the set of theorems is no longer recursively enumerable.

Grice's Cooperative Principle (Grice (1975)), and which form part of the linguistic context in which the presuppositions are derived; and, of course, presuppositions, the main topic of this thesis.

Drawing on the ideas of Gazdar as well as Kempson and Wilson, I describe in Chapter 3 the default logic approach for deriving presuppositions of asserted declarative sentences. Along with a summary of previous arguments defending a *vague* representation for natural language negation, the main theory is presented. The major issues are the representation of presuppositions and the inferencing mechanisms required for generating these inferences in a coherent fashion. Not only does the default logic approach provide a natural means to represent presuppositions, but also a single (slightly restricted) default proof procedure is required to generate the presuppositions. This method contrasts with the projection methods each requiring a variety of procedures. Also available to me is the proper treatment of '*or*' and '*if* ... *then* ...' which is not available to any of the projection–ists. Concluding this chapter is a tentative definition of presupposition which indicates its close analogy to entailment.

Chapter 4 compares the default logic approach with four other approaches, three projection methods and one non–projection method. The comparison proceeds in two parts. The first part is a detailed investigation of the four other methods. As well, this investigation serving the function of demonstrating empirical and methodological difficulties with each of the methods, it also provides the motivation for the topics discussed in connection with default logic approach. Some of the problems have been solved using my method, while others have only a sketch of a complete solution. The discussion in Chapters 3 and 4 demonstrates the close connection that presupposition, as discussed in this thesis, has to negation.

A brief discussion of the topic which originally motivated this research is given in Chapter 5. Providing corrective rather than direct answers to questions requires the derivation of presuppositions. Since the method presented in Chapter 3 depends crucially on the sentence being an asserted declarative sentence, a method which derives the presuppositions of the answer rather than of the question is presented.

1.2 Summary of Results

The research reported in this thesis has concentrated mainly on the issue of deriving presuppositions of natural language sentences using default logic. Because of the exploratory nature of

the research, some issues have been left unresolved. One goal of the research was to formulate an alternative to the projection methods. To be a credible alternative, the empirical scope of the new method must include the data explained by the previous approaches. Therefore, I have concentrated my efforts in this area. I believe that the issues that have been left for future work, although crucial for the new method's credibility, will require substantial investigation.

The major contribution provided by the use of default logic is to provide a means of inferring the ***preferred interpretation*** from the vague representation of the presuppositional environment, something which classical logics cannot do. Because the default logic approach provides a non–compositional method for generating the presuppositions of a natural language sentence, a proper treatment of '*or*' and '*if... then...*' is obtained. The improper treatment is of concern in data which include lexical items with non–binary features. Also, the non–compositionality of the default logic approach allows a clearer distinction between entailments and presuppositions. The importance of negation in the definition of presupposition is again revealed. The default logic treatment circumvents the problem of unmotivated rule ordering constraints found in previous methods. A framework has been established around which a model theory for presuppositions is possible. And lastly, the empirical scope of the default logic paradigm includes the data explained by previous methods as well as data that could not be previously handled. This latter data includes sentences with non–binary features and the sentential adverbs '*too*' and '*again*'.

Two topics that have been left for future work are finding a uniform representation of the presuppositional default rules to replace the one–environment–one–rule situation as it now exists, and finding a well–motivated method to prevent the misuse of default rules in inappropriate situations.

Chapter 2

Relevant Language Issues

Linguistic communication is one method for an intelligent being (referred to as the speaker) to transfer an idea to another intelligent being (referred to as the hearer). The transmitted idea may be some factual information, or a request for information, or a desire that some situation in the world be changed. Communicating through language requires an *utterance*. Formally, an utterance is a *statement–context* pair.[1] Although the transmission of information can be enhanced with input such as gestures or reference to objects in the visual field of the speaker and hearer, only that which is communicated directly through the language component is of interest here.

The meaning of an utterance has two main components: the information to be transmitted, what is known as the *propositional content*, together with inferences sanctioned by the rules of the communication act; and the intended purpose of the utterance. Very little is said about the second component in this thesis. And this thesis only deals with a small part of the first component: *presuppositions*. The theory developed in Chapter 3 views presuppositions as inferences sanctioned by rules of the communication act and inferred from the propositional content of the utterance and a set of facts embodying knowledge about the real world and knowledge about the communication act. As a matter of fact, I look at a very limited part of the communication act. Information can be transferred using a number of sentential forms: declaratives, interrogatives, and imperatives. As well, the speaker can intend the utterance

[1] A statement can be regarded as a natural language sentence that has been properly indexed by who is the speaker, who is the hearer, when is the sentence uttered, etc. This conflation of statement/sentence has no direct bearing on my theory, and I will assume that the indexicals are obvious in the examples that I give throughout this thesis.

to assert, promise, question, command, etc. This theory deals only with declarative sentences used as assertions.

Section 2.1 provides a slightly fuller view of the communication model and the body of knowledge used in constructing and interpreting utterances. Section 2.2.1 introduces the rules of the communication act which bear directly on the theory of presuppositions proposed in Chapter 3. The remaining sections introduce the concept of presuppositions and some of the previous attempts to develop a theory of presuppositions of natural language sentences.

2.1 A Model of Communication

One well–established view (Charniak (1976a, 1976b)) is that the meaning of a natural language utterance consists of at least the logical form of the utterance plus all of the inferences that can be made from the union of the logical form and a vast storehouse of knowledge. The method to generate these inferences is not agreed upon. Nor is there complete agreement on the logical representation. It is generally accepted that if the utterance is an asserted declarative sentence then the logical form is more or less the proposition asserted in the utterance (Gazdar (1979)). This thesis demonstrates the use of default logic to generate a particular kind of inference, presupposition, from a first order logic representation of asserted declarative sentences.

The basic design of any model of communication (Simmons (1973), Winograd (1977)) contains two processes: the generation of the utterance by the speaker (S) and the interpretation of the utterance by the hearer (H). A general form of the communication act depicted in Figure 2.1 shows these two processes. The first phase is the construction of the natural language sentence which is the carrier of the utterance. S forms this sentence with the understanding that it is to be interpreted by H (Winograd (1980)). The first assumption that is made about the model of communication shown in Figure 2.1 is that the rules given in Grice's theory of cooperative communication govern the communication act. These rules, collectively known as the Cooperative Principle will be discussed in more detail in section 2.2.1. S has an idea that is to be transmitted, an intended purpose for making the utterance (in this thesis the only intention that will be considered will be to assert some fact in order that H knows (or believes) that fact), and knowledge about how to construct utterances. In this model H determines S's intended meaning using knowledge about interpreting utterances. The second assumption that is made about the model of communication shown in Figure 2.1 is that the *meaning* of an as-

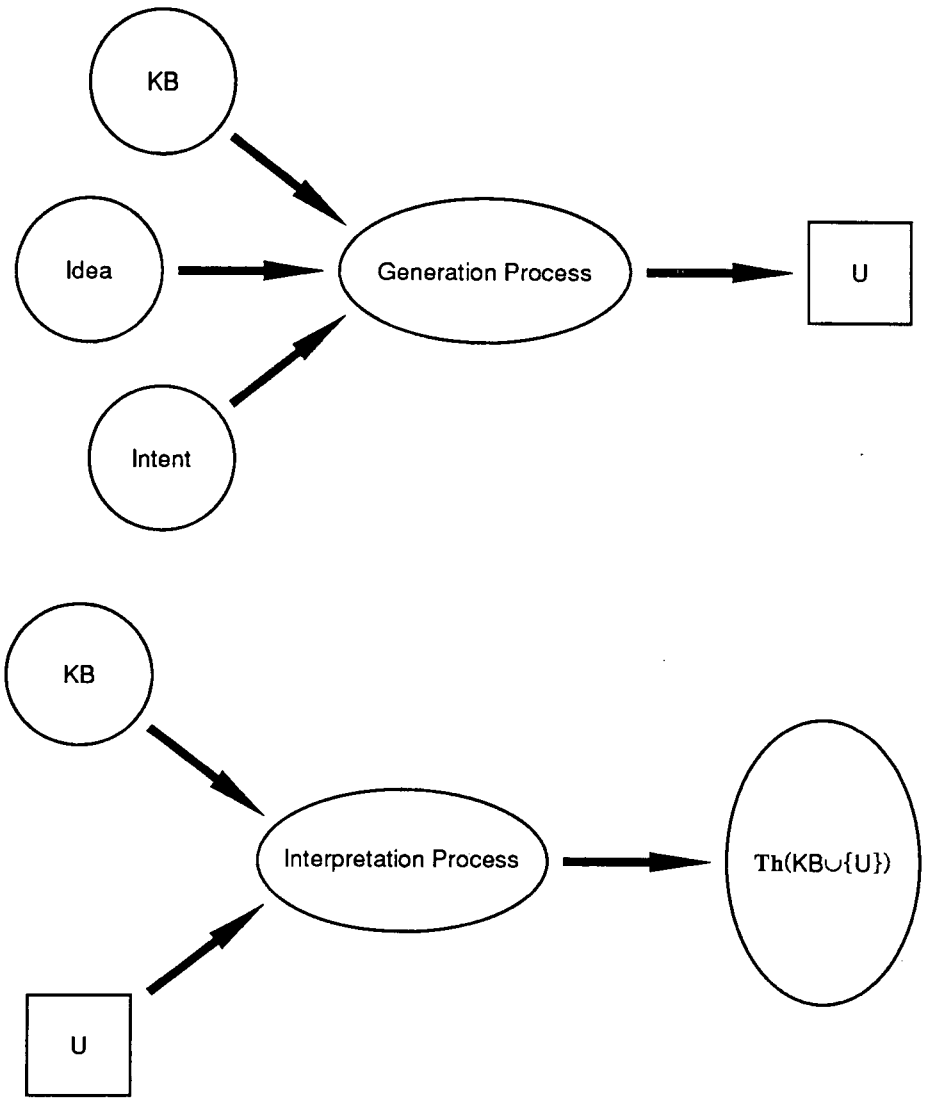

Figure 2.1: A Model of Communication

serted declarative sentence is approximately equivalent to *update your knowledge base with the logical form of the sentence just uttered. Updating a knowledge base* means add this proposition and all the inferences sanctioned by the proposition, the knowledge base, and the rules of inference to your knowledge base (that is the logical closure[2] of the knowledge base). Implied in this second assumption is a commitment to the principle that the inferences are generated by a well–founded proof theory working in conjunction with knowledge represented as statements in a logical language. The utterance can be considered successful if the understanding of the illocutionary act (S's intention) results in the appropriate perlocutionary act (the effect that the utterance has on H). In the simplest of models the knowledge of S and H would be the same and the creation and interpretation processes would be roughly inversions of each other. This thesis makes no comment about the details of these processes except for the part dealing strictly with the generation of presuppositions. What is of note here is that the procedure for generating presuppositions (described in Chapter 3) makes only the two assumptions about the model which I have mentioned in the previous discussion. In addition no assumptions about the contents of the knowledge bases is made by the presupposition relation. I will briefly discuss the positive aspects of this latter feature in section 2.1.2.

The presupposition relation has been deliberately separated from the knowledge base for two reasons. Firstly, I want a relation that is similar to the entailment relation. The assumption that S, by asserting a declarative sentence, intends H to update his knowledge base has been made. Also assuming that the update adds the proposition and that the knowledge base is logically closed, the addition of a proposition also generates[3] all the inferences that can be generated from the logical statements in the knowledge base. If $\mathbf{Th}^*$ is the logical closure operator which uses logical entailment, the presupposition relation described in Chapter 3, and any other relations that are desired (for example, a relation for implicatures), Γ is the knowledge base before the update with the utterance, $\mathbf{u}$, and $\triangle$ is the symmetric difference operator, then

[2]Here, logical closure allows logical relations other than semantic entailment.

[3]Actually this process may delete propositions found in the logical closure of the pre–update knowledge base. In practice this may require a Truth Maintenance System (Doyle (1979)). Since I am making the simplifying assumption that the set of propositions forming the knowledge base is knowledge rather than beliefs, the only propositions that may be deleted are the ones sanctioned by conjectural inference relations such as the presupposition relation.

the meaning of an utterance is the symmetric difference (2.1)[4]

$$\mathbf{Th}^*(\Gamma) \triangle \mathbf{Th}^*(\Gamma \cup \{\mathbf{u}\}). \tag{2.1}$$

Secondly, the separation of the process from the knowledge that it uses facilitates further study of the communication act. S knows that H's interpretation of the utterance will depend on the contents of H's knowledge base. But no utterance is constructed having complete knowledge about H's knowledge base. I would suggest that S makes the general assumption that unless there are reasons to believe otherwise [5], H has the same basic knowledge about the world and about linguistic competence (in a general sense) as S does. For example, S assumes that H has the Cooperative Principle as part of his linguistic competence, hence that H uses the presupposition relation when interpreting an utterance. Robustness in dialogue then allows S to decide whether the utterance has been misinterpreted. I make no comment about the generation process in this thesis, except for what I have just said. The interpretation process that I present (for presuppositions) in Chapter 3 produces inferences relative to the contents of the knowledge base of H. Because of this relativity, the knowledge base contents must be considered when considering the validity of the procedure as presented. If the knowledge base contains what would be considered "normal" then the procedure should produce what are normally considered the presuppositions of the utterance.

The inferencing process that has been mentioned throughout the previous discussion allows the use of diverse knowledge sources. I have categorized these knowledge sources into situational knowledge sources, background knowledge sources, and a notion of shared knowledge which is usually called the context[6]. I will discuss these three sources in the following sections.

[4]To be precise, the sentences must be tagged according to their originating set. This tagging provides the extra temporal information needed to indicate whether the sentence is an addition or a deletion (a revision can be considered as a deletion and an addition). In the communicative act used throughout the remainder of the thesis all sentences add to the knowledge base. Therefore this extra information required in the more general setting is superfluous.

[5]An example of a reason to believe otherwise is when talking to very young children, or talking to a non-expert about a technical subject.

[6]*Context* as used here is different than *situation*.

2.1.1 Situational Knowledge Sources

The utterance itself is a source of information that is particular to the present situation. It has a structural form, a logical form, and stress patterns. If this is not the first utterance in the exchange, then there is the information contained in the previous part of the discourse. Other situational knowledge is contained in S's model of H, and H's model of S. The physical situation plays a role in the construction and interpretation of utterances. The knowledge included here may be S knows what H can and cannot see (relative to what S can see), knowledge about whether this is a face–to–face conversation or one that is taking place over a telephone (since we use different conventions for each), and the number of participants (since the use of eye contact becomes important). The social environment plays a role in the communication act. How one talks to a boss may be different than how one talks to a friend.

Of all these situational knowledge sources, I am interested only in the information provided by the utterance itself. The theory that is presented later deals only with the technical aspects of H's computing the presuppositions of an utterance, and only the sentence itself and non–situational knowledge sources are used.

2.1.2 Background Knowledge Sources

Although the background knowledge can be arbitrarily divided into a number of categories of knowledge, these should be seen as forming a continuum. The categories that I am interested in are *real world knowledge* (*RWK*) (sometimes called encyclopædic knowledge (Smith (1982)), and *linguistic knowledge* (*LK*). RWK includes such mundane knowledge as: the *LEFT–OF* relation is transitive, the *ABOVE* relation is transitive, a *BLOCK* can have objects placed on top of it, a *PYRAMID* cannot have anything placed on top of it. Additionally, RWK includes structural knowledge: *structural/generalization hierarchies* (Havens and Mackworth (1983)) and *frames* (Minsky (1975)) which contain knowledge about the composition of objects, for example, what is expected in a room of a house; *scripts* (Schank (1975)) which contain temporally structured knowledge about events, for example, going to a restaurant. Other RWK includes such facts about the world as Bill van der Zalm is premier of British Columbia and the University of British Columbia is located in Vancouver.

Linguistic knowledge (*LK*) is conventionally subdivided into four categories: phonology, syntax, semantics, and pragmatics. Phonology does not take part in the discussion below, so

will be ignored. Syntactic knowledge is captured as a grammar, for example, transformational (Chomsky (1965)), case (Fillmore (1968)), government–binding (Chomsky (1981)), and generalized phrase structure (Gazdar, Klein, Pullum, and Sag (1985)). This knowledge is used to produce a structural description of the utterance. Semantic knowledge provides the means to generate the semantic representation of the natural language sentence, which corresponds to the propositional content of the utterance. Logical representation languages include first–order logic[7], Montague semantics (Montague (1974a)), and situations (Barwise and Perry (1983)). This knowledge could be in the form of rules for combining the meanings of the lexemes contained in the utterance according to how they are structurally related. In some instances, for example in GPSG, the syntactic and semantic knowledge is interrelated. In addition to the knowledge required to construct the semantic representation, semantic knowledge will also contain facts relating to entailments of utterances. For example, the semantic knowledge might provide facts such as: factive verbs (for example, '*regret*', and '*surprise*') entail their complements. Pragmatic knowledge is concerned with a multitude of issues that are vaguely connected along the dimension of how language is used in certain situations. Examples include discourse structure (Grosz and Sidner (1986)), focus (Grosz (1977)), and models of the speaker and hearer (Allen and Perrault (1980)). Of specific concern to this thesis is the knowledge regarding the cooperative nature of communication, in particular, Grice's Cooperative Principle (Grice (1975)).

In the grey area between the exemplars of RWK and LK that have been provided above, there exists knowledge which depending on the viewer could be categorized as either. Two kinds of knowledge that concern this thesis are the dictionary meanings of lexemes and selectional restrictions of verbs. Lexemes and their meanings can be captured as a set of *meaning postulates* (Carnap (1956)). For example the term '*bachelor*' could be given the meaning postulate (2.2).

$$\begin{aligned} &\forall x.BACHELOR(x) \equiv \\ &\quad HUMAN(x) \wedge ADULT(x) \wedge MALE(x) \wedge \neg MARRIED(x) \end{aligned} \tag{2.2}$$

Although selectional restrictions is the term used in linguistics, the same type of knowledge has been used in Artificial Intelligence under the term RWK. An example of this type of knowledge could be:

The subject of '*playing tennis*' must be animate, and able to hold a racquet.

[7]Because Default Logic is based on first–order logic, this logic is used as the representation language throughout.

Although this knowledge is required, I remain agnostic regarding the particular knowledge contained in the knowledge base. At one extreme is a Platonic view — that each concept has a true definition. Each knowledge base would then include the true definition. At another extreme would be for each knowledge base to have a definition for each term that is possibly different from all other knowledge bases. The theory presented in Chapter 3 generates inferences according to the contents of the knowledge base. Hence, if the knowledge base contains what would be the generally accepted definition of a lexeme, then the presupposition relation would generate the normally anticipated presuppositions.

In Chapter 3 I present a theory of presuppositions which has two noted features.

1. The presupposition relation is a logical one, like entailment. The relation has been separated from the knowledge base so that it can be defined independent of the knowledge with which it works.

2. The knowledge base is represented as a default theory (Reiter (1980). Default logic and default theories are discussed in Chapter 3. Here all that needs to be known is that a default theory contains well–formed formulae from first order logic and (defeasible[8]) default rules. I will use the default rules to extend the normal semantic notion of meaning postulates to capture some elements of pragmatic knowledge. So it may appear that I am conflating the linguistically separate concepts of semantics and pragmatics — at least that part of semantics concerned with entailments and that part of pragmatics which is concerned with presuppositions. All that is being done is treating the knowledge required for each logical relation in a uniform manner. By doing so we achieve a more unified view of the inferences generated from an utterance.[9] The notions of entailment and presupposition are distinct because the logical relations embodying these concepts are different and because the knowledge required is structurally different. For a more precise definition, see section 2.3.

In later discussions, the benefits of treating the knowledge uniformly will become evident.

[8]Classical inference rules are monotonic; that is, if a sentence α can be derived from a set of sentences, Γ, using some set of classical inference rules (for example, *modus ponens*) — denoted $\Gamma \vdash \alpha$ — then for any sentence β, $\Gamma \cup \{\beta\} \vdash \alpha$. Default rules do not have this property, on the other hand. So, for each default rule there exists some sentence which disallows the application of that rule.

[9]It will be argued later in this chapter that the conventional view of computing presuppositions is one of preventing the normal functioning of semantic composition rules.

The concept of presupposition spans the three divisions of linguistic knowledge. Presuppositional environments occur syntactically, for example, in cleft sentences, or definite noun phrases; semantically in a lexeme's meaning (if this is considered as LK), and presuppositions are affected by pragmatic components such as implicatures.

2.1.3 Context

Having discussed the kinds of information that are placed in the speaker's and hearer's knowledge bases, it is appropriate to look briefly at the context. Context is the one concept central to all pragmatic theories. To quote from Montague (1974b)

> ...pragmatics [is concerned solely] with relations among expressions, the objects to which they refer, and the users or contexts of use of the expressions.

Its importance stems from the need to interpret the utterance *against some common background assumptions*. Here an attempt is made to capture those qualities of the concept that are crucial for the understanding of presuppositional theories in general and the theoretical importance of my theory in particular. The context or set of background assumptions is given different definitions by different authors, some of which are investigated below.

While reformulating Grice's Maxim of Quantity, Kempson (1975) compares this maxim to Strawson's Presumption of Ignorance and Presumption of Knowledge (Strawson (1964)). The first presumption, an assumption of the speaker that the hearer does not already know what the speaker is telling him, is very much like the first half of Grice's Maxim of Quantity. And the second presumption, which is similar to the second half of this particular maxim, suggests to Kempson that there is a certain body of facts which in any discourse a speaker will presume that his hearer knows. Kempson calls this assumed knowledge the Pragmatic Universe of Discourse. This body of *mutual knowledge* (Lewis (1969), Schiffer (1972)) is that intersection of the speaker's and hearer's knowledge bases which both the speaker and hearer believe they share (that is, S believes P, S believes that H believes P, S believes that H believes that S believes P, S believes that H believes that S believes that H believes P, ...). Kempson gives a limited regress version of mutual knowledge as the definition of Pragmatic Universe of Discourse. The four conditions that a proposition must fulfil to be in this set are: S believes P, S believes that H knows P, S believes that H knows that S believes P, and S believes that H knows that S believes that H knows P. Two aspects of her discussion are noteworthy:

Firstly, all entailments of P are also in the set. Secondly, the set changes as the conversation progresses.

Karttunen and Peters (1979) call the context *common ground.* Theirs is a less precise definition than Kempson: At each point in the conversation there is a set of propositions that any participant in the conversation is rationally justified in taking for granted. The justification is based on what has been said in the conversation up to that point, what is perceived as true by all participants, and what they mutually know or assume. They also assume that the common ground changes as the conversation progresses, and that these modifications are realized as adjoining, replacing, or removing propositions.

Gunji (1982) describes a hierarchically structured context. His basic notion is the Extended Intensional Lisp lexicon which contains definitions of all the constants used in his system. It is not clear but one assumes that this database contains RWK as well as LK. For any particular conversation the basic unit is the Universe of Discourse (UD). The UD is a partial model, that is, it contains only a subset of the lexicon. Structure is imposed on the context by each utterance adding a new UD to the existing hierarchy of UD's. More precisely, UD_0, UD_1, ... , UD_n is a hierarchy of UD's where UD_n is the most recently activated UD and contains only the information invoked by the most recent utterance. UD_i $(0 < i < n)$ contains information contained in the ith through the nth utterance. UD_0 is the maximal UD which contains all the information that is independent of this particular situation plus all the information accumulated during the discourse.[10]

Stalnaker (1974) uses the terms *shared background of beliefs or assumptions* and *presumed common knowledge* in place of the more standard, context. Again, this set of background knowledge is the knowledge shared by the conversants and recognized by them to be so shared. The definition of presupposition given in Stalnaker (1974) catapults the notion of context into prominence, for he says that in conversations whose purpose is to exchange information or conduct a rational argument, the context and the presuppositions coincide.

Soames (1982) gives the following definition: The conversational context at time t is the set of propositions P such that at t speakers and hearers believe or assume P, and recognize this about each other. The importance of the conversational context is that it constitutes the background information, common to speakers and hearers, against which the utterance is

[10]Gunji (1982) is confusing here. Containing discourse–independent information contradicts his definition of UD.

evaluated.

Gazdar (1979) takes a different view of contexts, one which I follow approximately. He is not interested in contexts from a discourse point of view. For his theory he makes consistency the only criterion for a set of propositions to be a context. He uses contexts to develop definitions of implicatures and presuppositions. Potential implicatures and potential presuppositions become implicatures and presuppositions only if they *satisfiably increment*[11] the context. Underlying his use of abstract contexts is the powerful idea that given any context, C, the satisfiable incrementation of C is predicted just by the rule of satisfiable incrementation. In all of the other definitions that have been given above, contexts have other restrictions placed on them. So, to varying degrees the generation of inferences must finally resort to handwaving about the conversational maxims.

Given the definitions of context which are based on mutual knowledge, the communication model given in Figure 2.1 becomes somewhat simplified. If only the context is used as the knowledge source by both S and H when constructing and interpreting the utterance then S's intended meaning and H's interpreted meaning should coincide. The simplicity of this interpretation of Figure 2.1 belies the assumption that in practice the context needs to be a computable entity rather than a theoretical artifact. In the theory presented in Chapter 3 I have discarded completely the need for a context[12]. Presuppositions then can be defined relative to the contents of a knowledge base. This definition parallels Gazdar's definition of presuppositions relative to contexts (used in his sense). His use of the term context is more like my use of the term knowledge base than it is to the other uses of context mentioned earlier. The main difference between his theory and mine (in this respect) is that his presupposition generating functions are not part of the knowledge base, whereas in my theory they are (disguised as default rules).

2.2 Non–standard Inferences

It is now a well-accepted principle that in addition to its propositional content, represented by its logical form and sometimes referred to as what is asserted by the utterance, the meaning

[11]Discussed in section 4.2.

[12]Others have argued against the use of mutual knowledge on similar grounds. For example, see Sperber and Wilson (1982).

of an utterance includes inferences such as, entailments, presuppositions, and implicatures (Kempson (1975), Wilson (1975), and Karttunen and Peters (1979)). For example, (2.3) asserts that there is a relationship between John and an event described as a losing relationship between Sally and her dog. That the event actually occurred is entailed[13] by the sentence and the linguistic knowledge that verbs like '*regret*' entail their complements. That John exists, that Sally exists, and that Sally has a dog are also entailed by the sentence and the linguistic knowledge associated with proper nouns and possessive forms. Likewise (2.4) presupposes everything that (2.3) entails. This relationship between presupposition and entailment will be further explored in Chapter 3. In (2.5), (2.6), and (2.7) the concept of implicature is exemplified. Although '*but*' has the same semantic representation as '*and*', that is the logical connective '$\wedge$', it also has an extra sense of unexpectedness associated with it. Although '*some*' does not entail '*not all*' in logic, it does seem to carry this implication in natural language. And the use of imprecise terms such as '*a woman*' in situations which warrant more precision, usually licenses the implicature that the similar statement, in which the imprecise term is substituted with the more definite term, is false. So, 2.7 seems to suggest that the woman that John is meeting is not his wife.

John regrets that Sally lost her dog. (2.3)

John does not regret that Sally lost her dog. (2.4)

Jane likes avocadoes but doesn't like artichokes. (2.5)

Some of the boys went to the circus. (2.6)

John is meeting a woman this evening. (2.7)

[13]Many would say that the occurence of the event is *presupposed* by the sentence. However, the theory proposed in Chapter 3 is strongly committed to entailment in positive environments and presupposition in negative environments. Except when I am discussing the use by others of the terminology, I will use the terms entailment and presupposition in this way. If proponents of the use of the term presupposition to cover both categories want a label, then I would suggest *inference*.

Entailment[14] will be referred to as a standard inference since it is derivable from the utterance using standard techniques of logical deduction. Presuppositions and implicatures[15] will be referred to as non-standard inferences since standard logical deduction is unable to capture two crucial aspects of this type of inference: defeasibility and computation in the face of incomplete information.

Not surprisingly, the notions of implicature and presupposition have some very early beginnings in the philosophy of language. Horn (1973) traces implicatures back to Aristotle's attempts to characterize modal logic. And presuppositions can be traced to Frege (1892). Grice (1968, 1969) was the first to capture some of these extra-semantic parts of the meaning of an utterance in a pragmatic theory of natural language which he calls $meaning_{nn}$, or nonnatural meaning. It is here that he differentiates between *what is said* (asserted) and *what is implicated.*

Grice uses the term implicature to distinguish some of these non-standard, non–truth–conditional inferences licensed by conversational principles from those inferences which are derived using standard deduction techniques operating on the logical form of the utterance. Although he was mainly interested in two particular classes of inferences to which he gave the labels *conventional implicatures* and *conversational implicatures*, others (Kempson (1975) and Wilson (1975)) have attempted to define presuppositions in terms of Grice's pragmatic theory. Since my theory also has foundations in Grice's conversational principles, it may be thought that presuppositions are just a category of implicature. While they may well be, presuppositions are neither conventional nor conversational implicatures. In the past the label *presupposition* has been misused, capturing all sorts of phenomena including implicatures. Although this misuse provides a good reason to discard the label, I will continue to use it because it has has become a standard term (Oh and Dineen (1979)). In section 2.2.2 conventional and conversational implicatures are described, and in sections 2.3–2.3.5, presuppositions, including a summary in section 2.3.2 of presuppositional and non–presuppositional inferences with examples of implicatures and other phenomena (such as RWK) that have been misclassified as being presuppositional. Now I turn to Grice's conversational principles, the foundation for the present theory.

[14]Here, the term is used in its linguistic sense, not in its logical sense.

[15]Actually, conventional implicatures (see section 2.2.2) are best considered as standard inferences.

2.2.1 Grice's Conversational Theory

Grice has proposed certain maxims of conversation which attempt to capture the essential nature of the 'rules' people usually follow during a cooperative conversation. As Kempson (1975) aptly points out, although Grice intends to provide an explanation of linguistic meaning (what Grice calls *timeless meaning*) in terms of utterance meaning (or *occasion meaning*) which is in direct conflict with a truth-based explanation of meaning, most accept a weaker version of Grice's theory. This more accepted version proposes that utterance meaning depends on a prior definition of truth-based semantic meaning and is augmented with inferences licensed by rules of how utterances are used in a conversation. It is this set of rules, known collectively as the *Cooperative Principle*, which is of interest here. A conversation which is governed by this principle will be called a *cooperative conversation*. The Cooperative Principle is best known by its four submaxims: Quality, Quantity, Relevance, and Manner. Others (Kempson (1975), Gazdar (1979), Joshi (1982), and Hirschberg (1985)) have proposed refinements to the original maxims. I will briefly look at these refinements later.

Grice's pragmatic theory is based on his *Cooperative Principle*:

> Make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged.

This principle is further divided into four maxims of conversation:

1. Quantity

   (a) Make your contribution as informative as is required.

   (b) Do not make your contribution more informative than is required.

   Example

   S: Some of the boys went to the party.

   I: Not all of the boys went to the party.

   The implicature, **I**, of sentence **S** can be derived from this maxim. If the speaker knew that all of the boys went to the party, the statement specifying this more complete knowledge would be the one normally used.

2. Quality: Try to make your contribution one that is true.

   (a) Do not say what you believe to be false.

   (b) Do not say that for which you lack adequate evidence.

   Example

   Suppose A wishes to visit C and the following conversation with B takes place:

   A: Where does C live?

   B: Somewhere in British Columbia.

   In this example we have a good example of flaunting a maxim to provide more information. The information that B gives A is not adequate for A to visit C. This infringement on the maxim of quantity can be explained by the maxim of quality. If B does not know the town in which C lives, B cannot provide A with this information (the maxim of quality). Hence an implicature of B's statement is: B does not know in which town C lives.

3. Relation: Be relevant.

   Example

   The following conversation provides an implicature of this type:

   A: I am out of gasoline.

   B: There is a garage around the corner.

   Included in the implicatures of B's statements are:

   The garage may be open.
   The garage may have gasoline to sell.

4. Manner: Be perspicuous.

   (a) Avoid obscurity of expression.

   (b) Avoid ambiguity.

   (c) Be brief (avoid unnecessary prolixity).

   (d) Be orderly.

Example

Submaxim (4c) is required to choose between:

(a) Watch out for that spider!

(b) Watch out for the black, half inch long spider that has a green dot in its centre and is about six inches from your left shoulder at a vertical angle of about sixty degrees.

Submaxim (4d) can help to explain the differences in meaning between:

(a) John stole the money and went to the bank.

(b) John went to the bank and stole the money.

2.2.2 Implicatures – Conventional and Conversational

Implicatures are important in their own right. However for the purposes of this thesis a basic understanding is all that is required. Some of the presuppositional theories described later in this chapter as well as my theory incorporate certain aspects of implicatures. In section 2.3.2 certain features of these inferences will be used to help to delimit the concept, presupposition.

Informally, an *implicature* is a proposition that is implied by a sentence in a context even though that proposition is neither a part of nor an entailment of the sentence. Grice (1975) proposes two types of implicature, *conventional* and *conversational.*

Conventional implicatures arise solely from features conventionally attributed to words. For example two clauses conjoined by '*and*' and '*but*' have the same truth–conditions. However the lexical item '*but*' conventionally implicates a proposition involving some sort of contrast, unexpectedness, or the like. Thus the dictionary entry for '*but*' would need this extra pragmatic component.

Conversational implicatures are subdivided into two categories, *particularized* and *generalized.* The first category describes those inferences that arise usually because of something in the context and that are not normally carried by the sentence itself. (2.8) is an example from Gazdar (1979).

A: What does Julian do when he's not at the hairdresser's?

B: He waits for boys in the restroom of the YMCA. (2.8)

B might carry a particularized conversational implicature that Julian is a homosexual. But if the context for the utterance of **A** and **B** contained information that Julian was a truancy officer, this sentence would not carry that particular implicature. Gazdar (1979) mentions that any inference that generates this implicature will require other knowledge. In addition the inference cannot be one of the simple modes of inference (*modus ponens*, universal instantiation) since the knowledge given in (2.9) is clearly false.

(a) If one hangs around YMCA restrooms then one is homosexual.

(b) All persons who hang around YMCA restrooms are homosexual. (2.9)

The sense of *usual* used to describe the inference found in 2.9 and its defeasibility in the *truancy officer* situation are so similar to the concepts of prototypical knowledge and default inference in Default Logic (Reiter (1980)) that default reasoning may be what Gazdar is searching for.

The second class, generalized conversational implicatures, arise when one can say that the use of a certain form of words normally (that is, in the absence of special circumstances) carries an implicature. Two examples have been shown in (2.6) and (2.7) and are reproduced here as (2.10) and (2.11) with their respective implicatures.

S: Some of the boys went to the circus.

I: All of the boys didn't go to the circus.[16] (2.10)

S: John is meeting a woman this evening.

I: The person to be met is not John's wife, mother, sister, or close friend. (2.11)

A common complaint regarding Grice's Maxims of Conversation is that they are so vague as to be without content. There have been attempts to make these maxims more precise. I now turn to this issue.

2.2.3 Reformulation of the Maxims

Some effort has been expended to provide more precision in Grice's maxims. Kempson (1975) provides a reformualtion which she then uses to describe those aspects of meaning which correspond to presuppositions. Joshi (1982) modifies the Quality maxim to be: don't say anything

[16] An equivalent statement would be '*Some of the boys didn't go to the circus.*'

that is false nor say anything whose inferences (based on the utterance and the context) are false. Hirschberg (1985) gives an extensive and detailed account of her modifications to Grice's maxims, including major modifications to Gazdar's quantitative scales. Since Gazdar's reformulation (which provided him with the tools that he required for his treatment of presuppositions) is adequate for my treatment of presuppositions, it is to this reformulation that the remainder of this section is devoted.

Gazdar (1979) is mainly concerned with the first two maxims. To clarify some of the fuzziness found in the Gricean formulation, Gazdar reformulates them as indicated below.

> Quality′: Say only that which you know. Therefore, for any declarative sentence, x, assertion of x by a speaker, S, implicates $\mathsf{K}_S x$ (where $\mathsf{K}_S x$ means S knows that x).[17]

This definition is similar to Hintikka's treatment of a similar situation in epistemic logic (Hintikka (1962)). So, the anomaly found in 2.12 can be explained by the Quality′ maxim. The statement '$p \wedge \neg \mathsf{K}_S p$' is not a contradiction in epistemic logic. However the Quality′ maxim commits the speaker to the knowledge of the statement. '$\mathsf{K}_S(p \wedge \neg \mathsf{K}_S p)$' is a contradiction in epistemic logic.

*Pithium is radioactive but I don't know that Pithium is radioactive. (2.12)

Quantity′

1. Potential scalar quantity implicatures. Given a quantitative scale, $\langle \ldots, a_i, a_{i+1}, \ldots \rangle$, such that an expression containing a_i entails an otherwise identical expression containing a_j, $j > i$, subject to the condition that the a's are not within the scope of any logical functors (which include negation, quantifiers, connectives, and modal operators), then a sentence X potentially scalar–quantity–implicates that $\mathsf{K}_S \neg Y$ if and only if there is a sentence X', entailed by Y, which is the same as X except that it contains a scalar expression with a lower index in the quantitative scale.

Example:

Quantitative scale: $\langle all, most, many, some, few, \ldots \rangle$

[17] $\mathsf{P}_S x$ means for all that S knows x is possible. The relationship between *sknow* and *sposs* is captured by $\mathsf{P}_S x \equiv \neg \mathsf{K}_S \neg x$.

S: Some of the boys were at the party.

I: $\mathsf{K}_S\neg$(All of the boys were at the party).

2. Potential clausal quantity implicatures. A compound sentence X potentially clausal–quantity–implicates that $\mathsf{P}_S Y$ and $\mathsf{P}_S\neg Y$ (where $\mathsf{P}_S Y$ means it is compatible with what the speaker knows that Y) for all sentences Y such that

   (a) $X = ZYZ'$, where Z and Z' are any expressions, possibly null,

   (b) $X \not\models Y$, and $X \not\models \neg Y$

   (c) Y is not potentially presupposed (this is important in Gazdar's theory because of the interaction between implicatures and potential presuppositions).

Example:

S: If John sees me then he will tell Margaret.

I: P_S(John will see me)

I: $\mathsf{P}_S\neg$(John will see me)

I: P_S(John will tell Margaret)

I: $\mathsf{P}_S\neg$(John will tell Margaret)

The first two implicatures are equivalent to '*Speaker doesn't know whether John will see him.*' and the last two, to '*Speaker doesn't know whether John will tell Margaret.*'

2.2.4 Summary

The Gricean view of a cooperative conversation is that the speaker can relay information as part of the utterance, but which is not asserted in the utterance, because the speaker and hearer both have knowledge about conversational exchanges and because the speaker believes that the hearer will infer this nonassertoric information as *implicated* by the utterance. Because the conversation is governed by this rule, to include the nonassertoric information would be a violation of the maxim of manner (Be brief.). It is also important to remember that Grice stresses that these inferences are not entailments. Gazdar has argued that presuppositions are not entailments of the utterance and context but rather only need to be consistent. But Gazdar's theory is 'passive' in the sense that his theory is concerned only with filtering undesirable

potential presuppositions. The potential presuppositions are generated by some unspecified set of functions. His theory makes no comment on why there are presuppositions. Kempson, Wilson my theory make a comment on this point.

Propositions which a speaker 'takes for granted' when making an utterance can include what I have called entailments and presuppositions. Unfortunately, these two distinct concepts have been conflated into what is usually referred to as pragmatic presuppositions. Kempson and Wilson argued strenuously against this conflation. The reason that they and I argue for a distinction is that in the case of entailments if the entailment is false the sentence is false. On the other hand if the presupposition is false the speaker is not following the cooperative principle. There is a significant difference here. So, regardless of the type of inference, these inferences (ie the propositions 'taken for granted') must be added to the hearer's view of the context.

2.3 Presuppositions

Garner (1971) traces the study of presuppositions from some of the work of Gottlob Frege (Frege (1892)) and Bertrand Russell (Russell (1905)) to its rebirth by P. F. Strawson (Strawson (1950)). Its present linguistic incarnation began in the late 1960's when researchers started the search for more precise logical, semantic, and pragmatic definitions. The concept defined logically provides a relation between sentences in the logic, just as logical entailment is a relation between sentences in the logic. Van Fraassen (1968, 1969) and Keenan (1972) discuss this kind of definition. Semantic presuppositions are defined in terms of linguistic features, specifically the meaning postulates of lexical items and syntactic constructs. Examples of this kind of definition are Kiparsky and Kiparsky (1970), Fillmore (1969, 1971), Keenan (1971). The latter category, pragmatic presuppositions, can be subdivided into definitions based on speaker beliefs (Stalnaker (1973, 1974)), definitions based solely on Grice's Maxims of Conversation (Kempson (1975) and Wilson (1975)), and those incorporating various modifications to the projection rule (Langendoen and Savin (1971), Karttunen (1973, 1974), Karttunen and Peters (1975, 1979), Soames (1976, 1979, 1982), and Gazdar (1977, 1979, 1979a)).

More recently, others have proposed computational theories of presuppositions. Weischedel (1979) uses an ATN grammar to implement the theory in Karttunen (1973). Gunji (1982) attempts to explain the projection rules found in Karttunen (1973) using a von Neumann ana-

logue (sequential processes and read–write memory) together with procedural attachment to evaluate logical expressions.

The disagreements concerning presuppositions have centred mainly on two issues:

1. What is the presupposition relation? What does it relate — statements or sentences? At which level of representation is the relation to be captured — in the logic, in the semantic representation of the sentence, or in a general pragmatic theory of conversation?

2. How do the presuppositions of a complex sentence relate to the presuppositions of its constituent clauses? This question is known as the *projection problem.*

It turns out that these two issues are closely connected, for it is their inability to generate presuppositions in compound sentences that provides conclusive evidence against logical or semantic realizations of the presupposition relation in natural language.

In the remainder of this section I will provide a working definition of presuppositions. Descriptions of the various attempts to define the presupposition relation are in later sections.

2.3.1 Defining Presuppositions

It is an unfortunate historical fact that the term presupposition does not have a single definition. The term has been used to describe everything from truth-value conditions to beliefs required of a speaker in order to make a successful utterance. The term has been used to capture a heterogeneous collection of phenomena including conventional and conversational implicatures, as well as the relation which would now be considered presupposition.

In this section I will use the term presupposition in the sense of *sentential presupposition.* I will outline the role of the speaker, the hearer, the context, and the utterance in giving presupposition its pragmatic sense in section 2.3.5. Informally, a sentential presupposition is the presupposition that a sentence has when uttered under the conditions specified by Grice's Cooperative Principle. This informal definition may seem a bit circular, but only with more formal apparatus can I give it a more precise definition. Historically, a basic problem with informal descriptions of presupposition have been their imprecision.

A word of caution: the sense in which the term *presupposition* is being used in the remainder of this thesis (unless scare quoted) does not correspond to its conventional linguistic usage. In the standard linguistic sense presuppositions are generated by "presuppositional environments", whether negated or not. These environments are discussed in section 2.3.4. Also,

presuppositions generated by the appropriate presuppositional environments in clauses of a matrix sentence S may be projected as presuppositions onto S. In Chapters 3 and 4 slightly different definitions are used: presuppositions are inferences produced from appropriate logical representations of the natural language sentences in which the presuppositional environments are in the scope of a negation, and the presuppositional behaviour of compound sentences is determined by the rules of inference rather than by a projection method. These two differences have a couple of significant implications: inferences generated in unnegated "presuppositional environments" are entailments, and the locution "presuppositions of the clauses of a matrix sentence S" has no place in the new theory.

Although a precise definition is not yet attainable, a number of criteria can be used to determine sentential presuppositions. Firstly, simple negated sentences must presuppose and their unnegated simple sentence counterparts must entail the same inferences. This criterion has been referred to as the *negation test* (Kempson (1977). Some prototypical examples of this idea are shown in (2.13)–(2.15). In each example the $\mathbf{S_1}$–sentence entails and the $\mathbf{S_2}$–sentence presupposes the **P**–sentence.

$\mathbf{S_1}$: The present king of Buganda likes whiskey.

$\mathbf{S_2}$: The present king of Buganda does not like whiskey. (2.13)

P: There exists a king of Buganda.

$\mathbf{S_1}$: Jack's children are bald.

$\mathbf{S_2}$: Jack's children are not bald. (2.14)

P: Jack has children.

$\mathbf{S_1}$: Fred stopped beating his wife.

$\mathbf{S_2}$: Fred didn't stop beating his wife. (2.15)

P: Fred has been beating his wife.

Secondly, presuppositions are *implied*, not *said*. The significance of this distinction is that presuppositions are not part of the truth conditions of the natural language sentence. Not being truth–conditional means that ordinary logical techniques are not sufficient to describe them.

Being implied rather than said is easily explained by looking at the representation of negative sentences. The following discussion anticipates a fuller exposition in Chapter 3. A negative sentence is represented as a logical negation of the representation of the negative sentence's

affirmative counterpart. For example, if the affirmative sentence is represented as $A \wedge B \wedge C$ then the negative sentence is represented as $\neg(A \wedge B \wedge C)$ which is equivalent to $\neg A \vee \neg B \vee \neg C$. If any of the terms in this statement are presuppositional environments, then no truth–condition preserving inference method will be able to deduce the presuppositions because each term is a disjunct. Placing presuppositions in the non–truth–conditional arena is a primary goal of Kempson (1975) and Wilson (1975).

Thirdly, the entailments are uncancellable in the positive sentence but the presuppositions are cancellable in the negative sentence. There are a number of ways to cancel a presupposition.

1. Contextually. The context provides information that directly contradicts what would be presupposed by the sentence if the context did not contain the contradictory information. For example, '*The present king of France is not bald.*' does not presuppose '*There exists a king of France.*' in any world in which the '*king of France*' does not presently exist. Note that the context is important here, since the use of this sentence in a situation in which this proposition had not been established would possibly be unacceptable in a cooperative conversation.

   Another method of contextual concellation is the sentence itself containing the contradictory information. For example, '*The present king of Buganda does not exist.*' would be self–contradictory if it were not for the contextual cancellation of the "presupposition" '*There exists a king of Buganda.*'.

2. Conversationally. Given Grice's Maxims for Cooperative Conversation, certain inferences can be generated from the utterance that indicate that some presupposition normally generated by a presuppositional environment found in the utterance is to be cancelled. For example, '*My cousin is a bachelor or a spinster.*' does not presuppose '*My cousin is male.*' nor is '*My cousin is female.*' presupposed. Grice's maxims indicate that the speaker must be allowing for the possibility of both bachelor–hood and spinster–hood for his cousin. If the sentence presupposed that '*My cousin is male.*' then it would be impossible that my cousin could be a spinster. Similarly for female. Thus the sentence does not commit the speaker to either of the inferences that would be licensed if the sentence were '*My cousin is a bachelor.*' or '*My cousin is a spinster.*'.

3. Entailments of the sentence which entail the presuppositions of the sentence. This type of cancellation demonstrates that entailments are in some sense a stronger type of inference

than presuppositions. This ordering is a result of the semantic view of entailment and presupposition. Entailments of a sentence, S, are true in all worlds in which S is true. Presuppositions, on the other hand, need only be true in those worlds in which the *preferred interpretation* of S is true.

How to realize this cancellation mechanism is the aspect on which the four methods introduced in section 2.3.5.3 and my theory differ.

This provides some criteria to categorize a number of linguistic phenomena. Gunji (1982) has provided a categorization of presuppositions, conventional implicatures, conversational implicatures, and denotations.[18] Each concept is distinguished by three features: ±said, ±conventional[19], and ±cancellable. I am not concerned with denotations here and since the ±said feature is used only for distinguishing between denotations and the other three categories I will leave this feature out of the discussion. The modified Gunji taxonomy looks like:

presupposition	+conventional	+cancellable
conventional implicature	+conventional	−cancellable
conversational implicature	−conventional	+cancellable

In addition to these definitions of sentential presupposition, most recent theories also incorporate some notion of commitment of the speaker to belief in or knowledge of the sentential presupposition. Gazdar (1979) commits the speaker to knowing the sentential presupposition, hence to the truth of the sentential presupposition. Soames (1982) states that the utterance

[18]Entailments are notably missing from Gunji's taxonomy. This category of inferences does not fit nicely into the ±said categorization. On the one hand if S were to utter 'A and B' then one would presume that S said $A \wedge B$, A, and B. But if $\Gamma \cup \{A\} \models Q$, then one wouldn't presume that S said Q. One way out would be to subdivide entailment into *logical* entailment, that is a relation which is defined to give only those sentences that can be derived from the utterance using standard proof techniques, and *semantic* entailment, that is a relation which is defined to give only those sentences that can be derived from the background knowledge and the utterance (and not including the logical entailments). Also throughout this thesis I use the term entailment to capture the same category that Gunji calls conventional implicature. Another subdivision of semantic entailment might be into one group in which Γ is what is usually thought of as facts about the world — this I would call entailments, and the other group in which Γ is what is usually thought of as conventional meanings/uses of words — this I would call conventional implicatures.

[19]My interpretation of conventional may be different than what Grice originally intended. What I interpret conventional to mean throughout my theory is that certain items in one's knowledge base are assumed to have more or less conventional meanings/uses. I do not interpret it to mean that each knowledge base has some predetermined conventional meaning/use for each of the items in question.

presupposition is undisputed and sentential presuppositions are defined as utterance presuppositions in normal utterances of the sentence. Gunji (1982) adds sentential presuppositions to the Universe of Discourse (which is the context). The Universe of Discourse is used as the background knowledge for the interpretation of future utterances. Although they differ in detail they all agree that the presupposition forms part of the meaning of the sentence hence becomes part of the context.

2.3.2 Non–Presuppositions

In the next sections I will discuss various views of the presupposition relation. Part of the discussion will give an historical perspective, part will provide information regarding presuppositional environments, and part will attempt to provide sufficient intuition to appreciate the projection rule methods, and the definition and theory of presupposition to be presented (Chapter 3). This section gives some indication of what presuppositions *are not*. The literature is replete with misclassifications, Since it is not yet possible to give a complete characterization of the presupposition relation, the class of non-presuppositions must be characterized by example. I defer to Kempson (1975), Wilson (1975), Boër and Lycan (1976), and Gazdar (1979) for further examples.

Typically, all definitions of presupposition include some idea that presuppositions are implied antecedent conditions. The notion that has plagued previous definitions of presupposition has been that this condition is both necessary and sufficient. In fact, the word *presupposition* itself promotes this notion. But included in the implied antecedent conditions are: entailments of the sentence and the background assumptions, and conventional and conversational implicatures. According to an early definition (Lakoff (1971)) the sentence S in (2.16) supposedly presupposes sentences $\mathbf{P_1}$ to $\mathbf{P_7}$. (Although the original presentation marks them as presuppositions, they are indicated here as being non–presuppositions.)

S: Nixon was elected, but the blacks won't revolt.

P_1: *Nixon is a Republican.

P_2: *If a Republican is elected, then social welfare programs will be cut.

P_3: *If social welfare programs are cut, the poor will suffer.

P_4: *Blacks are poor. (2.16)

P_5: *Blacks are discriminated against.

P_6: *Blacks form a substantial part of the population.

P_7: *One would expect that poor, suffering people who are discriminated against and who form a substantial proportion of the population would revolt.

But, using the taxonomy given above, all of these supposed presuppositions fall naturally into other categories. P_1–P_6 are −cancellable. These are entailments of the background knowledge. P_7 is a conventional implicature of the word '*but*' since it is −cancellable.

There are many other cases of inferences mislabelled as presuppositions. Some of the more infamous examples are: entailments of the sentence (both Kempson and Wilson argued strenuously against this misclassification), and the temporal ordering sometimes indicated by '*and*' (which is now labelled as a conversational implicature).

So, what I am proposing is that there are inferences derivable from the union of the sentence and the context. There are naturally defined subclasses, each with a relation that generates the inferences in that subclass[20]. There is an entailment relation which provides entailments[21], a presupposition relation that generates presuppositions, and (I conjecture) a conversational implicature relation that generates conversational implicatures.

In section 2.3.4.1 I will look at some supposed presuppositional environments which to my

[20]So, the notion that presuppositions are entailed in affirmative sentences (Gazdar (1979)) is not viable in this proposal.

[21]There may be some terminological difficulty here with the use of the word entailment, since it has been used in so many different ways. It can be used to describe those inferences that are derived solely from the sentence, for example, the truth of 'A and B' entails the truth of A and the truth of B. It can be used to describe those entailments of the sentence and the background knowledge which has been traditionally called RWK, for example, '*Nixon is a Republican*'. It can be used to describe those entailments of the sentence and background knowledge (considered as LK) which have traditionally been called conventional implicatures. I don't want to get into any discussion about whether these inferences constitute a single class.

knowledge have not been argued as being non–presuppositional. I am most interested in the environment that I have labelled *sentential adverbs*, since they provide a good example of the interaction of negation and the presuppositional environment.

2.3.3 Logical Presuppositions

Presuppositions were initially conceived by Frege (and then resurrected by Strawson) as a logical relation between a referring form and its referent. Without getting too detailed and using (2.17) as an example, their arguments were:

1. Both the affirmative sentence, $\mathbf{S_1}$, and the negative sentence, $\mathbf{S_2}$, *presuppose* $\mathbf{P}$.
2. If $\mathbf{P}$ is true, then one of $\mathbf{S_1}$ and $\mathbf{S_2}$ is true and the other is false. If $\mathbf{P}$ is false, then both $\mathbf{S_1}$ and $\mathbf{S_2}$ have no truth value.

$\mathbf{S_1}$: The present king of France is bald.

$\mathbf{S_2}$: The present king of France is not bald. (2.17)

$\mathbf{P}$: There is a king of France.

In contrast to the presupposition analysis, Russell argued for an entailment analysis. In (2.17) $\mathbf{S_1}$ entails $\mathbf{P}$. $\mathbf{S_2}$ is ambiguous between two different logical representations, one in which '*not*' is bound to '*bald*' and hence entails $\mathbf{P}$, and the other in which '*not*' negates the whole sentence and hence does not entail $\mathbf{P}$. My theory more closely resembles Russell's entailment analysis (but without the multiple representations).

What is constant in both the presupposition and entailment analyses is that both the positive and the negative sentences share the same presuppositions. It is easy to see that the simplest definition of presupposition is

$$A \textit{ presupposes } B \textit{ iff}$$
$$(i) \quad A \models B$$
$$(ii) \quad \neg A \models B$$

However in a bivalent semantics this definition is lacking. Firstly, all tautologies are presupposed by a sentence. Secondly, and more problematical, all presuppositions are tautologies. However, it can be easily seen in example (2.17) that presuppositions are not always tautologies.

To circumvent these problems, a nonstandard logic is required. Both Keenan (1972) and van Fraassen (1968, 1969) have developed nonstandard logics for this purpose. Keenan (1972) gives the same definition of presupposition as above except that his logic is based on a trivalent semantics. His equivalent definition for logical presupposition is:

A logically presupposes B iff A has the third truth-value whenever B is not true.

The inclusion of a third truth–value requires a definition of entailment for which *modus tollens* does not hold (if $A \models B$ and B is false then A can be either false or the third truth–value). Even though my theory also resorts to a non-standard logic, it retains a bivalent semantics.

But the problem facing this methodology is not that it requires a multi–valued semantics. Rather, this treatment of presuppositions cannot explain the compound sentence data. To demonstrate this inability would require quite a diversion. Let it suffice to say that a number of counterexamples to the logical analysis of natural language presuppositions (sometimes referred to as semantic presuppositions) can be found in Kempson (1975), Wilson (1975), Boër and Lycan (1976), and Gazdar (1979). In response to Wilson's and Boër and Lycan's analyses Martin (1979) provides an illuminating discussion of the logician's presuppositional agenda. Although his rebuttal shows some misunderstanding on the part of the linguists, he does not demonstrate any circumvention of the problems created by the compound sentence data (in particular, the problems of the connectives '*and*', '*or*', and '*if* ... *then* ...', and the cancelability feature of presuppositions). Lycan (1984) provides a further rebuttal to Martin's arguments.

2.3.4 Semantic Presuppositions

Most of the early work in linguistic presuppositions falls into the category of semantic presuppositions. Without spending too much time on this work since it has long since been surpassed, I will discuss the research reported by Fillmore (1969, 1971), Kiparsky and Kiparsky (1970), and Keenan (1971). The reasons for looking at these works are as follows:

1. Although the details of their theories have been refuted, the presuppositional environments discussed in their work are the ones that are to be considered throughout this thesis.

2. Historically, their work introduces concepts such as the negation test, two kinds of negation in natural language, and a precursor to the projection rule.

For both Fillmore and the Kiparskys the semantic components of a lexical item are divided into two categories. Those which may fall inside the scope of negation comprise the meaning of the lexeme. Those which can never fall into the scope of negation are the presuppositions of the lexical item. The question arises: How are these categorizations arrived at? The designation of meaning and presupposition for different semantic components is obtained through an application of the *negation test*. For example, what are the usual descriptions given to '*my cousin*' in the two sentences in (2.18).

(a) My cousin is a bachelor.

(b) My cousin is not a bachelor. (2.18)

Both sentences in (2.18) seem to indicate that '*my cousin*' is '*male*' '*adult*', and '*human*'. It is the semantic component '*unmarried*' that is being negated in (2.18b). Therefore, the meaning of '*bachelor*' is '*unmarried*' and the presuppositions are '*male*', '*adult*', and '*human*'.

Although the notion of presuppositional environments is not in dispute, the rigid split into a negatable part (the "meaning") and an unnegatable part (the "presupposition") is disputed. In section 2.3.4.1 I will discuss some presuppositional environments and also give arguments against others which I don't think fit the criteria given in section 2.3. Then in section 2.3.4.2 I will look at the problems created by semantic presupposition theories with respect to negation in natural language. In addition to these problems, semantic theories make the oftentimes incorrect prediction that if a sentence, Z, presupposes a sentence X, and Z is embedded in a sentence Y, then Y presupposes X. Section 2.3.4.3 will discuss this *projection problem* in more detail. Langendoen and Savin (1971) made the first attempt to capture this prediction as a *projection rule*. Much of the research since the early 1970's centred on repairing this rule. Discussion of these attempts is deferred to section 2.3.5.3 and Chapter 4.

2.3.4.1 Presuppositional Environments

Fillmore further extends the treatment of nouns discussed above in connection with example (2.18) to include a similar treatment of the class of verbs of judging, and the Kiparskys, to include the class of factive verbs. Keenan (1971) lists a number of other environments which demonstrate similar qualities when subjected to the negation test. Other environments have been discussed elsewhere (for example, Chomsky (1971)). A list of some of these lexical and syntactic environments follows. In each of the **S–P** pairs the **S**–sentence using the unbracketed

version of the environment entails the **P**–sentence, whereas the bracketed version presupposes the **P**–sentence.

Factives

S: Sally regrets (does not regret) that Mary failed her exam.[22]

P: Mary failed her exam.

S: Mary is surprised (isn't surprised) that Fred left.

P: Fred left.

Verbs of Judging

S: John criticised (didn't criticise) Mary for taking his books.

P: Mary is responsible for taking John's books.

P: Mary took John's books.

Definite Nouns, Noun Phrases, and Possessives

S: John married (did not marry) Fred's sister.

P: John exists.

P: Fred exists.

P: Fred has a sister.

S: The king of Buganda likes (doesn't like) whiskey.

P: There is a king of Buganda.

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[22]There are many other entailments (presuppositions) to be found in this sentence, for example

- Sally exists.
- Mary exists.
- Mary had an exam.

It will be a convention throughout the remainder of this thesis that only the entailment(s) (presupposition(s)) that is (are) necessary for the point or argument that is being discussed is (are) listed.

Cleft Sentences

S: It was (wasn't) John who robbed the bank.

P: Someone robbed the bank.

Pseudocleft Sentences

S: What Mary wanted was (wasn't) the dog.

P: Mary wanted something.

Selectional Restrictions

S: John is surprised (not surprised) that arithmetic is incomplete.

P: John is animate, intelligent.

Temporal Subordinate Clauses

S: John left (didn't leave) before Mary called.

P: Mary called.

Nonrestrictive Relatives

S: The Tiv, who respected Bohannon, are (are not) a generous people.

P: The Tiv respected Bohannon.

Certain Aspectuals

S: Fred stopped (didn't stop) beating the rug.

P: Fred had been beating the rug.

Iteratives[23]

S: Fred ate (didn't eat) another turnip.

P: Fred has eaten at least one turnip.

[23]This is not the same category as found in Keenan (1971). There, iteratives include sentential adverbs which have iterative features similar to the adjectives and verbs found in this category. I have placed '*again*' into a category that I call *Sentential Adverbs* which also includes '*too*'.

Contrastive Stress[24]

S: *Bill* wrecked (didn't wreck) the truck.

P: Someone wrecked the truck.

I have purposefully left out some of the categories found in Keenan (1971) and elsewhere (for example, Soames (1982)). Except for the category of sentential adverbs, which is a special case, each category fails on some criterion required of presuppositions given in section 2.3.1. Some of these categories follow.

Sentential Adverbs

Sentential adverbs have a peculiar feature that requires a more thorough investigation. The presuppositional aspects of two sentential adverbs have been looked at, in particular: '*again*' and '*too*'. A more precise characterization of the presuppositional and non–presuppositional characteristics of these two adverbs is given in Chapter 4.

Suffice it to say that the peculiar feature possessed by both '*again*' and '*too*' is that they create sentences which are ambiguous. No other presuppositional environment in the previous list has this feature. Only one of the representations possess presuppositions. The repercussions that this representational duality has on the analysis of compound sentences containing these sentential adverbs is discussed in Chapter 4.

All

S: All of the children residing on this street went (didn't go) to the circus.

P: *There are children residing on this street.

This category fails to be a presuppositional environment for two reasons. Firstly, the positive sentence does not entail the presupposition. **S** is true even when **P** is false. The positive sentence only implies **P** when delivered under the maxims of Cooperative Conversation. Secondly, the natural denial of the "presupposition" sounds peculiar:

[24]Signified by italic typeface.

All of the children residing on this street didn't go to the circus, because there aren't any children residing on this street.

I feel a better categorization for '*all*' is as a conventional implicature.

Presuppositional Quantifiers

S: (Not) only Fred shot himself.

P: *Fred shot himself.

The presupposition cannot be denied. Hence this inference is better categorized as a conventional implicature.

2.3.4.2 Ambiguous Negation

Although the notion of presuppositional environment is not in dispute, the concept that certain components fall into a negatable part (the "meaning") and the remaining components into an unnegatable part (the "presupposition") is disputed. Wilson (1975) and Kempson (1975) easily show that it is possible for the "presuppositional components" to fall within the scope of the negation. For example, (2.19a)–(2.19f) demonstrate that each component, or any combination of components, can be in the scope of the negation.

(a) That person is not a bachelor — he's married.

(b) That person is not a bachelor — he's only five years old.

(c) That person is not a bachelor — it's a woman.

(d) That person is not a bachelor — it's a woman, who is married. (2.19)

(e) That person is not a bachelor — it's a spinster.

(f) It was not a bachelor that frightened Mary–Ann — it was a scarecrow.

Anticipating these arguments, the Kiparskys' claim that there are two kinds of negation — straightforward denial of an event or situation, and denial of the appropriateness of the word in question. Even though this claim has intuitive appeal it presents serious technical problems.

Other proponents of semantic presupposition have suggested that the bivocality of the '*not*' be captured as either two different scopings of the negation in the underlying representation or

as two different operators. Both of these suggestions are usually referred to as internal and external negation in the literature. Again, technical problems arise. Although a detailed analysis of the problems encountered with an ambiguous negation is given in Chapter 3, a brief introduction to the problem is presented in (2.20) and (2.21). (2.20) is given the internal negation representation. (2.21) is given the external negation representation. Since internal negation is the "presuppositional negation" and external negation does not produce the presupposition, the presupposition of concern here is present in (2.20) but not in (2.21). How to choose the appropriate representation is not obvious.

S: John doesn't regret that he failed (because his failing means he can't enter the army). (2.20)

P: John failed.

S: John doesn't regret having failed (because, in fact, he passed). (2.21)

P: *John failed.

2.3.4.3 Projection Problem for Presuppositions

Most would also agree that there is some relationship between the presuppositions of a complex sentence and the presuppositions of it parts. Originally posed by Langendoen and Savin (1971) the projection problem can be simply stated as: how do the presuppositions of a complex sentence relate to the presuppositions of its constituent parts? Their proposed solution was that a complex sentence has all the presuppositions of the clauses that make it up. However it can be easily seen by example that this is not always true. (2.22)–(2.25) are examples of the relationship between the presuppositions of a complex sentence and those of its constituent clauses. In (2.22) the presuppositions of the antecedent and consequent clauses are the presuppositions of the sentence. (2.23) and (2.24) are examples of the connectives '*if* ... *then* ...' and '*(either)* ... *or* ...' not allowing the clausal presuppositions to be projected as presuppositions of the sentence. In (2.23) although **P** is a presupposition of the consequent clause it is not a presupposition of the sentence, because the antecedent clause entails it. In (2.24) because they are contradictory, the presuppositions of the clauses joined by '*either* ... *or* ...', are not presuppositions of the sentence. In (2.25) the subordinate clause presupposes that Harry exists, he has a wife, and he was beating his wife. The sentence as a whole does not presuppose these three propositions since verbs like '*dream*' do not project their clausal presuppositions.

S: If Fred has stopped beating Zelda, then Fred no longer resents Zelda's infidelity.

P: Fred has been beating Zelda. (2.22)

P: Zelda has been unfaithful.

S: If Harry is married, then his wife is no longer living with him.

P: *Harry has a wife. (2.23)

S: The liquid in this tank has either stopped fermenting or it has not yet begun to ferment.

P: *In the past, the liquid was fermenting. (2.24)

P: *In the past, the liquid was not fermenting.

S: Sheila dreamed that Harry stopped beating his wife.

P: *Harry has been beating his wife. (2.25)

2.3.5 Pragmatic Presuppositions

Presuppositions arise from the interaction of the conversational maxims and negation. But as was indicated at the end of the last section, difficulties encountered by attempts to capture the phenomenon semantically have proved to be insurmountable. Two important works, Kempson (1975) and Wilson (1975), which pointed out the problems with semantic definitions are discussed in section 2.3.5.2. They both give definitions which view presuppositions as pragmatic interpretations of semantically ambiguous representations of the utterance. Historically prior to these two works two disparate views of presuppositions emerged. One position, discussed in section 2.3.5.1, views presuppositions as felicity conditions on the use of an utterance in a conversation. I assume this view had its roots in Frege's notion of logical presupposition being prior to a statement having a truth value. The other position, discussed in section 2.3.5.3, was that the projection method proposed by Langendoen and Savin needed some modifications.

2.3.5.1 Speaker Beliefs

Definitions of pragmatic presuppositions usually require some notion of a speaker and listener and some conversational context. The view given by the collection of definitions that I have referred to as speaker beliefs is that the speaker and the context are the primary factors in that definition. Gazdar (1979) has summarized a number of these definitions. A representative

portion of his list is given below.

1. Sentence *A pragmatically presupposes* a proposition *B*, if and only if, whenever *A* is uttered sincerely, the speaker of *A* assumes *B* and assumes that his audience assumes *B* also. (Karttunen (1973), but Stalnaker (1972) and Keenan (1971), also)

2. *A pragmatically presupposes B relative to* a set of assumed facts *C* if and only if it is not acceptable to utter *A* in the context of *C* unless *C* entails *B*. (Karttunen (1973))

3. A proposition *B* is a *pragmatic presupposition* of a speaker in a given context just in case the speaker assumes or believes that *B*, assumes or believes that his audience assumes or believes that *B*, and assumes or believes that his audience recognizes that he is making these assumptions or had these beliefs (Stalnaker (1974)).

4. Sentence *A pragmatically presupposes* proposition *B* if and only if it is felicitous to utter *A* in order to increment a common ground *C* only in case *B* is already entailed by *C*. (Karttunen and Peters (1975))

As Gazdar points out these definitions fail for a number of reasons. The first reason is the abundance of undefined terminology, most notably '*unacceptable*', '*assumes*', '*believes*', and '*recognizes*'. Secondly, rather than a sentence being unacceptable when its presupposition clashes with the context, it just has its presupposition cancelled. Examples of this phenomenon have been provided throughout this chapter. Thirdly, most definitions of pragmatic presupposition require that the presupposition be an *entailment* of the context. This means that presuppositions cannot be used to convey new information. But (2.26) presents an example of a presupposition carrying new information. If uttered to two people, the first who knows that the speaker owns a car and the second doesn't, (2.26) would be acceptable to the first and unacceptable to the second.

I'm sorry I'm late, my car broke down. (2.26)

For the second person the speaker would need to include the fact that the he or she owns a car. Of course, this inclusion of new facts is not in accord with what is done in normal conversation. Gazdar (1979) requires that presuppositions and implicatures need only be *consistent with* (actually *satisfiable by*) the context. Fourthly, there are some propositions that all sentences would need to presuppose, for example:

The addressee can understand what the speaker is saying. (2.27)

Propositions such as (2.27) are better classified as a rule of Cooperative Conversation. Lastly, these definitions essentially equate the definition of presupposition with the definition of context given in section 2.1.3.

The more recent view of presupposition is that the speaker must believe (actually in the more precise versions it is required that the speaker know) the presupposed inferences. Thus the main change between the present view and the previous ones is that the presupposition needs to be only consistent with rather than entailed by the context.

2.3.5.2 Kempson and Wilson

Both of the major works produced by these two linguists (Kempson (1975), Wilson (1975)) had an important impact on the field of presuppositions. Although their solutions are different, I am not so interested in the details of these solutions; rather I am interested in the motivation and general principles. Therefore I will discuss both works together as if they are one. I will not give a detailed account of their arguments here. These arguments are long and complex and span the wide spectrum of presuppositions — from sentential presuppositions to speaker presuppositions. With the caution already given, I will however give a short synopsis of their ideas.

Generalizing on the work of Frege and Strawson, linguists prior to Kempson and Wilson, had developed a notion of presupposition that attempted to explain those characteristics of many lexemes and some syntactic structures which were similar to the presuppositional characteristics of referring noun phrases. These characteristics have been explained in the section 2.3. Through a series of well-reasoned arguments and convincing examples, Kempson and Wilson undermine these early attempts at defining *presupposition*.

Their main task was to remove the notion of sentential presupposition from the realm of semantics and to place it in pragmatics. They accomplished this change of view by showing that

1. Entailment and presupposition in natural language sentences have different features. A basic claim in both of their arguments is that positive sentences do not presuppose but rather entail what others have called presuppositions. They base their arguments on assymetric properties of positive and negative sentences. One such argument is the fact that in negative sentences the presuppositions can be cancelled but in positive sentences this is not the case. From a truth conditional semantics point of view this would definitely

put the relation found in positive sentences as one of entailment. Additionally, much of what had been called presupposition could be more easily explained using an entailment analysis.

2. The presuppositional analysis has problems with conjunctions, disjunctions, and implications. As well, a presuppositional analysis has difficulty with various kinds of cancellation devices. As previous examples have shown, negative sentences have a preferred internal negation interpretation. However as other examples have shown, the external negation interpretation can be invoked by placing heavy stress on the verb, by explicitly stating that the presupposition is false, or by adding something that entails the negation of the presupposition.

3. Multi-valued logics, which are required by any realistic presupposition theory, have problems with conjunctions, disjunctions, and implications.

Once they had defeated the early attempts at a semantically-based theory of presuppositions, they still faced the problem of providing a coherent theory to explain the data. In proposing their pragmatic theory of presupposition they broke from tradition by explaining the data without any presupposition relation whatsoever. In both cases they explain the data using Grice's theory of meaning. In addition, Wilson gives an alternative account based on what she calls a confirmation or evidential theory.

It is their contention that previous attempts to formalize the notion of presuppositions mistakenly placed the phenomenon in the semantic arena. By placing the concept of presupposition in a pragmatic theory they are able to define a context-sensitive method to choose the preferred interpretation of a semantically ambiguous logical representation of a natural language sentence. Semantic theories are insensitive to context and they are incapable of disambiguating semantically ambiguous logical forms. The two major contributions found in their pragmatic theory are the following:

1. The notion of preferred interpretation[25] is central to their theories and the preferred interpretation of sentences can be given by recourse to Grice's Maxims of Cooperative Conversation. They both require that a semantic theory must generate a semantic representation of a sentence that can capture all of the possible interpretations that may

[25] Wilson's term. Kempson uses the term *natural interpretation*. This concept is discussed further in chapters 3 and 4.

be encountered in a *vague* utterance. However the semantics plays no part in deciding which interpretation to choose among the many possible interpretations engendered by the vagueness. It is in the realm of a pragmatic theory to choose among the possible interpretations for the most contextually appropriate interpretation. This pragmatic theory was based upon Grice's theory of conversation.

2. The notion of context sensitivity in the choice of the preferred interpretation is also central to their theories. Kempson captures the essence of their arguments in the following:

   > The mistake of presupposition supporters lay in setting down a requirement that such an assumption [the presupposition] ***necessarily hold.*** (my italics) As we have seen in much of the earlier discussion, this implication is context-dependent, and as such is not a semantic property of the sentence in question. (Kempson (1975), p 191)

   My theory addresses this comment directly by proposing default logic as the representational device needed to capture the essence of presuppositions. The default rules are context-sensitive because there are means to block the firing of rules.

Subsequent to Kempson and Wilson, most of the research energy has been spent on finding appropriate modifications of the projection rule (Langendoen and Savin (1971)). These methods will be introduced in section 2.3.5.3. One of the major differences between Kempson's and Wilson's method and the projection methods is that the projection methods still require the notion of a presupposition relation — that is, lexemes and syntactic structures have certain features that are different than entailments. Another difference is that the projection methods span the semantic–pragmatic boundary. So, the projection methods are not as conceptually clean as Kempson's and Wilson's method. And the projection methods still depend upon a concept, presupposition, which has been most slippery to define. The projection methods do incorporate the notion of context–sensitivity. As I will discuss in section 2.3.5.3, the various amounts of success of each method corresponds to its ability to cancel unwanted presuppositions. Even though my theory was influenced by Gazdar's projection method, it more closely resembles Kempson's and Wilson's method of preferred interpretations.

2.3.5.3 Projection Methods

All of the pragmatic projection methods are based on the purely compositional projection method of Langendoen and Savin (1971). What gives each pragmatic method its pragmatic quality is the inclusion of context–sensitive rules that block the normal functioning of the purely compositional rules (Karttunen (1973, 1974), Karttunen and Peters (1975, 1979)), or that delete over–produced potential presuppositions (Gazdar (1979)), or both (Soames (1982)). Detailed analysis of these methods together with a non–projection method suggested by Gunji (1982) are discussed in Chapter 4.

These methods do have the usual qualities associated with pragmatic theories. The affect of the context is crucial; the methods require that the presuppositions are either entailed by or consistent with the context. In each method, the speaker is committed to the truth of the presuppositions because either they are already part of the context or they are to be added to the context "uncontroversially".

Although the three methods are considered to be pragmatic in nature, they all have their roots in the semantic arena. The projection methodology is just one view of Fregean compositionality (the meaning of a sentence is a combination of the meanings of its parts). Compared to the methods discussed in sections 2.3.5.1 and 2.3.5.2, the methodological waffling of the projection methods makes them not as clean as the others.

Chapter 3

A Default Logic Approach to Presuppositions

Throughout this thesis the meaning of a natural language sentence is considered to include the inferences generated from three sources of information: the sentence, knowledge about the world, and knowledge about language use. One type of inference which can be generated in this manner is called a *presupposition*. What typifies this kind of inference is that it is implied by sentences containing the environment responsible for the inference or its negation. Originally proposed to infer the existence of a referent, it is now used to define those inferences, generated from a number of linguistic situations, which pass this *negation test*.

The following sentences demonstrate some prototypical examples of presuppositions. In each of these examples the affirmative a–sentence entails[1] and the negative b–sentence presupposes the d–sentence. The c–sentence in all cases is an example of a sentence which does not have

[1]Most authors would call the relationship between the a–sentence and the d–sentence presuppositional, or both presuppositional and entailment. Because of the projection method used to generate the presuppositions of complex sentences, this relationship seems to be necessary. Unlike previous attempts, a difference (called for by Kempson, Wilson, and Gunji) between entailing and presupposing can be realized and exploited.

the d–sentence as either an entailment or a presupposition.

(a) The present king of Buganda is bald.

(b) The present king of Buganda is not bald.

(c) The present king of Buganda is not bald; Buganda is a republic. (3.1)

(d) There exists a present king of Buganda.

(a) Jack's children are bald.

(b) Jack's children are not bald.

(c) Jack's children are not bald; he doesn't have any. (3.2)

(d) Jack has children.

(a) Mary is surprised that Fred left.

(b) Mary is not surprised that Fred left.

(c) Mary is not surprised that Fred left because he didn't leave. (3.3)

(d) Fred left.

(a) John stopped beating the rug.

(b) John did not stop beating the rug.

(c) John did not stop beating the rug because he hadn't started. (3.4)

(d) John has been beating the rug.

(a) My cousin is a bachelor.

(b) My cousin is not a bachelor.

(c) My cousin is not a bachelor because he's only three years old. (3.5)

(d) My cousin is a male adult.

The persistent theme in the early attempts by linguists at defining presuppositions, as summarized in Chapter 2, is that presuppositions are *entailments* of the sentence (and context

in the case of the pragmatic definitions). Gazdar (1979) makes a major paradigmatic shift when he argues that presuppositions should be defined in terms of consistency rather than entailment. His arguments centre around the other main issue for linguists, the *projection problem*: given the presuppositions of a simple sentence, which ones survive the embedding of this sentence in a more complex sentence. From the point of view of consistency a more general question is how does the *context* affect a sentence's potential presuppositions.

Gazdar's point is that a presupposition of a sentence is consistent with that sentence. However when the sentence is placed in a larger context (either as a clause in a sentence or into the context of the utterance), the presupposition may be inconsistent; hence it can no longer be inferred. The defeasibility of potential presuppositions is one feature of this type of inference. Another related feature has also been noticed (Gunji (1982)), though not in the terms presented here. The inference, once generated can be contradicted somewhat later without an creating an inconsistency in the discussion. So the inference can be regarded as a conjecture.

Another point of view, professed by Kempson (1975), Wilson (1975), and Atlas (1977) is that natural languages, unlike formal languages, can be *semantically ambiguous* or *vague*. Because reasonable semantic representations of natural language sentences must sometimes allow for various interpretations, the representation must underconstrain the mapping from natural language sentence to interpretation. However, rules of conversation, such as Grice's maxims, prohibit multiple interpretations of an utterance. Since the semantic representation does not contain enough information to accomplish the required disambiguation, Kempson and Wilson suggest (though not in these terms) that these ambiguities are resolved according to *pragmatic rules* to generate the *preferred interpretation* of the natural language sentence. Negated presuppositional environments are a source of vagueness.

These inherent features of presuppositions — the conjectural and defeasible nature of the inference, and the incompleteness of the knowledge from which the inference is made — suggest the use of some sort of non–monotonic logic to capture the extra pragmatic rules. Non–monotonic logics have the features that are required: defeasible inference rules, conjectural inferences, and model theories that are analogous to the idea of preferring one interpretation from many. Default logic was chosen for historical reasons. Careful application of other forms of non–monotonicity such as circumscription could have been used (Etherington (1986)) summarizes methods for translating default theories into appropriately circumscribed first–order theories, and Etherington, Mercer, and Reiter (1985) indicates that predicate circumscription

without appropriate modifications is unable to generate the presuppositional inferences). The Default Logic approach has some advantages, which will be seen in later sections: default rules capture the idea of defeasibility, and rules can be attached to the presuppositional environments.

The position is taken that presuppositions of a natural language sentence S are inferences generated from default rules together with S and the appropriate knowledge sources. Presuppositions are then used to generate the ***preferred interpretation*** of the ambiguous natural language sentence. A preferred interpretation is circumvented by an explicit inconsistency contained in the sentence itself or in the other knowledge sources.

The background topics which include a discussion of the representation language, the semantic representation of the natural language sentence, the importance of inferencing in a theory of meaning, and default logic is provided in section 3.1. Section 3.2 demonstrates the appropriateness of using *default rules* (Reiter (1980)) to represent certain common examples of presupposition in natural language. Section 3.3 exploits an appropriately modified proof theory to reveal a method of obtaining presuppositions from complex sentences (specifically those with the filters '*or*' and '*if ... then ...*', and the hole '*possibly*') without recourse to any projection methods.

3.1 Logical and Representational Preliminaries

3.1.1 First–Order Representation

The representation language and underlying logic used throughout the remainder of this thesis is that of a first–order $S4$ modal logic. This language has the usual morphology: a countably infinite set of predicate symbols, constant symbols, and variable symbols, plus the logical symbols $\wedge$, $\vee$, $\supset$, $\neg$, K_S, and P_S. The last two symbols, called modal operators, are to be interpreted as '*the speaker knows that*' and '*for all the speaker knows, it is possible that*', respectively. For a discussion of knowledge and belief see Hintikka (1962). For a discussion of Modal Logic, in particular the logic $S4$ and its connections to knowledge and belief see Hughes and Cresswell (1972) or Chellas (1980). Since no modal operator occurs in the scope of a first–order quantifier in any of the representations in this thesis, all of the sentences containing modal operators can be treated as propositions. No direct contact is made between the modal statements and the default rules. Only the sentence that is uttered and the clausal implicatures that are generated from the sentence are represented with a modal operator (which for the purposes here is

redundant). The clausal implicatures are used only to constrain the default proof theory, and the uttered sentence can be used to generate just the first–order body of the modal statement.

Throughout the remainder of this thesis it is assumed that the speaker's utterance has undergone the first phase of the interpretation process which generates a semantic representation of the sentence uttered. This semantic representation will be a well–formed formula (a sentence, actually, because there will be no unbound variables) in a first–order $S4$ modal language. I believe that straightforward representations have been chosen for all of the examples, and that the proposed method is not an accident of the particular representations[2] that have been chosen for these examples.

Recalling the discussion in Chapter 2, the hearer–based meaning of an utterance is represented by the set difference of the closures of a logical theory before and after the addition of the logical statement representing the sentence uttered by the speaker. Throughout the following discussion, utterances are represented by logical theories that have the form shown by (3.6).

$$\left\{\begin{array}{c} \textit{semantic representation of sentence} \\ \\ \textit{clausal implicatures of sentence} \\ \text{(if needed)} \\ \\ \textit{first–order statements} \\ \textit{and default rules} \\ \textit{representing appropriate} \\ \textit{extended meaning postulates} \\ \vdots \end{array}\right\} \tag{3.6}$$

The semantic representation of the sentence is a modal statement giving (what I believe to be) an adequate representation of the sentence uttered by the speaker. The clausal implicatures are modal statements as well. The remainder of the explicit theory represents the meaning of the terms or syntactic environments that give rise to the appropriate presuppositions. The statements are referred to as *extended* meaning postulates because they do not conform to Carnap's original definition (Carnap (1956)). The vertical dots are meant to represent that the theory presented only portrays part of the hearer's knowledge base. This open–endedness of the theory could lead to some confusion since the application of default rules depends on certain

[2]It is assumed that the negation of an affirmative sentence is represented *vaguely*. However, this is the basis of the method, not an accidental side–effect. Vague representations are discussed in section 3.1.3.1.

facts being consistent with the entire theory (see section 3.1.4 for details). An appropriate warning is that the unspecified part of the theory does not contain any facts that would lead to inconsistencies. Those that do not appreciate this sort of hand–waving can just remove the vertical dots from all of the examples.

3.1.2 Importance of Inferencing

One of the subgoals of this thesis is to provide some evidence that logical[3] inference may be a unifying treatment for the two aspects of meaning[4] of natural language sentences: *semantics* and *pragmatics*. Semantics is that part of meaning which is not affected by the physical or linguistic context, except for indexicals which can be properly treated in a possible worlds semantics. Any other meaning that is to be found in a natural language sentence has been relegated to *pragmatics*[5]. Presuppositions and implicatures are included in the pragmatic meaning of an utterance.

Where does inferencing fit into a model of meaning? Kempson (1975) gives four basic requirements of a semantic theory:

1. It must predict the meaning of any sentence on the basis of the meaning of the lexical items and the syntactic relations between them. If there is more than one meaning it must predict them all.

2. There may only be a finite number of semantic rules.

3. It must separate the semantically well–formed sentences from the contradictory or anomalous ones.

4. It must predict meaning relations between sentences, for example, entailment, contradiction, and synonymy.

Items 2 and 3 are not of concern here. Point 2 is motherhood, and the viability of point 3 depends on whether the set of well–formed sentences is decidable. Items 1 and 4 are germane to this discussion. If item 1 is rewritten as:

[3]It might be argued that this should be *quasi*–logical inference since default logic is not a true logic.

[4]The discussion will not be concerned with the major competing theory of utterance meaning, Speech Acts. (Austin (1962), Searle (1969))

[5]Pragmatics is also used to label those issues dealing with the use of language such as social conventions in discourse, structure of dialogue, etc.

> A semantic theory must predict the logical form of any sentence on the basis of the semantic tokens associated with the lexical items and the syntactic relations between them. If there is more than one logical form the semantic theory must predict them all.

Grammar formalisms such as GPSG (Gazdar, Klein, Pullum, and Sag (1985)), Government–Binding (Chomsky (1981), and Logic Grammar (Pereira and Warren (1980)) provide the means to generate the logical form required by the rewritten item 1. Item 4 is of special importance. A strictly compositional theory (with filters, if pragmatics is included) requires the logical form to embody the predictive ability stipulated by item 4. However, meaning relations between sentences in a semantic theory that incorporates inferencing as its basic rule arise automatically by virtue of the inference procedure without any additional machinery being required. The general notion of a two–phase semantic theory has its supporters (see Davidson (1967) and Lycan (1984) for example). This support is on theoretical lines. In addition, if the model of communication given in Chapter 2 is a reasonable one, then "non–linguistic" as well as "linguistic"[6] knowledge is used in both the generation and interpretation phases of the communication act. A theory which treates all knowledge as statements in a knowledge base does not have to defend differentiation of particular sets of statements nor would it need multiple copies of knowledge, one for each component of intelligence in which it is used. Also there are reasons for developing a theory of (semantic/pragmatic) meaning along these lines for practical reasons. In a purely compositional theory (with contextual filters in the case of pragmatics) the building of the logical representation which must capture the total meaning of the natural language sentence is performed by the repertoire of semantic and pragmatic rules. The more rules that a semantic/pragmatic theory has, and the more subtle their interactions become, the more likely the theory will collapse under its own weight.[7] The projection methods discussed in Chapter 4 provide convincing evidence for this pessimistic attitude towards a monolithic theory of (semantic/pragmatic) meaning. By making the logical form generation process as simple as possible and the inclusion of a general inference method, a modularization of function

[6] Scare quotes are used because of the discussion of various types of knowledge given in Chapter 2.

[7] A future goal of the research program that began with this thesis is to find a more general representation method for the presupposition generating default rules that are presented in section 3.2. However, even with the variety of default rules that exist, there are no interactions among them, so the default logic method does not succumb to this criticism.

is achieved.

But another reason promotes interest in the two–phase approach. If to Kempson's list a fifth item is added:

> A theory of pragmatics must predict meaning relations between sentences, for example, presuppositions and implicatures.

a more complete theory of meaning is obtained — one that directly includes presuppositions and implicatures. If this last item can also be captured using an inference procedure then a sought after unifying feature has been secured.

What I propose in this thesis is that one pragmatic issue, presuppositions, can be viewed as a conjectural inference. I will attempt to show that the notion of presuppositions can be incorporated in a natural way into an inference based theory of meaning by extending the form of inference rules that are allowed. In addition to the classical logical inferencing that is used in a semantic theory, the pragmatic theory has non–classical logical inferencing. Conjectural reasoning has two fundamental features that distinguish it from normal logical inference: the inference rules are context–sensitive, and the rules can be invoked even though the truth value of some of the antecedent conditions is not known. Context–sensitivity is the hallmark of pragmatics. Making inferences (conjectures, actually) in the face of incomplete information might be another standard feature that sets pragmatics apart from semantics. However, in order that conjectural forms of inferencing be a distinguishing feature it must find application in other areas of pragmatics. This speculation must remain as such since it is beyond the scope of this thesis.

So, for this particular pragmatic phenomenon, a more unified treatment of semantics and pragmatics is obtained unlike the usual dichotomous approach. A distinction between semantics and pragmatics still exists since the semantic inferencing will be modelled by entailment which does not allow any contextual effects, whereas pragmatic inferencing (presuppositions in particular) will use default inferencing which allows context to affect the inference procedure. Merely speculating, if this use of default (or other non–monotonic) inferencing carries over to other pragmatic concepts, a different view of the distinction between semantics and pragmatics could emerge. At present, the distinction is one of opposites: the boundaries of semantics is defined and whatever is not semantics is pragmatics. Probably the most important difference is the affect of context. In the emergent view the distinction between semantics and pragmatics could be presented as a continuum. So, for instance, both semantics and pragmatics have

foundations in inferencing. However, semantics uses classical entailment whereas pragmatics uses non–monotonic forms of inferencing. Now the differences are seen as distinction within features, rather than different features. The all–important context is now just a side–effect of the type of inference rules that are used — entailment is not affected by context, whereas non–monotonic forms of inference are.

3.1.3 Representing Natural Language Negation

Negation in natural language is a rather complex issue (Lyons (1977, pp768–777)). Firstly, affirmative sentences can be used as denials. For example, the second sentence in (3.7) denies the first.

The door is not open.
The door *is* open. (3.7)

Although this type of negation causes no problems if only one negation operator appears in the representation language, it does cause problems if there is more than one negation operator. Arguments against multiple negation operators, given in section 3.1.3.3, are convincing enough that the representation language used throughout this thesis has a single negation operator. Thus, this issue is of no consequence.

Secondly, negation in natural language can be used to create contradictory and contrary sentence pairs. In those cases in which a gradable expression (for example,'*like*') is negated the contrary of the affirmative sentence is usually produced rather than the contradictory. (3.8) is an example of this phenomenon. '*Not liking*' can mean anything from '*hate*' to '*not prefer*'. Only contradictory negation is considered in this thesis.

I like modern music.
I don't like modern music. (3.8)

The third problem is the classic one of representation. Standard treatments of the representational problems that are caused by negation usually include quantifiers and modal operators. A premise of this thesis is that all presuppositional environments (including quantifiers and some of the modal operators) are subject to the same representational problems when negated. One representational problem occurs because the standard method of negation in the representational language (I am assuming first–order logic), which is to negate the representation of the affirmative sentence, does not correspond to the *usual sense* of negation in natural language which requires the negation to be more closely bound to only a portion of the affirmative sentence's representation. It is also important to realize that the usual sense is impossible in some

situations. The second problem means that some situations require the availability of different representations. These problems are exemplified in (3.9). The affirmative sentence (3.9a) is represented in (3.9b). The sentence (3.9c) is the negation of the affirmative sentence. Although the negation of (3.9b) is given in (3.9d), the usual meaning of (3.9c) is more closely represented by (3.9e). On the other hand, (3.9f) cannot be represented by (3.9e).

(a) The king of Buganda is bald.

(b) $\exists x.\mathit{King\text{-}of\text{-}Buganda}(x) \wedge BALD(x)$

(c) The king of Buganda is not bald.

(d) $\neg\exists x.\mathit{King\text{-}of\text{-}Buganda}(x) \wedge BALD(x)$ (3.9)

(e) $\exists x.\mathit{King\text{-}of\text{-}Buganda}(x) \wedge \neg BALD(x)$

(f) The king of Buganda is not bald because there is no king of Buganda.

There are two approaches to solving the representational problems caused by negation in natural language. The orthodox view says that negation is (syntactically or lexically) ambiguous between two or more representations. The orthodox syntactic view, exemplified by Russell (1905), gives (3.9d) and (3.9e) as the two representations of the ambiguous (3.9c). Both representations are required to capture the presuppositional and non–presuppositional readings of (3.9c). The problem for this view is to provide the means to decide which representation to use in different situations. The heterodoxy states that negation is *vague* (semantically ambiguous), that is, there exists only one representation which is true under more than one set of truth conditions. The logical statement (3.9d) is the single representation provided by the heterodox view. If the '$\neg$' is brought inside the quantifier and distributed over the conjunction, the more familiar disjunctive representation is obtained. The various truth conditions that make the disjunction true (which correspond to any non–empty set of the disjuncts) correspond to the different interpretations of the vague (3.9c). The problem for this view is to provide the means to generate the appropriate interpretations from the disjunctive representation when needed. Noting that (3.9e) entails (3.9d), but not vice versa, if negation is treated as being vague, some method other than logical entailment will be needed to generate the normal interpretation. And because sentences such as (3.9f) disallow the normal transformation, the transforming process must be defeasible. This thesis presents such a method for negated presuppositional

environments.

The remainder of this section discusses the differences between ambiguity and vagueness, gives tests to decide whether a certain situation exemplifies ambiguity or vagueness, and concludes with arguments against the orthodox view for representing natural language negation.

3.1.3.1 Ambiguity and Vagueness

The two typical kinds of ambiguity found in natural language are lexical and structural. Lexical ambiguity is the result of two lexemes having one surface form and the use of that single surface form in a sentence which is semantically well–formed using either lexeme. An example of this is the word '*port*'. '*Port*' is associated with two lexemes: $port_1$ meaning *harbour*, and $port_2$ meaning *a kind of fortified wine*. (3.10) can be understood properly with both lexemes.

We passed the port at midnight. (3.10)

Structural ambiguity results from two phrase structures having the same surface form, or more precisely,

> A grammatically ambiguous sentence is any sentence to which there is assigned (by a generative grammar of the language–system) more than one structural analysis at the grammatical level of analysis. (Lyons, 1977)

An example of this type of ambiguity is found in (3.11). The two structural representations differentiate between '*the act of flying planes can be dangerous*' and '*planes that are flying can be dangerous*'.

Flying planes can be dangerous. (3.11)

Kempson (1975) discusses the kinds of vagueness that exist in natural language. Even though the following three kinds of vagueness may not encapsulate all possible types, they are sufficient to exemplify the phenomenon.[8] What is common to all of the categories described

[8]Kempson (1975) gives a fourth kind, referential vagueness; that is, where the application of a lexical item whose meaning is reasonably clear to a certain object is difficult. For example, when is a mountain a mountain and not a hill, when is a chair a chair and not a stool. The problem does not exist for those referents which are clear cases of the meaning incorporated by a lexical item. Rather it is the borderline cases which are the problems. (A related AI problem is the *recognition problem.*) But since this is a problem more for generation than interpretation, it is not included in the list above.

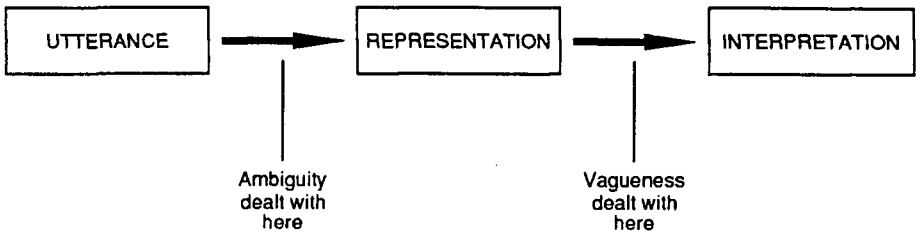

Figure 3.1: Determining the Meaning of an Utterance

below is that there is insufficient information to give a more precise representation of the vague natural language term or construction. The semantic representation must, however, allow for all of the more precise interpretations of the vague concept. The third item is of most interest to this thesis.

The first type of vagueness is indeterminacy of meaning. An example of this type is the possessive construction, for example, '*John's train*'. Does this mean the train that John takes each morning to commute to work, or is it the train that he is about to catch, or is it the train that he is engineer of, or is it the train that he designed, or is it the train that he owns?

A second kind is lack of specification. Examples include verbs such as '*go*' and '*do*'. The sentence '*He went to the office.*' can be used to describe many dissimilar actions such as walking, cycling, motoring, going by subway or bus.

The third type of vagueness involves a disjunction in the possible interpretations of the meaning of an item. This is the kind of vagueness that is important for this thesis. An example of this kind is found in negations of lexical items whose positive meaning is a conjunct. If it is given that a '*bachelor*' is '*an unmarried male adult*' then '*not a bachelor*' is someone who is '*married*' or '*female*' or '*not an adult*'.

Figure 3.1 provides an intuitive view of the difference between ambiguity and vagueness in determining the meaning of a sentence. The diagram indicates that determining the meaning of an utterance is a two stage process. The first phase computes the semantic representation of the utterance. During this process any ambiguity that occurs is detected and resolved. Thus ambiguity results in more than one semantic representation of the utterance (either lexically or structurally). Ambiguity is resolved by choosing one of the possible representations. The second phase is the interpretation of the representation. I use the term *interpretation* in its model-theoretic sense, that is, the mapping of symbols in the representation language to elements in some interpretation domain. Only those interpretations which are models of the logical theory composed of the background knowledge of the hearer and the utterance are of interest

here. Vagueness in the semantic representation is resolved, if possible, at this stage. Resolution of vagueness can be viewed as the process of discarding some of the models allowed by the vague representation. In particular, the vagueness of negated sentences which are captured as disjunctive sentences in the logical theory, is resolved using Grice's Maxims of Cooperative Conversation to produce conjunctive sentences whose models are a subset of the models of the original disjunctive representation.

In addition to the arguments given in section 3.1.3.3 against treating negation as ambiguous, wanting the logical form of the sentence (the representation referred to in Figure 3.1) to be a semantic representation is an argument in favour of treating negation as being vague. A semantic representation, by definition, should be derivable solely from the sentence in a purely compositional manner (see the discussion in section 3.1.2). Requiring pragmatic knowledge (that is, knowledge about the context or the relevance of other parts of the sentence) to be part of the derivation of the semantic representation contradicts this definition. Treating natural language negation as being vague means that a logical form can be given to negated sentences without access to pragmatic knowledge.

A main theme of this thesis is to capture presuppositions as default rules. By doing so, a nice harmony among a number of disparate issues has been obtained. Resolving the vagueness of natural language negation is viewed as an inferencing process, similar in nature to other inferencing processes, such as computing entailments. Natural language semantics and pragmatics (at least for presuppositions) is viewed as two stages of the interpretation process in the Model of Communication introduced in Chapter 2. Natural language semantics constructs the logical form of an utterance and adds it to a knowledge base. The semantic and pragmatic rules logically close the knowledge base to give the meaning of the utterance. And this unity has been obtained without forcing any of the pieces. Default logic provides the means to discard some of the possible models of vague statements which is exactly what resolution of vagueness requires.

3.1.3.2 Linguistic Tests for Ambiguity and Vagueness

One of the important contributions of linguistics is the development of independently motivated procedures to test grammatical and semantic features of natural language sentences. These tests are used to ascertain linguistic features in sentences which do not fit into any classification in an intuitively or introspectively obvious way. Some of these tests form part of the argument

against the ambiguity of negation in the next section.

There are many linguistic tests for ambiguity (Zwicky and Sadock (1975)). One of these is that ambiguity is preserved over verb–phrase pronominalisation, that is, in conjoined sentences in which the second conjunct has the common piece deleted due to a deletion transformation, the same sense of the possible ambiguity must hold for both conjuncts. In (3.12) only combinations of the lexemes $port_1$ and $port_1$ or $port_2$ and $port_2$ are allowed. The mixed combinations of $port_1$ and $port_2$ are disallowed[9].

We passed the port at midnight and so did the other group. (3.12)

In (3.13) only combinations of '*the act of flying planes*' and '*the act of sailing ships*' or '*planes that are flying*' and '*ships that are sailing*' are allowed. The representations for '*the act of ...*' and '*... that are ...*' are structurally different.

Flying planes can be dangerous and so can sailing ships. (3.13)

Like ambiguity, vagueness is preserved over verb–phrase pronominalisation. However, unlike the case for ambiguity in which identical lexemes or structures are required, only the fact that vagueness in terms is required to hold. (3.14) and (3.15) are two examples of this preservation of vagueness.

John likes music and Harry does too: John likes pop and Harry classical. (3.14)

John has one neighbour and Mary has one too: John's neighbour is a spinster and Mary's is a widower. (3.15)

Here the terms '*music*' and '*neighbour*' are vague and the vagueness of the terms holds across verb–phrase pronominalisation. However the actual meaning of the vague term need not be the same in both cases. The same holds true for negation as (3.16) demonstrates.

John didn't run away and Harry didn't either: John walked slowly off and Harry stayed stock still. (3.16)

It seems that this test for ambiguity and vagueness indicates that ambiguity occurs during the building of the semantic representation (to which the deletion transformation applies) whereas vagueness is a characteristic of the semantic representation and is resolved during semantic interpretation; that is, after the representation has been fixed.

[9]Except in situations which require the breaking of this rule in order to convey the desired intent; humour, for example.

One kind of lexical ambiguity occurs with *privative opposites.* Privative opposites are two lexemes one of which entails the other (that is, it is a lexical extension, more traditionally called polysemy) because some feature of one lexeme is unspecified in the other. So dog_1 meaning '*canine*' and dog_2 meaning '*male canine*' are privative opposites with respect to the feature of gender. Here, dog_2 entails dog_1. Sentences such as (3.17) are semantically well–formed. These sentences provide an ambiguity test to show if two lexemes should be considered as privative opposites.

That's a dog (in the dog_1 sense), but it isn't a dog (in the dog_2 sense). (3.17)

Another test, *semantic differentia*, states that if the two meanings of the ambiguous sentence are greatly distinct, this would point to a difference based on ambiguity rather than vagueness.

3.1.3.3 Arguments Against the Ambiguity Hypothesis

The two negations in natural language are referred to as denial and descriptive negation. Denial negation is used to deny a statement. Descriptive negation describes a particular state of the world. It has been mentioned that there are two options available to represent natural language negation, *ambiguously* and *vaguely*. In this section a summary is given of some arguments given by Kempson (1975), Wilson (1975), Atlas (1977), and Gazdar (1979) against regarding negation as ambiguous.

Two methods are available to represent negation ambiguously: syntactically and lexically. Russell (1905) takes the syntactic approach: the ambiguity of negation can be represented as differing scopes of a single negation operator. His example (3.18) can be represented as (3.19) in which the occurrence of '*the King of France*' is primary (sometimes referred to as internal negation), or can be represented as (3.20) in which the occurrence of '*the King of France*' is secondary (sometimes referred to as external negation).

The King of France is not bald. (3.18)

$$\exists x.King\text{-}of\text{-}France(x) \wedge \neg Bald(x)^{10} \tag{3.19}$$

$$\neg\exists x.King\text{-}of\text{-}France(x) \wedge Bald(x) \tag{3.20}$$

These two representations led to many of the controversies concerning presuppositions. When

[10]The term which guarantees uniqueness of the King of France has been left out only because it does not add anything to the phenomenon being investigated.

P	$\neg P$
T	F
F	T
#	#

descriptive negation

P	$-P$
T	F
F	T
#	T

denial negation

Figure 3.2: Two Types of Negation

negation is in the narrow–scope predicate–negation position, it is said that the sentence presupposes the existence of the King of France. When negation is in the wide–scope sentence–negation position it is said that the sentence does not presuppose the existence of the King of France.

A different approach is to represent the ambiguity of negation with two different negation operators in the representation language. One of these operators, called descriptive or choice negation is associated with the normal logical not and is used to describe a particular state of affairs. The other operator, called denial negation, is used to deny a particular state of affairs.[11] Descriptive negation is represented by '$\neg$' and denial negation by '$-$' in the following discussion. The two negations in a three–valued logic can be given the truth tables in Figure 3.2. The symbol '#' is used for '*not true or false*'. This second operator is most peculiar to anyone who is more familiar with the first operator since the inclusion of this second kind of negation into the semantic vocabulary allows positive and compound sentences to deny a state of affairs, but the representation of the denial is just $-[X]$ where $[X]$ is the representation of the state of affairs being denied.

Kempson, Atlas, and Wilson take a radical approach to these orthodoxies. Instead of treating negation ambiguously, Kempson and Atlas treat negation as being vague. Wilson takes the point of view that negation creates a disjunctive set of propositions (which is the vague hypothesis) but does not use the term vague. She argues from the point of view that entailments and presuppositions have the same distributional characteristics in natural language rather than from any of the counter–arguments given below. (Kempson (1979) gives credit to Wilson for the idea that negation in natural language should be treated unambiguously as a disjunction of propositions.) Gazdar (1979) takes this point of view as well. I will also take this view;

[11]This negation corresponds to the normal logical negation of a statement. But the two negations given here are usually captured using multi–valued logics.

that is, negation has one representation with many possible interpretations. This important distinction places the solution to the problem (deciding upon one representation from many (ambiguity) or deciding upon one interpretation from many (vagueness)) at a different point in the generation of the meaning of an utterance as was shown previously. Ambiguity resolution occurs when the representation is being computed whereas vagueness resolution occurs when an appropriate interpretation of the representation is being formed. It is also of primary importance to any theory of presupposition since that theory will be heavily influenced by the decision on whether negation is ambiguous or vague. As will be seen in future sections which discuss various approaches to the problem of deriving presuppositions of natural language utterances, the notion of an ambiguous negation is crucial to many of the theories.

The following statement aptly notes that room exists for points of view other than the orthodox:

> ... though philosophers often claim that expressions are ambiguous, their subtle judgements rarely receive rigorous defence. (Atlas (1977))

Kempson, Atlas, and Gazdar make the following arguments against negation being treated as ambiguous (lexically or structurally). If some of the statements in support of negation's being ambiguous seem inappropriate — that is they are straw men — it should be remembered that the only means to obtain ambiguity are lexically and structurally.

1. (Kempson) The incorporation of a denial operator into the logical vocabulary has awkward consequences. For example, seemingly unambiguous sentences can turn out to be many ways ambiguous. This can happen for positive sentences since they can be used as denials. For example, in (3.21) **B**'s statement denies **A**'s statement.

   A: John hasn't passed his exams.
   B: John has passed his exams. (3.21)

   Given that $\neg P$ corresponds to descriptive negation and $-P$ corresponds to denial negation, (3.22) gives the representations for **A**'s and **B**'s utterances (where $[X]$ is the representation of 'X').

   A: $\neg$[John has passed his exam]
   B: $-[\neg$[John has passed his exam]] (3.22)

The use of an ambiguous '*not*' presents a most unsatisfactory situation in which **B**'s statement, which would be considered unambiguous by most, is now ambiguous between two representations: the one given and the normal representation, [John has passed his exam]. There is at least a third representation. The situation presented in (3.23) provides the necessary environment.

B: John has passed his exam.

A: John has not passed his exam. (3.23)

B: John has passed his exam.

The representation of **A**'s statement this time would be with a denial operator, and since **B**'s statement is a denial of **A**'s the representation of **B**'s second statement would be that shown in (3.24).

B: −[−[John has passed his exam]] (3.24)

Even more representations could be obtained (by continuing the repetition of **A**'s and **B**'s statements) depending on whether successive denial operators collapse as do successive ¬'s.

2. (Kempson) The denial operator does not have any viable sense for compound sentences. The denial operator's main purpose is to deny some state of affairs. So, (3.25) represented as (3.26) can be denied using (3.27), which would be represented as (3.28).

In 1976 the Pope will give the annual address. (3.25)

[In 1976 the Pope will give the annual address]. (3.26)

In 1976 the Pope will not give the annual address, but it will be the Prefect of the Sacred College of rites who gives it. (3.27)

−[In 1976 the Pope will give the annual address]. (3.28)

But the denial, (3.28), can be false if the Prefect is not the one giving the address even if the positive sentence, (3.26) is false. But this contradicts the truth table for denial negation given in Figure 3.2.

3. (Kempson and Gazdar) Since a major reason for having an ambiguous '*not*' is to retain a projection rule based definition for presuppositions, then similar analyses for other lexical items displaying similar presuppositional phenomena should be considered. A similar analysis for the word '*before*' is exemplified in (3.29).

   (a) John got to safety before the boiler blew up.
   (b) John got to the safety handle before the boiler blew up. (3.29)

   (3.29a) presupposes that the boiler blew up whereas if getting to the safety handle before the boiler blows up is assumed to be able to prevent the boiler blowing up, then (3.29b) does not presuppose it. On the other hand, other lexical items, most notably the connectives '*and*', '*or*' and '*if* ... *then* ...' have similar presuppositional phenomena, do not have second meanings to appeal to. So, in some cases which are normally considered unambiguous, an ambiguity analysis may be forced, and in other cases where an ambiguity account is impossible, an important generalization in the semantics of natural language may be lost. Hence rather than making the semantics of natural language simpler, an ambiguous '*not*' may in fact be making it more complex. And it seems pointless to try to force this analysis in view of all the counterevidence.

4. (Kempson, Wilson, and Gazdar) Any analysis of negative sentences as ambiguous is committed to the contradictory view that a positive sentence both entails and presupposes the presupposition of the sentence. The reasoning goes as follows: assume S is a sentence and P is its presupposition. Then if not–S is ambiguous between descriptive and denial negation following set of conditions arise:

   descriptive negation:
   if not–S is true then S is false and P is true
   if not–S is false then S is true and P is true
   therefore S presupposes P

   denial negation:
   if not–S is true then S is false and P is false (or true)
   if not–S is false then S is true and P is true
   therefore S entails P

Wilson argues that if a sentence S both entails and presupposes a sentence P then P must necessarily be true. Gazdar gives a similar argument. But from the conditions given above, P can be false hence S cannot both entail and presuppose P. If this were the case many of the theories given in later sections would be completely false since they require that positive sentences entail and presuppose their presuppositions. However Martin (1979) gives an argument against Wilson's reasoning. This argument revolves around the use of three–valued logic in any theory of presupposition, which undermines one of Wilson's statements about entailment which is crucial to her conclusion that S's entailing and presupposing P is contradictory. However even though this criticism lessens the impact of Kempson's point, it does indicate that any presuppositional theory which incorporates the ability for S to entail and presuppose P must subscribe to a multi–valued logic. Kempson's point that if not–S is ambiguous between two types of negation then S must both entail and presuppose P is maintained. Even though I concur with the heterodoxy of Kempson and Atlas that negation is vague, it is important to note that my theory would be required to relinquish the orthodox view that negation is ambiguous, since it does not allow a sentence S to simultaneously entail and presuppose a sentence P.

5. (Kempson and Atlas) Ambiguity tests can be used to provide strong evidence against negation being ambiguous between a "presuppositional" and a "non–presuppositional" sense. Verb–phrase pronominalisation, exemplified in (3.30) gives evidence that '*not*' is not ambiguous but rather vague.

   The king of France is not wise (since France is not a monarchy) and the same thing goes for the Queen of England (who is a typical Windsor). (3.30)

   Other tests for ambiguity also fail for '*not*'. The test for privative opposites is one. The internal negation and external negation lexemes are candidates for being privative opposites. Internal negation entails external negation, and they differ in the feature, presupposition (if such a feature exists). Atlas notes however that (3.31) is a semantically anomalous sentence. This indicates that the two senses of '*not*' are not privative opposites (which is one kind of lexical ambiguity).

   The king of France is not wise but he is (not non–) wise. (3.31)

Another test, *semantic differentia*, can be used to classify a difference based on ambiguity rather than vagueness. Unlike the strong contrast in the two meanings of the lexically ambiguous sentence '*I saw her duck.*', Atlas argues that the difference between the two meanings of '*The king of France is not wise.*' is small. He appeals to Russell's argument of enumerating all wise individuals and looking down the list not finding the king of France. The reasons are that he exists but is not in the list or that he does not exist and hence is not in the list. The close similarity of his not being on the list in both cases rather than the difference for not being there leads Atlas to conclude that the burden of proof for '*not*' being ambiguous shifts to those who claim it is.

6. (Gazdar) Unlike other lexically ambiguous terms, '*not*' is not disambiguated by translating it to any other language (of which Gazdar is aware).

The evidence seems to be strongly biased toward a vague representation of natural language negation. The remainder of this chapter develops a quasi–logical method for deriving the *preferred interpretation* of a natural language sentence from its *vague representation.*

3.1.4 Default Logic

The inference rules of classical logic produce *safe* deductions. Deductions are safe if they are, in some sense, already known. Examples of this type of inference include: deducing that a particular individual has a property from the knowledge that all individuals have that property; deducing the truth of two conjuncts given the truth of the conjunction; and deducing the consequent of a material implication given the truth of the antecedent. Unfortunately, this form of logical inference is not powerful enough for a solution to the problem at hand; that is, forcing a single interpretation from an vague representation.

Default logic (Reiter (1980)), on the other hand, allows (in a principled manner) the conjecturing of new information in the face of incomplete information. Since vague representations of an utterance do not provide complete information, and since a more complete interpretation of the utterance is required, default logic may embody the necessary tool to generate the required information to complete the interpretation of the utterance, at least for the presuppositional aspects. Before embarking on a study of the application of default logic to the problem of natural language presuppositions, a brief introduction to default logic is in order.

A *default rule* is a rule of inference denoted[12]

$$\frac{\alpha(\vec{x}) : \beta_1(\vec{x}), \ldots, \beta_n(\vec{x})}{w(\vec{x})}$$

where $\alpha(\vec{x})$, $\beta(\vec{x})$, $w(\vec{x})$ are all first order formulae whose free variables are among those of $\vec{x} = x_1, \ldots, x_m$. Intuitively, a default rule can be interpreted as *for all individuals* $x_1, \ldots, x_m$, *if* $\alpha(\vec{x})$ *is believed and if* $\beta(\vec{x})$ *is consistent with our beliefs, then* $w(\vec{x})$ *may be believed.* (Reiter (1980)). The α, β_i's, and w are referred to as the *prerequisite, justifications*, and *consequent* of the default rule, respectively.

Normal defaults are default rules with the properties $n = 1$ and $\beta_1(\vec{x}) = w(\vec{x})$. Since all the default rules used throughout this thesis are normal, discussion is restricted to this class. In addition to this structural property, normal defaults have other important properties which are discussed below. *Closed defaults* are default rules that contain no free variables in any of the first–order formulae. *Open defaults* are default rules that are not closed. An open default is meant to represent the set of closed defaults obtained by replacing all its free variables by ground terms. *Default rule schemata* are meta–default rules that represent the set of default rules obtained by replacing all the meta–variables with the appropriate substitution instance (for example, predicates, or formulae).

A *default theory*, Δ, is composed of a set of first–order formulae[13], W, and a set of default rules, D. The default rules can be viewed as *extending* the first–order formulae with the consequents of the default rules. An *extension*, E, of a closed default theory is a constructive fixed point having the following properties:

1. $W \subseteq E$
2. if $E \vdash a$, then $a \in E$ (E is logically closed, that is, $Th(E) = E$, where Th is a fixed point operator defined by $\vdash$)
3. for each default, $\frac{\alpha(\vec{x}) : \beta(\vec{x})}{\beta(\vec{x})} \in D$, if $\alpha(\vec{x}) \in E$, and $\neg\beta(\vec{x}) \notin E$, then $\beta(\vec{x}) \in E$

Normal default theories always have an extension. Multiple extensions are produced when two defaults conflict. Normal defaults conflict when their consequents cannot simultaneously be in the same extension. These multiple extensions are orthogonal, that is, pairwise, they differ on

[12]This notation differs from the original (Reiter (1980)) where an M precedes each of the β_i's. The positional information makes this extra notational feature redundant.

[13]This definition has been expanded to include modal first–order formulae.

the truth value of at least one formula. The third point in the definition of E is very important. Limiting the discussion to the effect that this definition has on the application discussed in the remainder of this chapter, since the first–order part of the default theory and all its entailments are in E, if a conflict occurs between a default and anything in the logical closure of W the consequent of the default rule is in no extension of Δ.

The following three examples demonstrate, respectively, a single extension theory, a multiple extension theory, and a theory in which a default rule does not contribute its consequence because its justification is inconsistent with a first–order derivable statement. To keep the discussion simple, propositional logic is used in place of first–order logic.

Example 1

$$\Delta_1 = \left\{A, \neg B, \frac{A : \neg C}{\neg C}, \frac{: D}{D}\right\}$$

Δ_1 has one extension, E_1.

$$E_1 = Th(\{A, \neg B, \neg C, D\})$$

Example 2

$$\Delta_2 = \left\{A \vee B, \frac{: \neg A}{\neg A}, \frac{: \neg B}{\neg B}\right\}$$

Δ_2 has two extensions, $E_{2.1}$ and $E_{2.2}$.

$$E_{2.1} = Th(\{A, \neg B\})$$
$$E_{2.2} = Th(\{\neg A, B\})$$

Example 3

$$\Delta_3 = \left\{A, A \supset \neg B, \frac{A : \neg C}{\neg C}, \frac{: B}{B}\right\}$$

Δ_3 has one extension, E_3.

$$E_3 = Th(\{A, \neg B, \neg C\})$$

The consequent of the default rule, $\frac{: B}{B}$, cannot be in any extension because its justification $\neg B$ is inconsistent with a statement that can be derived with only first–order inference rules (B can be derived from A and $A \supset \neg B$ using *modus ponens*).

Being a logic, along with the syntax goes a proof theory. The following provides the definition of a default proof.

Definition 1 *If D is any set of defaults then*

$$CONSEQUENTS(D) = \left\{ w(\vec{x}) \,\middle|\, \frac{\alpha(\vec{x}) : \beta_1(\vec{x}), \ldots, \beta_n(\vec{x})}{w(\vec{x})} \in D \right\}$$

Definition 2 *If D is a finite set of closed normal defaults, then*

$$PREREQUISITES(D) = \bigwedge_{\frac{\alpha : w}{w} \in D} \alpha$$

Definition 3 *Let $\Delta = (D, W)$ be a closed normal default theory and β be a first-order sentence. A finite sequence $D_0, \ldots, D_k$ of finite subsets of D is a* default proof of β with respect to Δ *iff*

1. $W \cup CONSEQUENTS(D_0) \vdash \beta$
2. *For* $1 \leq i \leq k, W \cup CONSEQUENTS(D_i) \vdash PREREQUISITES(D_{i-1})$
3. $D_k = \phi$
4. $W \cup \bigcup_{i=0}^{k} CONSEQUENTS(D_i)$ *is satisfiable.*

If these four conditions are satisfied, then the sentence β can be believed (that is, β is in some extension), and if β is in some extension (that is, it can be believed) then there exists a sequence of defaults which satisfies these conditions. However, since the last condition is not decidable, the proof procedure is not decidable, even for those β which are in some extension (that is, the proof procedure is not even semi-decidable). Reiter (1980) provides a formal proof procedure that determines the D_i in the general case. Since all of the proofs in this thesis contain only one default, the presentation will be informal. Notationally, if a formula a is provable from Δ, then $\Delta \vdash_\Delta a$. If a formula a is provable solely from W, then $\Delta \vdash a$.

One feature of first-order proof theory that is lacking in default proof theory is the ability to do *case analysis*[14] on disjunctive statements. The definition of a default proof requires the prerequisites of any default used in a proof to be provable. Since case analysis is using the principle of the excluded middle, neither of the disjuncts is provable. To simulate a case analysis, the default theory can be modified so that all the defaults have no prerequisites. This is done in Besnard, Quinou, and Quinton (1983). The transformation is given in (3.32).

$$\frac{\alpha(\vec{x}) : \beta(\vec{x})}{\beta(\vec{x})} \Longrightarrow \frac{: \alpha(\vec{x}) \supset \beta(\vec{x})}{\alpha(\vec{x}) \supset \beta(\vec{x})} \tag{3.32}$$

[14] Also referred to as conditional proofs.

A default theory that has been transformed in this manner does not have precisely the same properties as the original theory, but for the purposes here the difference is insignificant. Because the case analysis gives the same results as the transformed theory using Reiter's default proof theory, the case analysis approach is used in the sequel.

3.2 Representing Presuppositions Using Default Rules

> The need to make default assumptions is frequently encountered in reasoning about incompletely specified worlds. (Reiter (1980))

When developing default logic as a formal specification of default reasoning, Reiter (1980) was motivated by a desire to represent beliefs about

1. Defaults and Exceptions (prototypical situations)

   Example: If x is a bird, then in the absence of any information to the contrary, infer that x can fly.

2. Default Values in Frames

   Example: Whenever x is a person, then in the absence of any information to the contrary, assume $hometown(x) =$ '*Palo Alto*'.

3. The Closed World Assumption

   Failure to find a proof of a sentence Q sanctions the inference $\neg Q$.

4. The Frame Default

   Every action is assumed to leave every relation unaffected unless it is possible to deduce otherwise.

Implicit in each of these examples is the need to generate inferences (conjectures, actually) in an incompletely specified world which normally would not be sanctioned by the usual inference rules of a logic.

I will show throughout this chapter a theory of deriving presuppositions which is based on default logic. This theory makes a novel use of default rules as a representational device. The novelty is that the default rules are used to augment the usual first order logic representations of

meaning postulates (Carnap (1956)). The presuppositions of a sentence can be viewed as default assumptions (the consequences of default rules) and the preferred interpretations of vague (semantically ambiguous) linguistic forms are then inferences made using these assumptions.

The three features of default logic that the theory relies on are given below. Monotonic logics (first–order logic, for example) are incapable of doing any of these three functions.

1. Default logic has *context–sensitive* inference rules. The meaning of '*in the absence of any information to the contrary*' is captured in default logic as '*if it is consistent to believe*'. Therefore inference rules are defeasible; that is, they don't generate an inference if the context blocks the firing of the rule.

   Example: Normally the S–sentence in (3.33) presupposes the **P**–sentence. But given the added context in (3.34) the presupposition found in (3.33) is not generated.

   S: Jack does not regret that Sally lost her book.
   P: Sally lost her book. (3.33)

   S: Sally did not lose her book. So, Jack does not regret that Sally lost her book.
   P: *Sally lost her book. (3.34)

2. Because it is a non–monotonic logic, default logic provides the representational and deductive tools to describe the deductive closures of a static default theory. Default logic itself does not have the facilities to retract a conjectural inference in a dynamic world when contradictory information is presented. What the default logic provides is a criterion for marking the conjectural inferences as being substantively different than normal inferences derived from using only standard monotonic inference rules. The addition of a Truth Maintenance System (Doyle (1979)) would be required to retract conjectural inferences when contradictory non–conjectural information is acquired. So, the first S–sentence in (3.35) presupposes '*Someone robbed the bank.*' But when the final S–sentence is reached, this inference must be retracted.

   S: It wasn't Jack who robbed the bank. And it wasn't Pete. Nor was it the man from Room 222. ... It seems that no one robbed the bank. (3.35)

   P: *Someone robbed the bank.

3. Default logic allows the generation of inferences (conjectures) in the face of incomplete knowledge. In section 3.1.3.1 the implicit incomplete information in utterances which are vague, in particular, those utterances which generate presuppositions was demonstrated.

A reasonable intuition of the difference between entailment and inferences sanctioned by a default rule is given below. This intuition may give some insight into the utility of default logic in the natural language environment, specifically presuppositions.

1. A set of sentences, Γ, entails E if and only if E is true in all the models of Γ. Since E could also be true in interpretations which are not models of Γ, the models of E are a superset of the models of Γ. If *informativeness* or *logical strength* is viewed as a subset relation on sets of models, the entailment is less informative or logically weaker than the original set of sentences. Additionally, the models of $\Gamma \cup \{E\}$ are just those of Γ. No new information is gained from entailment.[15]

2. Default reasoning can generate a sentence, D, which is false in some of the models of the original set of sentences, Γ. Hence the models of $\Gamma \cup \{D\}$ is a subset of the models of Γ. Information has been gained.

3.2.1 The General Scheme

To derive the presuppositions of an uttered natural language sentence, default proof theory is used on a default theory representing the utterance. The default theory will contain a representation of the sentence and necessary background knowledge. The sentence must be translated from natural language into an appropriate logical form. Although there is no general method known to do this, some general rules can be followed. Any sentence with an explicit negation is translated into the widely scoped negation of its affirmative counterpart. Any compound sentence is mapped clause by clause into a logical form, each clause being treated as a sentence. During a case analysis in the default proof, the negation of a disjunct will be the wide scoped negation, unless there is some reason to do otherwise (see section 4.5.3).

In addition to the logical form, some extra information is required to guard against misuse

[15] What does entailment do? A great deal of knowledge can be stored in as few sentences as possible and then procedurally recaptured through deduction, or recombined into different forms.

of the default rules. The information is given in a special predicate, LF[16,17]. $LF(\Phi, \vec{\alpha})$ indicates that the predication of Φ on the constants $\vec{\alpha}$ is a result of the translation of the natural language sentence. Since the generation of the logical form requires this information, this predicate is available as a side effect of the generation process. No other mention of the LF predicate is given in the theories, so there is no other way to obtain it. Incorporating this predicate into the prerequisite of the default rule prevents the use of the rules in situations other than ones connected directly back to the presupposition generating environment. For example, rules can be given to derive the presuppositions of '*bachelor*'. These rules (see section 3.2.3 for details) contain $\neg BACHELOR$ in their prerequisites. The presuppositions generated by '*bachelor*' are not generated by '*female*' or by '*not a married male adult*'. Since $\neg BACHELOR$ can be derived from $FEMALE$ (given appropriate knowledge) these rules could be used in these situations unless the LF predicate is used also.

Some examples should point out the salient features. Although case analysis and the modal operators K_S and P_S are not required to derive presuppositions from simple sentences, I have kept the seemingly superfluous modal operators in the following examples to indicate that they are just restricted invocations of the more general procedure described in section 3.3. In these examples the default rules (or default rule schemata) may differ in form from example to example. I am not committed to any particular number of presuppositional categories (as exemplified by the form of the default rule) nor should the examples be regarded as exemplars of distinct categories. The first example will be given in some detail in order to describe the inferencing that leads to the *preferred interpretation* of a vague lexical item (or syntactic construct in later examples). The solution is to represent the preferred interpretation of a vague linguistic form as the inferences obtained as a result of deducing the consequent of a default rule. The formal definition of *a presupposition of the preferred interpretation of a vague lexical*

[16] An error in an earlier version of the default rule representation was pointed out by Henry Kautz and Mats Rooth.

[17] The LF predicate, although inelegant, prevents the possible misuse of an unguarded default rule. It has been used in order to acknowledge this problem without getting distracted by the details that would be incurred in a more elegant solution. Further research will provide the proper solution. Possiblities include producing extra modal sentences that would prevent the default rule's application (for example, along with $FEMALE(c_1)$) the extra $\mathsf{P}_S ADULT(c_1)$ and $\mathsf{P}_S \neg ADULT(c_1)$ would be added), or having a procedure which adds only the appropriate defaults to the theory. The defaults would be attached to lexical items in the lexicon or to syntactic rules.

item or syntactic construct is the consequent of a default rule.

3.2.2 Example 1 – Stop

In this example e represents an event, and t_1 and t_2 are time parameters meant to represent times relevant to the event, e. Even though a proper represention for continuous actions has yet to be obtained, I assume here that the definition of '*stop*' given in (3.36) is sufficient. Paraphrasing (3.36), an event stops if and only if there is a time, t_1, at which the event was being done and a later time, t_2, at which the event was not being done. By a simple negation of (3.36) the definition of '*not stop*' given in (3.37) can be generated. What is important to note here is that this is the wide scoping of the logical negation operator, which gives the vague semantic definition of '*not stop*'. In addition to the usual definition of '*not stop*' given in (3.37), the default rule (3.38) also supplies part of the meaning of '*not stop*'. Paraphrasing (3.38), if an event has not been stopped and it is consistent with the theory that this event has been going on, then assume that the event has been going on. This default rule plays a crucial role in generating the preferred interpretation of '*not stop*'.

$$STOP(e) \equiv \exists t_1 \exists t_2 . t_1 < t_2 \wedge DO(e, t_1) \wedge \neg DO(e, t_2) \tag{3.36}$$

$$\neg STOP(e) \equiv \forall t_1 \forall t_2 . (t_1 < t_2 \wedge DO(e, t_1)) \supset DO(e, t_2)^{18} \tag{3.37}$$

$$\frac{\neg STOP(e) \wedge LF(STOP, e) : \exists t . DO(e, t)}{\exists t . DO(e, t)} \tag{3.38}$$

Suppose that a speaker, S, utters (3.39). According to the rules of the communication act given in Chapter 2, the hearer can interpret this utterance as (3.40). The resulting default theory shown in (3.41) constitutes the $KB \cup \{\mathbf{u}\}$ discussed in Chapter 2. In (3.41), I have shown only $\mathbf{u}$ and that part of KB which is important for this discussion. Both (3.42) and (3.43) can be derived from (3.41) using the default logic proof theory described in section 3.1.4. The sequence $\left\{ \frac{\neg STOP(e) \wedge LF(STOP, e) : \exists t . DO(e, t)}{\exists t . DO(e, t)} \right\}, \phi$ is a default proof. Where W is the set comprising the first–order statements in (3.41), the four requirements of a sequence of sets of defaults rules to be a default proof are met:

[18] This representation is equivalent to the disjunctive notation

$$\neg STOP(e) \equiv \forall t_1 \forall t_2 . \neg(t_1 < t_2) \vee \neg DO(e, t_1) \vee DO(e, t_2)$$

which I have used in previous discussions.

1. $W \cup \{\exists t DO(BEAT\text{-}RUG(John), t)\} \vdash \exists t DO(BEAT\text{-}RUG(John), t)$

2. $W \vdash \neg STOP(BEAT\text{-}RUG(John))$

3. $\phi = \phi$

4. $W \cup \{\exists t DO(BEAT\text{-}RUG(John), t)\}$ is satisfiable.

(3.42) represents the presupposition of (3.39). (3.43) represents the preferred interpretation, which can be paraphrased as there is some time at which the event $BEAT\text{-}RUG(John)$ was being done and it continues to be done at all future times.

John did not stop beating the rug. (3.39)

$$\mathsf{K}_S \neg STOP(BEAT\text{-}RUG(John))^{19} \wedge LF(STOP, BEAT\text{-}RUG(John)) \tag{3.40}$$

$$\left\{ \begin{array}{c} \mathsf{K}_S \neg STOP(BEAT\text{-}RUG(John)) \wedge \\ LF(STOP, BEAT\text{-}RUG(John)) \\ \forall e. \neg STOP(e) \equiv \forall t_1 \forall t_2. (t_1 < t_2 \wedge DO(e, t_1)) \supset DO(e, t_2) \\ \dfrac{\neg STOP(e) \wedge LF(STOP, e) : \exists t. DO(e, t)}{\exists t. DO(e, t)} \\ \vdots \end{array} \right\} \tag{3.41}$$

$$\exists t. DO(BEAT\text{-}RUG(John), t) \tag{3.42}$$

$$\exists t. DO(BEAT\text{-}RUG(John), t) \wedge \forall t'. t < t' \supset DO(BEAT\text{-}RUG(John), t') \tag{3.43}$$

On the other hand, the speaker can use the '*because*'–clause in (3.44) to indicate the extra qualification represented in (3.45) which is added to (3.41) to give (3.46). Neither (3.42) nor (3.43) can be derived from the theory generated by this utterance, given in (3.46). Any derivation of (3.42) must include a successful invocation of the default rule (3.38). But in the default

[19]This representation should be interpreted as a succinct notation for the First Order representation:

$$\mathsf{K}_S(\exists e. EVENT(e) \wedge TYPE(e, BEAT) \wedge SUBJ(e, John) \wedge OBJ(e, Rug) \wedge \neg STOP(e)).$$

theory (3.46) invocation of this rule is blocked by the sentence (3.45)[20].

John did not stop beating the rug because he was never doing it. (3.44)

$$\mathsf{K}_S \forall t.\neg DO(BEAT\text{-}RUG(John), t) \wedge LF(STOP, BEAT\text{-}RUG(John)) \tag{3.45}$$

$$\left\{ \begin{array}{c} \mathsf{K}_S \neg STOP(BEAT\text{-}RUG(John)) \wedge \\ LF(STOP, BEAT\text{-}RUG(John)) \\ \mathsf{K}_S \forall t.\neg DO(BEAT\text{-}RUG(John), t)) \\ \forall e.\neg STOP(e) \equiv \forall t_1 \forall t_2.(t_1 < t_2 \wedge DO(e, t_1)) \supset DO(e, t_2) \\ \dfrac{\neg STOP(e) \wedge LF(STOP, e) : \exists t.DO(e, t)}{\exists t.DO(e, t)} \\ \vdots \end{array} \right\} \tag{3.46}$$

Although it is desirable to interpret the presupposition as known by the speaker, it is not possible to derive the appropriate modal statement from the default theory. The first–order presentation of the defaults is justified in the following way: The speaker utters a sentence knowing that the hearer should be able to generate an interpretation that coincides with the speaker's intended meaning. The speaker, assuming that the hearer has the appropriate means to obtain the correct interpretation, gives just enough information for the hearer to obtain it. That the hearer's interpretation coincides with what the speaker knows is a meta–theorem of this interpretation.

3.2.3 Example 2 – Criterial and Noncriterial properties

In this example I look at a type of lexical presupposition which is based on the deciding criterion for a negated lexeme's meaning. Before looking at the proposed default logic representation for this class of presuppositions, I first need to explain what is meant by *the deciding criterion for a negated lexeme's meaning.* Figure 3.3 represents a small portion of an *ISA* hierarchy of some hearer, H. The arcs have been labelled with properties and the nodes have been labelled by the term which is associated with the set of properties defined by the path from the root node. The deciding criterion for a negated lexeme's meaning is asssociated with the last property which labels the last arcs in the paths from the root node to the negated and unnegated lexical nodes.

[20]The '*because*'–clause (3.45) together with the definition (3.37) can be used to derive

$$\neg STOP(BEAT\text{-}RUG(John))$$

which paraphrases as '*John did not stop beating the rug.*' Although the ability to derive the main clause of the sentence may have significance, say for an analysis of relevance or causation, I am not interested in it here.

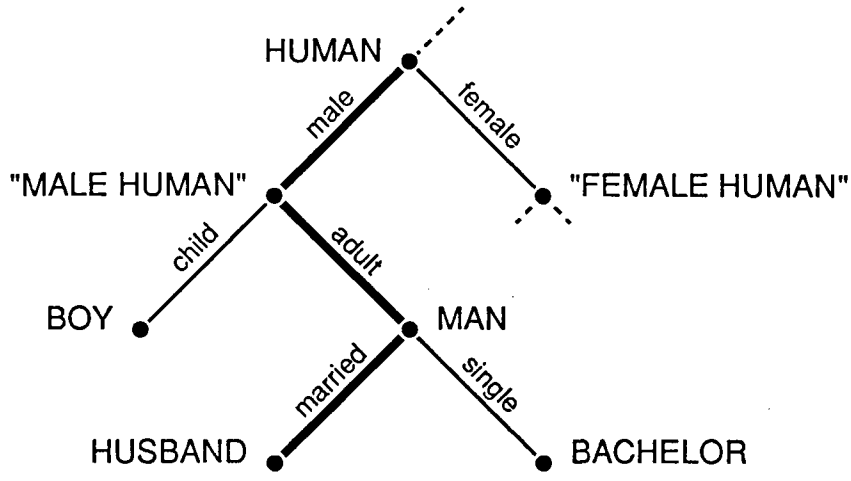

Figure 3.3: Portion of H's *ISA* hierarchy.

In this instance the criterial property is $MARRIED$ — $\neg MARRIED$. The emboldened path in Figure 3.3 represents the preferred interpretation of '***not a bachelor***', that is, '***a married adult male human***'[21].

Say then for purposes of this example, that the definition of '***bachelor***' is represented by the first order sentence (3.47). Then the negation of '***bachelor***' would be represented by (3.48). In the same manner as Example 1, the pragmatic rule for generating presuppositions is captured in the default rule *schema* (3.49), where $NONC$ represents information about the non–criterial features of the negated lexeme. The knowledge of noncriterial features would thus be part of the knowledge base and could be represented as (3.50).

$$BACHELOR(x) \equiv MALE(x) \wedge ADULT(x) \wedge \neg MARRIED(x) \tag{3.47}$$

$$\neg BACHELOR(x) \equiv \neg MALE(x) \vee \neg ADULT(x) \vee MARRIED(x) \tag{3.48}$$

$$\frac{\neg P(x) \wedge LF(P,x) \wedge NONC(P,P_1) : P_1(x)}{P_1(x)} \tag{3.49}$$

$$\begin{array}{c} NONC(BACHELOR, MALE) \\ NONC(BACHELOR, ADULT) \end{array} \tag{3.50}$$

If a speaker, S, utters (3.51), which is represented as (3.52), the default theory that results is given in (3.53). This theory includes two instances of the default rule schema (3.49), one in which P is $BACHELOR$ and P_1 is $MALE$, and the other in which P is $BACHELOR$ and P_1 is $ADULT$. Both of the sentences in (3.54) can be derived from (3.53). These two sentences are

[21] In the representation that I discuss later, I have left out the features associated with *HUMAN* since it doesn't add anything to the discussion.

the presuppositions of (3.51). Additionally, (3.55), the preferred interpretation of (3.51), can also be derived.

My cousin is not a bachelor. (3.51)

$$\mathsf{K}_S(\neg BACHELOR(c_1)) \wedge LF(BACHELOR, c_1) \tag{3.52}$$

$$\left\{\begin{array}{c} \mathsf{K}_S(\neg BACHELOR(c_1)) \wedge LF(BACHELOR, c_1) \\ \forall x.\neg BACHELOR(x) \equiv \neg MALE(x) \vee \neg ADULT(x) \vee MARRIED(x) \\ NONC(BACHELOR, MALE) \\ NONC(BACHELOR, ADULT) \\ \dfrac{\neg BACHELOR(c_1) \wedge LF(BACHELOR, c_1) \wedge NONC(BACHELOR, MALE) : MALE(c_1)}{MALE(c_1)} \\ \dfrac{\neg BACHELOR(c_1) \wedge LF(BACHELOR, c_1) \wedge NONC(BACHELOR, ADULT) : ADULT(c_1)}{ADULT(c_1)} \\ \vdots \end{array}\right\} \tag{3.53}$$

$$\begin{array}{c} MALE(c_1) \\ ADULT(c_1) \end{array} \tag{3.54}$$

$$MALE(c_1) \wedge ADULT(c_1) \wedge MARRIED(c_1) \tag{3.55}$$

3.2.4 Example 3 – Factive verbs

In Chapter 2 I introduced the category of factive verbs. These verbs, which can take a relative clause complement, normally imply the relative clause whether the verb is negated or not. For example, (3.56a) entails (3.57) and under normal circumstances, (3.56b) presupposes (3.57).

(a) John regrets that Mary came to the party.

(b) John does not regret that Mary came to the party. (3.56)

Mary came to the party. (3.57)

In order to capture the knowledge about factive verbs which would be sufficient to capture the relationships between the sentences in (3.56) and (3.57) the axiom schema (3.58) and the

default rule schema (3.59) are needed. In these two rules[22] ϕ is any proposition. Note that the knowledge base must also contain the linguistic fact (3.60).

$$\forall x.P(x,\phi) \wedge FACTIVE(P) \supset \phi \tag{3.58}$$

$$\frac{\neg P(x,\phi) \wedge LF(P,x,\phi) \wedge FACTIVE(P) : \phi}{\phi} \tag{3.59}$$

$$FACTIVE(REGRET) \tag{3.60}$$

If a speaker, S, utters (3.56b), represented as (3.61), the default theory (3.62) results. Both (3.63), the presupposition of (3.56b), and (3.64), the preferred interpretation of (3.56b), can be derived from the theory (3.62).

$$\mathsf{K}_S(\neg REGRET(John, COME(Mary,p_1))) \wedge LF(REGRET, John, COME(Mary,p_1)) \tag{3.61}$$

$$\left\{\begin{array}{l} \mathsf{K}_S(\neg REGRET(John, COME(Mary,p_1))) \wedge \\ \qquad LF(REGRET, John, COME(Mary,p_1)) \\ \qquad FACTIVE(REGRET) \\ \dfrac{\begin{array}{l}\neg REGRET(John, COME(Mary,p_1)) \wedge \\ LF(REGRET, x, COME(Mary,p_1)) \wedge \\ \qquad FACTIVE(REGRET) : COME(Mary,p_1)\end{array}}{COME(Mary,p_1)} \\ \qquad \vdots \end{array}\right\} \tag{3.62}$$

$$COME(Mary,p_1) \tag{3.63}$$

$$COME(Mary,p_1) \wedge \neg REGRET(John, COME(Mary,p_1)) \tag{3.64}$$

The presupposition can be blocked in a context that blocks application of the default rule. For example, the sentence (3.65) provides the information in (3.66). In the theory augmented with (3.66), the factive default rule cannot be applied.

John does not regret that Mary came to the party because she didn't come. (3.65)

$$\neg COME(Mary,p_1) \tag{3.66}$$

[22]These representations should be considered as abbreviations for an event-based representation. For example, (3.56b), represented as

$$\neg REGRET(John, COME(Mary,p_1))$$

should be considered as being actually represented as

$$\exists e.EVENT(e) \wedge TYPE(e, COME) \wedge SUBJ(e, Mary) \wedge OBJ(e,p_1) \wedge \neg REGRET(John, e)$$

3.2.5 Example 4 – Focus[23]

Two methods of focusing parts of sentences which produce presuppositions are a syntactic method called clefting (clefts and pseudoclefts), and an intonational method called contrastive stress. I won't give a formal definition for these notions. Instead examples (3.67), (3.68), and (3.69) point out the presuppositional features of clefts, pseudoclefts and contrastive stress. In each of these examples the focused sentences have the presupposition displayed, but the normal, unfocused sentence does not.

Sentence: John did not come.

Cleft: It was not John who came. (3.67)

Presupposition: Someone came.

Sentence: John did not want the dog.

Pseudocleft: What John wanted was not the dog. (3.68)

Presupposition: John wanted something.

Sentence: Bill did not wreck this truck.

Contrastive stress: *Bill*[24]did not wreck this truck. (3.69)

Presupposition: Somebody wrecked this truck.

The normal sentences are given the standard representations shown in (3.70). Some method for representing focused items is needed, wherever they occur. I will use λ–abstracted predicates as suggested in Nash–Webber and Reiter (1977) and Gazdar (1979). (3.71) are the suggested representations (disregarding tense) for the focused sentences.

$$\begin{array}{c} \neg COME(John) \\ \neg WANT(John, dog_1) \\ \neg WRECK(Bill, truck_1) \end{array} \tag{3.70}$$

[23]I have included this category of presuppositional environments since it has been considered a source of presuppositions in most of the literature on presuppositions. However, more recent study indicates that this environment is not a source of presuppositions (Rochemont (1986)).

[24]Normal stress occurs at the end of a sentence. The italicized item is contrastively stressed.

Cleft: $\neg\{\lambda x COME(x)\}John$

Pseudocleft: $\neg\{\lambda x\, WANT(John, x)\}dog_1$ (3.71)

Contrastive stress: $\neg\{\lambda x\, WRECK(x, truck_1)\}Bill$

The default rule (3.72) is proposed to capture the pragmatic knowledge associated with focused sentences. If a speaker, S, utters the contrastively stressed sentence in (3.69), which is represented as (3.73), the default theory (3.74) results. Statement (3.75), which is the presupposition found in (3.69), can be derived from this theory.

$$\frac{\neg\{\lambda x \phi(x)\}u : \exists y \phi(y)}{\exists y \phi(y)} \tag{3.72}$$

$$\mathsf{K}_S(\neg\{\lambda x\, WRECK(x, truck_1)\}Bill) \tag{3.73}$$

$$\left\{ \begin{array}{c} \mathsf{K}_S(\neg\{\lambda x\, WRECK(x, truck_1)\}Bill) \\ \hline \neg\{\lambda x\, WRECK(x, truck_1)\}Bill : \exists y\, WRECK(y, truck_1) \\ \hline \exists y\, WRECK(y, truck_1) \\ \vdots \end{array} \right\} \tag{3.74}$$

$$\exists y\, WRECK(y, truck_1) \tag{3.75}$$

3.2.6 Correctly Interpreting the Inferences

Throughout the literature, presuppositions of natural language sentences are presented as natural language sentences. In this section presuppositions have been displayed as statements in a first–order logical language. Some confusion may result and it is the purpose of this section to prevent any misinterpretation of the derived statements. The discussion proceeds by way of an example.

Suppose that the presuppositions of (3.51) have been derived by the method described in section 3.2.3. The presuppositions of (3.51), listed in (3.54), are reproduced here as the modal first order sentence (3.76) allowed by the stronger meta–theoretic interpretation of the first–order statement that can be derived.

$$\mathsf{K}_S(MALE(c_1) \wedge ADULT(c_1)) \tag{3.76}$$

The presuppositions of (3.51) are normally given in the literature as the natural language sentence (3.77).

My cousin is a male adult. (3.77)

On the surface there doesn't appear to be any problem. (3.51) and (3.76) are equivalent. But difficulties do appear under close scrutiny. Assuming that the procedure described in section 3.2.3 uses a complete first–order modal logic (which it does) then (3.51) is not the only statement that is derivable. Many statements (for instance, tautologies) can be derived which are not considered as presuppositions of (3.51). These kinds of statements are eliminated by the definition given in section 3.4.1. (Looking ahead, the definition states that all derivations of a presupposition must necessarily invoke a default rule.) In addition, other statements are also derivable. For example, call the derived presupposition p. Since the logic is complete, it can derive $p \vee \psi$ for any ψ whatsoever. Although (3.78) is derivable from (3.53), no one would suggest that (3.79) is a presupposition of (3.51).

$$(MALE(c_1) \wedge ADULT(c_1)) \vee FEMALE(c_1) \tag{3.78}$$

My cousin is male and adult, or female. (3.79)

Does this example suggest that using a complete logic is incompatible with the derivation of presuppositions? The answer is a qualified no[25]. The derivable statements must be interpreted appropriately. Or from another point of view, (3.79) and the logical representation (3.78) are not equivalent. What is assumed throughout the literature (without being explicitly stated, since there has been no need) is that presuppositions, when given as natural language sentences, are governed by the same rules as any natural language sentence uttered in a conversation governed by Grice's maxims. Hence, clausal implicatures must be involved in the translation from (3.78) to (3.79). In the case of (3.79) the second disjunct is not possible (because $\mathsf{K}_S MALE(c_1)$ is derivable), therefore the sentence is not well–formed according to Grice's maxims. To be more explicit, for the above schema $\mathsf{P}_S\psi$ must be derivable from the theory representing the utterance in order that the logical disjunct appear as a disjunct in the natural language sentence. This procedure will eliminate this type of misinterpretation of the logically derived statements. The process also applies to any ψ which is provable. Since the clausal implicatures also require that $\mathsf{P}_S\neg\psi$ (which is not the case) the translation of derivable sentences such as $p \vee \psi$ must not include the translation of the second disjunct.

Other forms of derived statements can cause similar problems, too. For example, if p is a

[25]Another answer might be to use a different sort of logic such as Relevance Logic (Anderson and Belnap (1975)).

presupposition both $p \vee (\psi \vee \neg\psi)$ and $p \wedge (\psi \vee \neg\psi)$ can be derived. Since the additional disjunct or conjunct is a tautology, the clausal implicature method cannot be used. However Grice's maxim of brevity can be used to eliminate any tautologous forms when translating the logical statement into the appropriate natural language statement. For this example then the maxim of brevity would translate only the p–part.

In a slightly different setting, interpretation problems can also occur in the following situation: suppose that p is the derived presupposition and suppose that ψ is provable also, all proofs of ψ require a default, but the logical representation of the uttered sentence is not required to derive ψ. Is ψ to be considered as a presupposition of the sentence? The answer is no. But since none of the theories presented in any of the examples in this thesis can generate sentences of this type, I have not been concerned with them. This caveat has been noted in the definition in section 3.4.1.

3.2.7 Entailment *vs* Presupposition

In this section the notion that entailment is logically *stronger*[26] than presupposition is presented. This concept provides a method to distinguish between entailments and presuppositions of sentences. A definition of the *relative strengths* of entailment and presupposition is required to derive an inference as a presupposition from the case analysis when one case entails the proposition and another case presupposes it. This definition is also useful to tag an inference of a sentence properly as an entailment when the sentence both entails and presupposes the same sentence. The definition of presupposition given in section 3.4 gives a formal treatment of the idea of logical strength.

Logically, the entailment relation is stronger than the presupposition relation in the following sense: The entailment relation is monotonic, the presupposition relation (captured in a default logic) is non–monotonic. So, if S is a sentence and S' is entailed by S, then S' is true in all models of S. On the other hand, if S is a sentence and P is presupposed by S, then P is true in some of the models of S. In section 3.4 I will call these particular models of S in which P is true the *preferred models* of S. Since entailment is better behaved in this model–theoretic sense, I will say that the entailment relation is stronger than the presupposition relation. Stated another

[26] Usually *stronger*, when used in locutions such as '*Sentence A is logically* stronger *than sentence B.*' means that the set of models for sentence A is a subset of the set of models for sentence B. Here, however, I am using it in the sense that the entailment relation is *better behaved*, logically, than is the presupposition relation.

way, presuppositions are defeasible, whereas entailments are not. Another way of comparing the logical strengths of the two relations is through the proof theory. Entailments of a sentence S can be proved without having to resort to the extra machinery required by presuppositions of S, that is, the default proof theory.

Linguistically, entailment is viewed as holding in a subset of those cases in which presupposition holds. Although some concerns about the linguistic definitions of presuppositions have been given earlier, the intuition of the strengths of the two relations seems to hold across all definitions.

3.2.8 Controlling the Application of the Default Rules

The use of the default rules to capture certain aspects of linguistically sanctioned inferencing allows inferences which would not be normally sanctioned in a logical setting. A previous example demonstrates how $\neg BACHELOR(A)$ can be interpreted as (3.80) using linguistically sanctioned inferences — the presuppositions of '*A is not a bachelor.*'.

$$MALE(A) \wedge ADULT(A) \wedge MARRIED(A) \tag{3.80}$$

Unsanctioned use of the presuppositional default rules can occur. Although all of the unsanctioned uses of the default rules derive from a common logical base, the discussion has been split into two distinct parts. The discussion on the unguided invocation of default rules in case analysis has direct application in the theory of deriving presuppositions in complex sentences. Constraining the use of defaults in case analysis is discussed in section 3.2.8.1. The other instances in which default rule invocation must be constrained are described in section 3.2.8.2.

3.2.8.1 Constraining Default Rule Application in Case Analysis

Deduction using case analysis in the extended default proof theory described in section 3.1.4 is sanctioned whenever a logical or ('$\vee$') is present in the representation of the sentence. However, as presently constituted the inference system with case analysis is inappropriate for deducing presuppositions from representations of natural language sentences.

In order for a statement to be inferred from a disjunctive statement, the default proof theory with case analysis (described in detail in section 3.3) must be able to infer this statement from each case. A simple example indicates the problem. A sentence of the form $\mathsf{K}_S\phi \vee \psi$ can be derived from any knowledge base that includes $\mathsf{K}_S\phi$ and the axioms of modal logic. If $\neg\phi$ allows

a particular default rule to infer its consequent, but ψ blocks the rule, then the consequent is not inferred in the case $\neg\phi \wedge \psi$. Failing to derive a statement in one case means that the statement is not derivable from the original disjunctive statement. Finding the set of sufficient cases in which to perform the case analysis is crucial for its correct operation.

In addition to the sufficiency condition just described, a necessary set of cases for the case analysis is also critical. Because a statement is derivable from a disjunctive statement only if the case analysis derives it in *all* the cases, omitting a case in which the statement is not derivable would be disasterous.

Preserving the default logic approach for deriving presuppositions requires some additional machinery to provide the necessary and sufficient cases for the case analysis. However, this extra machinery must have some valid reason to be included in the theory, beyond its immediate purpose here. Since the default rules that generate presuppositions are designed to capture linguistically sanctioned inferences, the solution lies in finding a method that distinguishes among those cases which the speaker intends and those that he does not.

Gazdar in his formal treatment of Grice has provided a means to distinguish between the linguistic and nonlinguistic origins of the '$\vee$' in the sentence undergoing case analysis. The sentence uttered by a speaker commits the speaker not only to the truth of the sentence but also the possibility of its clauses (its parts). So in the case of the speaker uttering '*A or B*' or '*if A then B*' the speaker is committed to $\mathsf{P}_S A$, $\mathsf{P}_S \neg A$, $\mathsf{P}_S B$, and $\mathsf{P}_S \neg B$. The implicatures will provide the needed restraint on the default rule application. Case analysis will only be allowed and must be performed in those cases whose possibility is derivable from the statement and its implicatures.

Example

Suppose the sentence '*A or B*' is uttered. The information derived from this utterance would be

$$\left\{ \begin{array}{ll} A \vee B & \\ \mathsf{P}_S A & \mathsf{P}_S \neg A \\ \mathsf{P}_S B & \mathsf{P}_S \neg B \end{array} \right\} \vdash \begin{array}{l} \mathsf{P}_S(A \wedge \neg B) \\ \mathsf{P}_S(\neg A \wedge B) \end{array} .$$

On the other hand, if $A \vee B$ has been derived from a source other than an utterance, then the implicatures would not be available. Contrary to the previous case none

of the necessary statements are derivable.

$$\left\{ A \vee B \right\} \nvdash \begin{array}{l} \mathsf{P}_S(A \wedge \neg B) \\ \mathsf{P}_S(\neg A \wedge B) \\ \mathsf{P}_S(A \wedge B) \end{array} .$$

Returning briefly to the examples presented in sections 3.2.2–3.2.5, notice that the analysis of the simple negated sentence is just a special instance of the process discussed above. In the simple negated sentence there is only one case and the speaker is committed to the possibility of that case for the simple reason that if $\neg X$ represents the sentence then the theory representing the utterance contains $\mathsf{K}_S \neg X$ and the modal logic $S4$ has the following theorem: $\vdash \mathsf{K}_S \neg X \supset \mathsf{P}_S \neg X$. Since there is only one case, the analyses performed in sections 3.2.2–3.2.5 have been carried out in the necessary and sufficient cases.

3.2.8.2 Constraining Default Rule Application in General

None of the examples presented in sections 3.2.2–3.2.5 require any extra constraint on the inferencing process to derive only the desired inferences. Broadening the understanding of the subtleties of the constraining factors is the intent of this section. There are two controls on the default rules: the prerequisite, which must be provable[27], and the justification, which must be consistent.

The prerequisite of each default rule is a conjunction of the LF predicate and the negated predicate representing the negated presuppositional environment. Since the LF predicate is true ony by virtue of the natural language sentence, the presuppositional environment must be part of the sentence. So, for example, although '*My cousin is female.*' (represented by $FEMALE(c_1)$) implies $\neg BACHELOR(c_1)$, the default rule that produces $ADULT(c_1)$ is inapplicable because $LF(BACHELOR, c_1)$ is not provable. Requiring that the second conjunct be provable prevents presuppositions being generated from within belief–environments or reporting–environments. Since the prerequisite must be proven for the rule to be applicable, the absence of information is the constraint on default rule application.

Although the prerequisites decide the environments in which the default rule is active, the justifications also play an important role. Given that the rule's prerequisite is provable, the justification allows the rule to infer its consequent if the negation of the justification is not provable. An impoverished theory may allow undesired inferences to be made. The following

[27] This condition is relaxed for case analysis. There, the prerequisite must be provable in the particular case.

example demonstrates this feature. Suppose that (3.81) has been uttered by the speaker. Again suppose that the theory being considered to represent this utterance is (3.82). The theory (3.82) produces the presuppositions (3.83).

My pet rock is not a bachelor, because it is inanimate. (3.81)

$$\left\{\begin{array}{c} \mathsf{K}_S(PET\text{-}ROCK(a) \wedge \\ \neg BACHELOR(a) \wedge \neg ANIMATE(a)) \wedge LF(BACHELOR, a) \\ \forall x.BACHELOR(x) \equiv MALE(x) \wedge ADULT(x) \wedge \neg MARRIED(x) \\ NONC(BACHELOR, MALE) \\ NONC(BACHELOR, ADULT) \\ \dfrac{\neg BACHELOR(x) \wedge LF(BACHELOR, x) \wedge NONC(BACHELOR, MALE) : MALE(x)}{MALE(x)} \\ \dfrac{\neg BACHELOR(x) \wedge LF(BACHELOR, x) \wedge NONC(BACHELOR, ADULT) : ADULT(x)}{ADULT(x)} \end{array}\right\} \tag{3.82}$$

$$\begin{array}{c} MALE(a) \\ ADULT(a) \end{array} \tag{3.83}$$

It is conceivable that a hearer who is represented by this theory would generate these presuppositions. What is peculiar is that these "presuppositions" are not expected normally. But this undesirable circumstance is not a result of the method being used. Rather it is the inappropriateness of the default theory. The presuppositional defaults infer as many presuppositions as possible. If the theory lacks what is considered normal (though trivial) knowledge, addition of this knowledge may prevent the unwanted inferences being generated. Adding the two statements in (3.84) prevents the derivation of the statements in (3.83).

$$\begin{array}{c} \forall x.MALE(x) \supset ANIMATE(x) \\ \forall x.ADULT(x) \supset ANIMATE(x) \end{array} \tag{3.84}$$

The information provided by (3.84) provides a fuller definition of the concepts of *MALE* and *ADULT*. Adding more features to these concepts blocks the undesirable inferences. Unlike purely first–order theories which lack power if concepts are underdefined, default theories may be too powerful if concepts are not closed off.

3.3 Deriving Presuppositions in Complex Sentences

That presuppositions arise from lexical and syntactic environments is no longer a source of disagreement. However, the projection problem — how does a complex sentence inherit the

presuppositions of its parts[28] — has been a major source of problems for linguists. Examples (3.85) and (3.86) exhibit a classic concern: two sentences that have the same form (two clauses joined by '*or*') have differing presuppositional properties. The first disjunct '*Mary stopped beating the rug*' of the S–sentence in (3.85) presupposes that '*Mary was beating the rug*'. Likewise the second disjunct presupposes that '*John was beating the egg*'. The sentence inherits all the presuppositions of its constituents.

S: Mary stopped beating the rug or John stopped beating the egg.
P: Mary was beating the rug and John was beating the egg. (3.85)

The first disjunct '*Your teacher is a bachelor*' of the S–sentence in (3.86) presupposes that '*Your teacher is male and an adult*'. The second disjunct '*Your teacher is a spinster*' presupposes that '*Your teacher is female and an adult*'. It is obvious that the sentence does not inherit all the presuppositions of its constituents.

S: Your teacher is a bachelor or a spinster.
P: Your teacher is an adult. (3.86)

The three standard fixes to the projection rule have been: a set of rules that take the presuppositions of the clauses and filter out the undesirable presuppositions as the sentence meaning is being composed (Karttunen (1973, 1974), Karttunen and Peters (1975, 1979), Soames (1979)), a set of rules invoked after the sentence has been fully interpreted, that filter out the unwanted presuppositions from a complete set of presuppositions that have been accumulated from all of the clauses (Gazdar (1979)), or a set of rules that embody both of these methods (Soames (1982)). A non–projection rule method that interprets the sentence in a left–to–right sequential manner, closely resembles the non-cumulative filtering idea (Gunji (1982)). The desired result in each case is to retain all and only the presuppositions of the complex sentence. These varied attempts will be discussed in more detail in Chapter 4.

On the other hand, this thesis rejects the projection rule paradigm and replaces it with the theory that presupposing is just a form of inference. The rejection is based on a number of issues.

1. The sentence is the smallest linguistic unit that has presuppositions. Its components do

[28] Although I have rejected the chimera that clauses of a sentence have presuppositions, I will, when discussing the projection rule be forced to use this terminology.

not. (Compare with entailment.) That presuppositions are the properties of lexemes and syntactic forms which are then inherited by the clauses that contain them and which in turn are inherited by the sentence which the clauses form is a chimera. All projection rule methods must subscribe in one form or another to this illusion.

2. All projection methods require that presuppositions are entailed and presupposed in the affirmative environment. Wilson (1975) argues that this view leads to inconsistency.

3. The projection rule treats sentences as unstructured collections of presupposition sources. No information about the sentential structure (for example, that a sentence is a conjunction rather than a disjunction) is used by the projection rule. All knowledge of how to use this structural information is embodied in the embellishments (except for Gazdar (1979) which still treats sentences as collections of clauses). Lacking this crucial information indicates that the projection rule, which is the foundation on which all of the fixes rest, may be the wrong concept. In addition, each generation of projection rule modifications becomes increasingly more complex and less explicative.

4. From a logical point of view the projection rule is suspect. Using entailment as an analogy: Let $a \models c$ and $b \models d$, then a "projection rule for entailment" would predict that $a \vee b \models c \wedge d$. This, of course, is not correct, in general. Should rules then be added to the "projection rule for entailment" or should the rule be rejected and a new definition of entailment be looked for?[29]

Replacing the projection method with a logical framework has a number of positive consequences.

1. Viewing presupposition–generation as logical inference can be viewed as an extension to the concept of *meaning postulates* as they were originally presented in Carnap (1956).

[29] It may be argued that the analogy may be weak because $a \vee b \models c \wedge d$ is true only in very special cases, for example, when a and b are identical, or when c and d are identical, or when $c \models d$ or $d \models c$, or when $a \vee b$ entails anything. On the other hand, the projection rule for presuppositions works in the normal cases and only in special cases does it not work. Any argument of this sort would be required to define precisely what are normal and special cases for presupposition. I think that it is extremely important to note that by rejecting the projection rule and providing a logical basis for presuppositions, there are no normal or special circumstances. The theory presented later in this chapter demonstrates that presuppositions of all sentences are derived in precisely the same manner.

Derivation of the desired inferences is performed by detaching the meaning components from the meaning postulate index (the *left hand side*). Derivation is accomplished by *modus ponens* and default logic proof techniques for the first order meaning postulates and the default rule meaning postulates, respectively. This is a shift in point of view from deriving presuppositions in a bottom–up compositional manner to a procedure that derives them top–down.

2. If the logic has a model theory, then that model theory can provide meaning for the derivational procedure. In section 3.4 I will discuss a model theory for presuppositions which is analogous to the model theory for entailment.

3. By returning presuppositions to a logical setting the notion may be easier to formalize. As well similarities, analogies, or generalizations may be regained. (This point has been discussed in greater detail in section 3.1.2).

4. By bringing presuppositions back into the logical fold and as an example of proof in particular it can be viewed as a special case of a more general phenomenon (commonsense reasoning), making the proposed theory less ad hoc. Additionally, some of the intuitions prevalent in the earlier projection rule modifications (for example, plugs, holes, and filters) may have an explanation in the logical theory.

The theory for deriving presuppositions of simple and complex sentences is strongly influenced by Gazdar's theory. In section 3.2 the idea of consistency as captured by the use of default rules was introduced. The inclusion of context is captured by what is contained in the logical theory from which the presuppositions are derived.

Another influence is displayed in the examples discussed below. The default logic method requires the clausal implicatures to control application of the defaults in a case analysis proof. Note this use is in a sense like Gazdar's use of blocking a presupposition but it is not used to cancel but rather to prevent the default firing. However there is one essential difference. Where Gazdar requires an ordering for his context incrementation (for which he admits he has no explanation), my theory is a fixed point theory (default logic). The only factor that ordering produces is in the possible extensions that can be produced, if there are incompatible defaults.

One example of a situation which sanctions case analysis on the representation of the sentence is a disjunctive sentence. However, the use of case analysis is not limited to this situation. Other sentences include '*Possibly* ...', and '*if* ... *then* ...'. Some examples of the deductive

system operating on default theories (representing utterances of a speaker, S, being interpreted by a hearer, H) are given in the following sections. The five examples include two disjunctions, two indicative conditionals, and the modal '*possible*'.

3.3.1 Example 1 – *Or*: No cancellation

Sentence (3.87) "inherits" all of the "presuppositions from its two disjunctive clauses".[30] The derivation procedure given below indicates one way of deriving the appropriate presuppositions and provides the intuitions that lay behind the default logic approach to deriving presuppositions in complex sentences.[31]

Mary stopped beating the rug or John stopped beating the egg. (3.87)

Recalling the discussion in section 3.2 regarding the representation of an utterance as a default theory, the theory that represents an utterance of (3.87) is (3.88).

$$\left\{\begin{array}{c} \mathsf{K}_S(STOP(BEAT\text{-}RUG(Mary)) \vee STOP(BEAT\text{-}EGG(John))) \wedge \\ LF(STOP, BEAT\text{-}RUG(Mary)) \wedge LF(STOP, BEAT\text{-}EGG(John)) \\ \mathsf{P}_S STOP(BEAT\text{-}RUG(Mary)) \\ \mathsf{P}_S \neg STOP(BEAT\text{-}RUG(Mary)) \\ \mathsf{P}_S STOP(BEAT\text{-}EGG(John)) \\ \mathsf{P}_S \neg STOP(BEAT\text{-}EGG(John)) \\ \forall e.STOP(e) \supset \exists t_1 \exists t_2.t_1 < t_2 \wedge DO(e,t_1) \wedge \neg DO(e,t_2) \\ \dfrac{\neg STOP(e) \wedge LF(STOP,e) : \exists t.DO(e,t)}{\exists t.DO(e,t)} \\ \vdots \end{array}\right\} \quad (3.88)$$

The first and last two statements are the ones required in the theory described in section 3.2.2: the representation of the sentence, the first order definition of $STOP$, and the default rule for $\neg STOP$. In addition to these statements the theory now requires the other four statements which are the clausal implicatures obtained from the disjunctive sentence. The two statements given in (3.89) are derivable from (3.88). Case analysis can be applied to the cases represented

[30] I have placed scare quotes around those locutions which, according to this new theory, don't have any meaning. In future examples I won't use the scare quotes.

[31] The case analysis used in the following examples is not permitted as shown. However, as discussed in section 3.1.4, the case analysis is informally presented as occurring at the default rule level, but is formally carried out at the first-order level in the transformed default theory.

in the bodies of these two statements.

$$\begin{array}{l} \mathsf{P}_S STOP(BEAT\text{-}RUG(Mary)) \wedge \neg STOP(BEAT\text{-}EGG(John)) \\ \mathsf{P}_S \neg STOP(BEAT\text{-}RUG(Mary)) \wedge STOP(BEAT\text{-}EGG(John)) \end{array} \tag{3.89}$$

I will now detail the derivation as it proceeds in the two cases.

Case 1: Assume (3.90). The conjuncts (3.91) and (3.94) are derivable. Using (3.91), (3.92), universal instantiation, *modus ponens*, and discharging the conjunct, (3.93) can be derived.

$$STOP(BEAT\text{-}RUG(Mary)) \wedge \neg STOP(BEAT\text{-}EGG(John)) \tag{3.90}$$

$$STOP(BEAT\text{-}RUG(Mary)) \tag{3.91}$$

$$\forall e.STOP(e) \supset \exists t_1 \exists t_2.t_1 < t_2 \wedge DO(e, t_1) \wedge \neg DO(e, t_2) \tag{3.92}$$

$$\exists t.DO(BEAT\text{-}RUG(Mary), t) \tag{3.93}$$

Note that (3.93) has the status of an entailment in this case because it is derivable using only first order proof theory.

Using (3.94), the default rule (3.95), and default proof theory, (3.96) can be derived. Note that (3.96) has presuppositional status because it is derivable using default proof theory but not using first order methods alone.

$$\neg STOP(BEAT\text{-}EGG(John)) \tag{3.94}$$

$$\frac{\neg STOP(e) \wedge LF(STOP, e) : \exists t.DO(e, t)}{\exists t.DO(e, t)} \tag{3.95}$$

$$\exists t.DO(BEAT\text{-}EGG(John), t) \tag{3.96}$$

Case 2: Assume (3.97). The conjuncts (3.98) and (3.100) are derivable. Using (3.98), the default rule (3.95), and default proof theory, (3.99) can be derived.

$$\neg STOP(BEAT\text{-}RUG(Mary)) \wedge STOP(BEAT\text{-}EGG(John)) \tag{3.97}$$

$$\neg STOP(BEAT\text{-}RUG(Mary)) \tag{3.98}$$

$$\exists t.DO(BEAT\text{-}RUG(Mary), t) \tag{3.99}$$

Note that (3.99) has presuppositional status because it is derivable using default proof theory but not using first order methods alone.

Using (3.100), (3.92), universal instantiation, *modus ponens*, and discharging the conjunct, (3.101) can be derived.

$$STOP(BEAT\text{-}EGG(John)) \tag{3.100}$$

$$\exists t.DO(BEAT\text{-}EGG(John), t) \tag{3.101}$$

Note that (3.101) has the status of an entailment in this case because it is derivable using only first order proof theory.

(3.93) in Case 1 and (3.99) in Case 2 are the same statements, and are labelled D_1. Similarly the statements found in (3.96) and (3.101) are labelled D_2. Examining each of the derived sentences: D_1 is entailed in Case 1 and presupposed in Case 2. Therefore since it is derived in both cases the original sentence, (3.87), and D_1 are related by the weaker of the two relationships, that is, (3.87) presupposes D_1. Similarly, (3.87) presupposes D_2. This situation is exactly what is predicted for (3.87).

3.3.2 Example 2 – *Or*: Intrasentential cancellation

Sentence (3.102) is an example of intrasentential cancellation of clausal presuppositions. In terms of the theory presented here cancellation of clausal presuppositions is a failure to derive those inferences which the disjuncts would display if used in an appropriate context.

My cousin is a bachelor or a spinster. (3.102)

The default theory that is generated as a result of (3.102) being uttered is displayed in (3.103).

$$\left\{\begin{array}{c}
\mathsf{K}_S(BACHELOR(c_1) \vee SPINSTER(c_1)) \wedge \\
LF(BACHELOR, c_1) \wedge LF(SPINSTER, c_1) \\
\mathsf{P}_S BACHELOR(c_1) \\
\mathsf{P}_S \neg BACHELOR(c_1) \\
\mathsf{P}_S SPINSTER(c_1) \\
\mathsf{P}_S \neg SPINSTER(c_1) \\
\forall x.BACHELOR(x) \equiv MALE(x) \wedge ADULT(x) \wedge \neg MARRIED(x) \\
\forall x.SPINSTER(x) \equiv FEMALE(x) \wedge ADULT(x) \wedge \neg MARRIED(x) \\
NONC(BACHELOR, MALE) \\
NONC(BACHELOR, ADULT) \\
NONC(SPINSTER, FEMALE) \\
NONC(SPINSTER, ADULT) \\
\dfrac{\neg BACHELOR(c_1) \wedge LF(BACHELOR, c_1) \wedge NONC(BACHELOR, MALE) : MALE(c_1)}{MALE(c_1)} \\
\dfrac{\neg BACHELOR(c_1) \wedge LF(BACHELOR, c_1) \wedge NONC(BACHELOR, ADULT) : ADULT(c_1)}{ADULT(c_1)} \\
\dfrac{\neg SPINSTER(c_1) \wedge LF(SPINSTER, c_1) \wedge NONC(SPINSTER, FEMALE) : FEMALE(c_1)}{FEMALE(c_1)} \\
\dfrac{\neg SPINSTER(c_1) \wedge LF(SPINSTER, c_1) \wedge NONC(SPINSTER, ADULT) : ADULT(c_1)}{ADULT(c_1)} \\
\vdots
\end{array}\right\} \tag{3.103}$$

The statements in the theory which are important to the following discussion have been displayed in (3.103). They are four first order modal statements, results of the clausal implicature rule, six meaning postulates, the first two are first order statements defining the property of bachelorhood and spinsterhood, the next two are default rules concerning the preferred interpretation of '*not being a bachelor*' and the next two are about '*not being a spinster*', and four first order statements concerning the *non-criterial* components of '*being a bachelor*' and '*being a spinster*', The two statements given in (3.104) are derivable from (3.103). Case analysis can be applied to the cases represented in the bodies of these two statements.

$$\begin{array}{c}
\mathsf{P}_S BACHELOR(c_1) \wedge \neg SPINSTER(c_1) \\
\mathsf{P}_S \neg BACHELOR(c_1) \wedge SPINSTER(c_1)
\end{array} \tag{3.104}$$

I will now detail how the derivation of the presupposition concerning the sex of '*my cousin*' and the presupposition that '*my cousin is an adult*' is prevented.

Case 1: Assume (3.105). The conjuncts (3.106) and (3.110) are derivable. Using (3.106), (3.107), universal instantiation, and *modus ponens*, and discharging the two conjuncts, the two statements (3.108) and (3.109) can be derived. These two statements have the status of entailments because they are derivable solely by first order means.

$$BACHELOR(c_1) \wedge \neg SPINSTER(c_1) \tag{3.105}$$

$$BACHELOR(c_1) \tag{3.106}$$

$$\forall x.BACHELOR(x) \equiv MALE(x) \wedge ADULT(x) \wedge \neg MARRIED(x) \tag{3.107}$$

$$MALE(c_1) \tag{3.108}$$

$$ADULT(c_1) \tag{3.109}$$

Using (3.110), the two default rules (3.111) and (3.112), the two statements (3.113) and (3.114), and default logic proof theory, (3.115) can be derived. Recalling the description of the proof theory in section 3.1.4, the derivability of (3.108) from first order principles blocks the invocation of default rule (3.111). (3.115) has presuppositional status, but because it can also be derived solely using first order principles (see (3.109)), its status can be strengthened to that of entailment.

$$\neg SPINSTER(c_1) \tag{3.110}$$

$$\frac{\begin{array}{l}\neg SPINSTER(c_1) \wedge LF(SPINSTER, c_1) \wedge \\ \qquad NONC(SPINSTER, FEMALE) : FEMALE(c_1)\end{array}}{FEMALE(c_1)} \tag{3.111}$$

$$\frac{\begin{array}{l}\neg SPINSTER(c_1) \wedge LF(SPINSTER, c_1) \wedge \\ \qquad NONC(SPINSTER, ADULT) : ADULT(c_1)\end{array}}{ADULT(c_1)} \tag{3.112}$$

$$NONC(SPINSTER, FEMALE) \tag{3.113}$$

$$NONC(SPINSTER, ADULT) \tag{3.114}$$

$$ADULT(c_1) \tag{3.115}$$

Case 2: Assume (3.116). The two conjuncts (3.117) and (3.121) can be derived. Using (3.117), (3.118), universal instantiation, and *modus ponens*, and discharging the two conjuncts,

(3.119) and (3.120) can be derived. These two statements have the status of entailments because they are derivable solely by first order means.

$$\neg BACHELOR(c_1) \wedge SPINSTER(c_1) \tag{3.116}$$

$$SPINSTER(c_1) \tag{3.117}$$

$$\forall x.SPINSTER(x) \equiv FEMALE(x) \wedge ADULT(x) \wedge \neg MARRIED(x) \tag{3.118}$$

$$FEMALE(c_1) \tag{3.119}$$

$$ADULT(c_1) \tag{3.120}$$

Using (3.121), the two default rules (3.122) and (3.123), the two statements (3.124) and (3.125), and default logic proof theory, (3.126) can be derived. Again recalling the description of the proof theory in section 3.1.4, the derivability of (3.119) from first order principles blocks the invocation of default rule (3.122). (3.126) has presuppositional status, but because it can also be derived solely using first order principles (see (3.120)), its status can be strengthened to that of entailment. This result is analogous to Case 1 except that the *FEMALE* and *MALE* roles are reversed.

$$\neg BACHELOR(c_1) \tag{3.121}$$

$$\frac{\neg BACHELOR(c_1) \wedge LF(BACHELOR, c_1) \wedge NONC(BACHELOR, MALE) : MALE(c_1)}{MALE(c_1)} \tag{3.122}$$

$$\frac{\neg BACHELOR(c_1) \wedge LF(BACHELOR, c_1) \wedge NONC(BACHELOR, ADULT) : ADULT(c_1)}{ADULT(c_1)} \tag{3.123}$$

$$NONC(BACHELOR, MALE) \tag{3.124}$$

$$NONC(BACHELOR, ADULT) \tag{3.125}$$

$$ADULT(c_1) \tag{3.126}$$

Combining the results of the case analysis gives the sentences shown in (3.127). Both of the sentences in (3.127) are entailments of (3.102). So the presuppositional analysis does not provide any new inferences.

$$\begin{array}{c} MALE(c_1) \vee FEMALE(c_1) \\ ADULT(c_1) \end{array} \tag{3.127}$$

Except for the minor difference in interpreting how the derived sentences should be related to the utterance, this analysis coincides with what is predicted by any reasonable presuppositional theory.

In the remaining examples the discussion is not as laboured as it is in the previous two examples. However, the case analysis proceeds in the same manner and the steps are justified with analogous reasons to those given in the previous analyses.

3.3.3 Example 3 – *If ... then ...*: No cancellation

The theory (3.129) represents the utterance (3.128). The derivation of the presuppositions of (3.128) from (3.129) is given below.

If Mary came to the party then John regrets that Sue came to the party. (3.128)

$$\left\{\begin{array}{c}
\mathsf{K}_S(COME(Mary,p_1) \supset REGRET(John, COME(Sue,p_1))) \wedge \\
LF(REGRET, John, COME(Sue,p_1)) \\
\mathsf{P}_S COME(Mary,p_1) \\
\mathsf{P}_S \neg COME(Mary,p_1) \\
\mathsf{P}_S REGRET(John, COME(Sue,p_1)) \\
\mathsf{P}_S \neg REGRET(John, COME(Sue,p_1)) \\
\forall x.REGRET(x, COME(Sue,p_1)) \wedge \\
FACTIVE(REGRET) \supset COME(Sue,p_1) \\
FACTIVE(REGRET) \\
\neg REGRET(John, COME(Sue,p_1)) \wedge \\
LF(REGRET, x, COME(Sue,p_1)) \wedge \\
\hline
FACTIVE(REGRET) : COME(Sue,p_1) \\
\hline
COME(Sue,p_1) \\
\vdots
\end{array}\right\} \tag{3.129}$$

To derive the cases for the case analysis, first the material implication is changed to a logical or. The statements in (3.130) (which are derivable from (3.129)) describe the admissible cases for the case analysis.

$$\begin{array}{l}
\mathsf{P}_S(\neg COME(Mary,p_1) \wedge \neg REGRET(John, COME(Sue,p_1))) \\
\mathsf{P}_S(COME(Mary,p_1) \wedge REGRET(John, COME(Sue,p_1)))
\end{array} \tag{3.130}$$

Case 1: Assume (3.131). (3.132) is derivable using only first order inference rules. The second result, (3.133), requires the invocation of the default rule for $\neg REGRET$.

$$\neg COME(Mary,p_1) \wedge \neg REGRET(John, COME(Sue,p_1)) \tag{3.131}$$

$$\neg COME(Mary, p_1) \tag{3.132}$$

$$COME(Sue, p_1) \tag{3.133}$$

Case 2: Assume (3.134). The inferences (3.135) and (3.136) are both derivable from first order proof theory. So both have entailment status.

$$COME(Mary, p_1) \wedge REGRET(John, COME(Sue, p_1)) \tag{3.134}$$

$$COME(Mary, p_1) \tag{3.135}$$

$$COME(Sue, p_1) \tag{3.136}$$

Combining the case analysis produces the two inferences (3.137) and (3.138). The first statement is a tautology which is provable without default proof theory. Since the second inference has entailment status in one case and presuppositional status in the other, the case analysis gives it presuppositional status. That it is a presupposition of (3.128) is the correct analysis.

$$\neg COME(Mary, p_1) \vee COME(Mary, p_1) \tag{3.137}$$

$$COME(Sue, p_1) \tag{3.138}$$

3.3.4 Example 4 – *If ... then ...*: Intrasentential cancellation

The theory (3.141) represents the utterance (3.139). The derivation of the presuppositions of (3.139) is discussed below. In particular, it is shown that (3.140), which is not a presupposition of (3.139), is not derivable from (3.141) using the proposed analysis.

If Mary came to the party then John regrets that she did. (3.139)

$$COME(Mary, p_1) \tag{3.140}$$

$$\left\{\begin{array}{c}
\mathsf{K}_S(COME(Mary,p_1) \supset REGRET(John, COME(Mary,p_1))) \wedge \\
LF(REGRET, John, COME(Mary,p_1)) \\
\mathsf{P}_S COME(Mary,p_1) \\
\mathsf{P}_S \neg COME(Mary,p_1) \\
\mathsf{P}_S REGRET(John, COME(Mary,p_1)) \\
\mathsf{P}_S \neg REGRET(John, COME(Mary,p_1)) \\
\forall x.REGRET(x, COME(Mary,p_1)) \wedge \\
FACTIVE(REGRET) \supset COME(Mary,p_1) \\
FACTIVE(REGRET) \\
\neg REGRET(John, COME(Mary,p_1)) \wedge \\
LF(REGRET, x, COME(Mary,p_1)) \wedge \\
\underline{FACTIVE(REGRET) : COME(Mary,p_1)} \\
COME(Mary,p_1) \\
\vdots
\end{array}\right\} \tag{3.141}$$

Analogously to the example in section 3.3.3, the cases for the case analysis are generated. The admissable cases for the case analysis are described by the statements in (3.142).

$$\begin{array}{l}
\mathsf{P}_S(\neg COME(Mary,p_1) \wedge \neg REGRET(John, COME(Mary,p_1))) \\
\mathsf{P}_S(COME(Mary,p_1) \wedge REGRET(John, COME(Mary,p_1)))
\end{array} \tag{3.142}$$

Case analysis proceeds as follows:

Case 1: Assume (3.143). (3.144) is derived as an entailment. The default rule which could potentially derive (3.145) is blocked because the rule's justification is inconsistent in this case of the case analysis.

$$\neg COME(Mary,p_1) \wedge \neg REGRET(John, COME(Mary,p_1)) \tag{3.143}$$

$$\neg COME(Mary,p_1) \tag{3.144}$$

$$COME(Mary,p_1) \tag{3.145}$$

Case 2: Assume (3.146). (3.147) is derived as an entailment directly as one of the conjuncts of (3.146).

$$COME(Mary,p_1) \wedge REGRET(John, COME(Mary,p_1)) \tag{3.146}$$

$$COME(Mary,p_1) \tag{3.147}$$

When the two cases are combined the tautology (3.148) is obtained. Thus the theory correctly predicts that (3.140) is not derived as a presupposition of (3.139).

$$COME(Mary,p_1) \vee \neg COME(Mary,p_1) \tag{3.148}$$

3.3.5 Example 5 – *Possibly*

The previous examples have shown a reasonably straightforward process to derive the presuppositions from a sentence that has been uttered. The case analysis is based on the cases generated from the disjunctive representation of the sentence that is uttered. The admissable cases are chosen by resorting to the Gricean clausal implicatures. For the presuppositional environment '*possibly*' (which is considered to be a *hole* or some similar device in all projection theories) the situation is quite different. Here, the case analysis is based on the cases generated from a tautology and the admissable cases are indicated by the sentence uttered and an inference derived from this sentence using Grice's maxims. (3.149) typifies this class of sentences. It presupposes (3.150).

Possibly John regrets that Mary came to the party. (3.149)

$$COME(Mary, p_1) \tag{3.150}$$

The theory that represents an utterance of (3.149) is given in (3.151). The first logical statement in (3.151) is just a direct translation of (3.149). It is the second statement that is of most interest to this discussion. It is derived from (3.149) using Gazdar's scalar implicatures: $\langle \mathsf{K}_S, \mathsf{P}_S \rangle$ forms a quantitative scale. S, upon uttering '*Possibly A.*' (which is represented $\mathsf{P}_S A$), is committed to $\neg \mathsf{K}_S A$. But $\neg \mathsf{K}_S A$ is just equivalent to $\mathsf{P}_S \neg A$.

$$\left\{ \begin{array}{c} \mathsf{P}_S REGRET(John, COME(Mary, p_1)) \\ \mathsf{P}_S \neg REGRET(John, COME(Mary, p_1)) \\ \forall x. REGRET(x, COME(Mary, p_1)) \wedge \\ FACTIVE(REGRET) \supset COME(Mary, p_1) \\ FACTIVE(REGRET) \\ \neg REGRET(John, COME(Mary, p_1)) \wedge \\ LF(REGRET, x, COME(Mary, p_1)) \wedge \\ FACTIVE(REGRET) : COME(Mary, p_1) \\ \hline COME(Mary, p_1) \\ \vdots \end{array} \right\} \tag{3.151}$$

Since (3.152) is a tautology, it is derivable from (3.151).

$$REGRET(John, COME(Mary, p_1)) \wedge \neg REGRET(John, COME(Mary, p_1)) \tag{3.152}$$

Because the two disjuncts in (3.152) are provably possible (the possibility of the two disjuncts are axioms of the theory) they are admissable in the case analysis which proceeds as follows.

Case 1: Assume (3.153). Using first–order principles, (3.154) can be derived.

$$REGRET(John, COME(Mary, p_1)) \tag{3.153}$$

$$COME(Mary, p_1) \tag{3.154}$$

Case 2: Assume (3.155). Using default logic proof theory, (3.156) can be derived.

$$\neg REGRET(John, COME(Mary, p_1)) \tag{3.155}$$

$$COME(Mary, p_1) \tag{3.156}$$

Putting the results of the case analysis together, (3.156) is derived as a presupposition of (3.149).

3.4 A Definition of Presupposition

In this concluding section a definition of *presupposition* is provided, first a proof theoretic (or operational) definition. This definition coincides with the examples that have been provided throughout this chapter. Also it is the style of definition which most closely resembles the projection rule definitions that are in the literature. The second definition is a model theoretic one. Because a logical framework has been used throughout, and the logic has a model theory (Łukaszewicz (1985)), this second definition comes as an extra benefit. This kind of definition is lacking in all writings on presuppositions, except for Gazdar (1979). But, whereas Gazdar is interested in models because he has no proof theory, the purpose here is to show that the presupposition relation defined by the default proof theory and its model theory is a logical relation similar in some ways to entailment. And both of these relations are useful in the study of the meaning of natural language sentences.

3.4.1 A Proof–Theoretic Definition of Presuppositions

Definition 4 *A sentence α is a presupposition of an utterance* u, *represented by the default theory $\Delta_{\mathbf{u}}$*[32], *if and only if $\Delta_{\mathbf{u}} \vdash_{\Delta} \alpha$ and $\alpha \in Th(CONSEQUENTS\{D\})$, but $\Delta_{\mathbf{u}} \nvdash \alpha$ and*

[32]For purposes of this definition, the only defaults in $\Delta_{\mathbf{u}}$ are the presupposition generating defaults. In reality the default theory would contain many other kinds of defaults. The definition would have to be changed so that the proof of α, requires the invocation of a presupposition generating default, and that $\alpha \in Th(CONSEQUENTS\{D'\})$, where D' is the set of presupposition generating defaults. As well, as already mentioned in section 3.2.6, all proofs must require the use of the statement representing the semantic representation of the uttered sentence.

$\Delta_{\mathbf{u}} \nvdash_{\Delta} \neg\alpha$[33].

This definition can be loosely paraphrased as: if α is in the logical closure of the default consequents and is provable from the utterance, and all proofs require the invocation of a default rule and in the case of multiple extension default theories, α is in all extensions, then α is a presupposition of the utterance.

3.4.2 A Model–Theoretic Definition of Presuppositions

Definition 5 *A sentence α is a presupposition of an utterance* $\mathbf{u}$*, where* $\mathbf{u}$ *is composed of a set of statements Γ representing the background knowledge (which includes real world and linguistic knowledge) and s representing the sentence uttered, if and only if α is true in all preferred models of $\Gamma \cup \{s\}$ but is not true in all preferred models of Γ and is not true in all models of $\Gamma \cup \{s\}$.*

Given the notation $\models_p$ for *true in all preferred models*, this definition is written: a sentence α is a presupposition of an utterance $\mathbf{u}$, where $\mathbf{u} = \Gamma \cup \{s\}$, if and only if $\Gamma \cup \{s\} \models_p \alpha$ and $\Gamma \not\models_p \alpha$ and $\Gamma \not\models \alpha$.

The most important notion — preferred model — has been left undefined. Although it may seem worthless to provide a definition that includes undefined terms, I am more interested in providing the form of a semantic definition rather than the precision required by such a definition. Any attempt to define the notion preferred model will be quite an undertaking. Reviewing the literature on natural language presupposition, it is quite obvious that early authors were persuing this goal without it being stated in this manner. Although a definition of preferred model seems relatively straightforward for simple statements, any definition will encounter the same problems that these early attempts discovered, in particular, those situations that deviate from the standard interpretation and complex sentences. It seems reasonable to assume that preferred models (which are exactly that subset of models that corresponds to the preferred

[33]Up to this point all examples have dealt with default theories having single extensions. In those theories which have multiple extensions, some way of stating that a presupposition is in all extensions is required. Since extensions of normal default theories are orthogonal, if $\Delta_{\mathbf{u}}$ has multiple extensions then there exists a sentence β such that $\Delta_{\mathbf{u}} \vdash_{\Delta} \beta$ and $\Delta_{\mathbf{u}} \vdash_{\Delta} \neg\beta$. I will call this situation being split along the β–dimension. If the extensions do not split along the α–dimension then either α is in all extensions or α is in no extension. So if $\Delta_{\mathbf{u}} \vdash_{\Delta} \alpha$ (which means that at least one extension contains α) and $\Delta_{\mathbf{u}} \nvdash_{\Delta} \neg\alpha$ (which means that no extension contains $\neg\alpha$, which means that the extensions do not split on the α–dimension) then α is in all extensions.

interpretation) are to be characterized by Grice's maxims, but of course something much more precise than any presently available description of these maxims is needed. Possibly, common-sense reasoning (which motivated the proof–theoretic definition) can be used to give a precise definition of preferred models. Additionally, the set of preferred models of Γ is a subset of the models of Γ. This relationship between the two concepts is evident in the restriction that a presupposition is not an entailment. Since everything true in all models will of course also be true in all preferred models all entailments would be presuppositions if the restriction were not added. This added restriction requires some notion of preference to enter the definition of presupposition (that is, what is true just in the preferred models is to be distinguished from what is true in all models). So, α is not a presupposition, if it happens to be an entailment. What is striking about this situation is that almost all previous theories included entailments in the presupposition category. The reason for separating these two kinds of inferences has already been discussed.

Arising from this definition are two interesting comparisons: the default logic approach and Gazdar's approach, and the default logic approach with Karttunen and Peters'. Given Łukaszewicz's model theory for normal default theories, a comparison with Gazdar's approach can be made. The method used by Gazdar, more or less, takes the intersection of all the preferred models to obtain the set of presuppositions. This method seems reasonable since whatever is true in all of the models is true in their intersection. The same results are obtained in the default logic approach if the default theories have a single extension. However, there are theories that have multiple extensions.[34] It is here that the two methods diverge. Since multiple extensions are orthogonal, the intersection of the models for these extensions is empty. This is precisely what is obtained by Gazdar — utterances that produce multiple extensions in the default logic approach have no presuppositions generated by Gazdar's method. However, there do exist disjunctive statements that are true in all of these models, and if they are not entailments then they are presuppositions. The connection that the default logic approach has to Karttunen and Peters' method is through the latter's view of presupposition as entailment. Although they provide a crisp definition of presuppositions, the clarity of the definition's meaning is clouded with some peculiar assumptions. But, with a little imagination these assumptions begin to resemble reasonable properties of preferred models. So, although I make a strong attack on some aspects of their methodology in Chapter 4, it is the technical details as presented

[34]Examples of utterances that create situations like this are discussed in detail in Chapter 4.

that is disputed rather than what may be their underlying intuitions.

The analogy to entailment is obtained as desired. With entailment the basic concept is the model. So, $\Gamma \models \alpha$ has the meaning that α is true in all models of Γ. Analogously, the basic concept for presupposition is the (as yet to be defined) preferred model. And in a manner paralleling the entailment relation $\Gamma \models_p \alpha$ means that α is true in all preferred models of Γ.

Chapter 4

Comparison of Various Approaches

The theory presented in Chapter 3 has been a radical departure from the normal projection theories proposed by a number of linguists. For this reason I will compare the competing theories on two levels: empirically, and methodologically. The main issue discussed will be how well each proposed method determines presuppositions over a wide range of cases. Some of the arguments presented will be summaries of previously published discussions. Some will be new. Other topics discussed will include the importance of a precise definition of presupposition for linguists (because of their projection method) and need for linguists to have positive environments both entail and presuppose their presuppositions.

The major difference that needs to be kept in mind throughout is that the linguistic methods to which I am comparing my approach are more oriented to the surface structure than my approach is. This varies from linguistic theory to linguistic theory with Karttunen and Peters (1975) and Soames (1982) being the most *surfacey* to Gunji (1982) and Gazdar (1979) being least *surfacey*. In the latter two cases the presuppositions are determined from a semantic representation of the surface sentence. However the semantic representation more closely resembles the surface sentence than the semantic representation that the default logic approach requires. For example, the mere existence of a presuppositional environment in the semantic representation generates a potential presupposition in Gazdar's method. Since the default logic approach requires a negation to be present, this approach may require the ability to derive equivalent representations in order to produce the required negated presuppositional environment. The other difference is that I am strongly committed to viewing the presupposition relation between sentences in much the same light as the entailment relation between sentences. From

this viewpoint I hope to generate a "proof–theoretic"[1] and "model–theoretic" definition for the presupposition relation. I provided a "proof–theoretic" definition in Chapter 3. However, I fall short of a good "model–theoretic" definition because although I provide a definition in Chapter 3, the definition of minimal model needs to be more precise.

This chapter is divided into five main sections. The first four sections deal with four previous approaches. Each section provides as much description of the approach as required by the critique. The critique is composed of a summary of previous counterexamples, some new counterexamples, and problems with the methodology. A better order of presentation notwithstanding, I will present the previous methods in chronological order. Section 4.1 is devoted to the approach by Karttunen and Peters. (The inclusion of the earlier work by Karttunen is required because Gunji (1982) compares his method to this earlier work.) Numerous counterexamples have been found. Previous methodological criticisms have focused on the delineation of the presuppositional categories of plugs, holes, and filters. In some detail I have provided an analysis of a different methodological problem, one which makes an important part of their method unsound. I spend some time on this problem because Soames (1982) uses their method as part of his method. So although it has been known for some time that their method has problems, the destruction of this fundamental part of their method serves also as an argument against Soames' method as well. In section 4.2 a discussion of Gazdar's method is given. Of particular importance is the problem of non–binary features. I believe this type of problem is a problem that no projection method can overcome since the sentential presupposition is not a conjunction of clausal presuppositions. In section 4.3 a close scrutiny of Gunji's approach is undertaken. Here the analysis is particularly detailed because I know of no similar analysis. And in section 4.4 Soames' method is presented. Again, I know of no other published analysis so the one presented is reasonably detailed. The fifth section cluminates the discussion of the default logic approach that was initiated in Chapter 3. The discussion compares this approach with the other four and demonstrates its performance on the counterexamples discussed in the previous sections.

The remainder of this chapter is quite heavy with technical results. The main results can be obtained by reading only section 4.5. However, a full appreciation of the discussion therein

[1] I use scare quotes here because the "proof" theory provided by default logic is not recursively enumerable so it is not a true proof theory. Likewise, the "model" theory is based on some notion of minimal model which is a much stronger notion than that found in definitions of standard Tarskian models.

requires a reading of the previous sections. The notation used throughout the chapter is the following: X^T is used to designate the *truth-conditions*, X^P, the *presuppositions*, and X^I, the *clausal implicatures* of the proposition X. And as always, the phrase *presuppositions of X* encompasses only those presuppositions that are important to the discussion at hand.

4.1 Karttunen and Peters

The most successful attempt before Gazdar (1979) was the work reported in Karttunen (1973, 1974) and Karttunen and Peters (1975, 1979). This solution first appeared under the metaphorical title of *Plugs, Holes, and Filters.* It has since been modified but this metaphor has remained.

Plugs do not allow the presuppositions of any underlying structure to become presuppositions of the matrix sentence. Complementizable verbs of saying, such as '*say*', '*ask*', and '*tell*', and external negation are categorized as plugs. An example is shown in (4.1).

S: Bill told me that the present king of France is bald.
P: *The king of France exists. (4.1)

Holes promote all presuppositions of the subordinate structure to presuppositions of the matrix sentence. Complementizable verbs, such as factives ('*know*', '*regret*'), aspectuals ('*begin*', '*stop*', '*continue*'), modals ('*be able*', '*be possible*'), and implicatives ('*manage*', '*remember*'), and internal negation are categorized as holes. No explanation for internal negation being the preferred sense of natural language negation is given in the theory. Examples are shown in (4.2)–(4.3).

S: Bill doesn't regret failing the exam.
P: Bill failed the exam. (4.2)

S: It is possible that John's children are away.
P: John has children. (4.3)

The two categories of plugs and holes are on the whole uninteresting. What goes in each category may not be easily–defined, but once the categories are decided upon, the actual functioning of these presuppositional devices have no hidden surprises. On the other hand the functional description of the third category, the *filters*, has been most difficult to characterize. *Filters* are projection rule metaphors for conjunctions, disjunctions, and conditionals. An evolution of definitions has occurred. What I will present are the two found in Karttunen (1973)

and Karttunen and Peters (1979). These two definitions are most important later in this presentation since the first is the theory against which Gunji (1982) measures the success of his own method and the second forms part of the theoretical base for Soames (1982). The earliest version of the definition of the filters is shown in (4.4).

(a) $(A \text{ and } B)^P = A^P \cup \{C | C \in B^P \wedge X \cup \{A\} \not\models C\}$
where X is a set of assumed facts and $X \not\models C$, and $X \not\models A$.

(b) $(A \text{ or } B)^P = A^P \cup \{C | C \in B^P \wedge X \cup \{\neg A\} \not\models C\}$
where X is a set of assumed facts and $X \not\models C$, and $X \not\models A$. (4.4)

(c) $(\text{if } A \text{ then } B)^P = A^P \cup \{C | C \in B^P \wedge X \cup \{A\} \not\models C\}$
where X is a set of assumed facts and $X \not\models C$, and $X \not\models \neg A$.

The examples given below demonstrate the functioning of these rules. I have given them only for conditional sentences. (4.5) projects the presupposition from the consequent clause to become a presupposition of the sentence. In (4.6) the presupposition '*Harry has a wife.*', found in the consequent clause, is filtered out because the set of assumed facts, X, which probably contains the fact '*if Harry is married then he has a wife*' entails it. '*Harry has a wife.*' is not a presupposition of the antecedent clause and since it is filtered by rule (4.4c) it is not a presupposition of the sentence.

S: If baldness is hereditary, then all of Jack's children are bald.
P: Jack has children. (4.5)

S: If Harry is married, then his wife is no longer living with him.
P: *Harry has a wife. (4.6)

The most recent definition (Karttunen and Peters (1979)) is given in (4.7).

(a) $(A \text{ and } B)^P = A^P \wedge (A^T \supset B^P)$

(b) $(A \text{ or } B)^P = (A^T \vee B^P) \wedge (A^P \vee B^T) \wedge (A^P \vee B^P)$[2] (4.7)

(c) $(\text{if } A \text{ then } B)^P = A^P \wedge (A^T \supset B^P)$

In the two rules, (4.7a) and (4.7c), there is one extra condition to be added: If the logical

[2]The last conjunct is not in the original version but was subsequently added in Soames (1979) to capture those presuppositions that are common to both clauses.

condition '$A^T \supset B^P$' is true only for truth conditional reasons[3] then the B^P can be detached. It is this condition which is the target of most of the criticism (see Gazdar (1979) and the discussion in section 4.1.1).

Some examples are given in (4.8)–(4.10). In (4.8) the presupposition is A^P. In (4.9) the presupposition contributed by the consequent is the logically trivial '*Mary came to the party* $\supset$ *Mary came to the party*', so no substantive presupposition is forthcoming. And in (4.10) the presupposition contributed by the consequent can be modified to B^P since it is unlikely that A^T infers B^P.

S: If John regrets that Mary came to the party then he will show his displeasure.
P: Mary came to the party. (4.8)

S: If Mary came to the party then John regrets that Mary came to the party.
P: — (4.9)

S: If Sue came to the party then John regrets that Mary came to the party.
P: Mary came to the party. (4.10)

4.1.1 Empirical Problems

The discussion in the previous section has indicated that the theory of Karttunen (1973, 1974) has evolved into the theory presented in Karttunen and Peters (1975, 1979). However the following characteristics have remained:

1. Presuppositions[4] are entailments[5] of the context and the utterance.

2. Presuppositions are of the noncancellable, sentential type.

[3]It is difficult to know exactly what this locution means — possibly that the background assumptions do not provide a *natural connection* between A^T and B^P. Being more precise, natural connection may mean entailment. However, this even causes problems because Karttunen and Peters discard tautologies because they are unsubstantive, though tautologies are entailments.

[4]They use the term *conventional implicature*. However in most cases the phenomena that they discuss have usually been categorized as presuppositional (see Gazdar (1979) and Soames (1982)). Some of their examples deal with '*too*', which I will argue is not a presupposition generating environment in the sense proposed by them.

[5]In the tradition of Gazdar I do not consider presuppositions to be entailments. However, their rules for generating presuppositions are important in their own right, partly because they are used in the hybrid definition of Soames (1982). The arguments that I give in this section against Karttunen and Peters do not depend on the entailment/satisfiability distinction.

3. Plugs, holes, and filters are the three categories of presuppositional devices in the theory.

Of all the presuppositional devices, the filters are the hardest to capture by any presuppositional theory. This category will be the focus of the following discussion, in particular the filter for conditional sentences.

Since there are many counterexamples to these theories (in Gazdar (1979) and Soames (1979, 1982)), I will present here only a synopsis of those that directly affect the filters. For other counterexamples, peculiar to each theory and also more linguistically subtle in nature, I refer the reader to Gazdar (1979) (pp 108–119).

The counterexamples fall into two categories:

1. contradictory presuppositions

2. presuppositions cancelled by conversational implicatures

I will give a counterexample for each filter such that each of these categories is exemplified. Even though Karttunen (1973) has been superceded by Karttunen and Peters (1979) I will show the false predictions given by both theories since Gunji refers to the earlier work of Karttunen. The examples for the later work are taken from Gazdar and Soames.

4.1.1.1 Example 1 — Contradictory Presuppositions

Example (4.11) which has been previously discussed in Chapter 3 has the representation shown in (4.12).

My teacher is a bachelor or a spinster. (4.11)

$$BACHELOR(t_1) \vee SPINSTER(t_1) \tag{4.12}$$

The presuppositions generated by these theories are as follows:

Karttunen (1973)

$S = A$ or B.

If $A \gg C$ then $S \gg C$, hence $S \gg MALE(t_1)$

If $B \gg D$ then $S \gg D$ unless $X \cup \{\neg A\} \models D$, where $X \not\models A$ and $X \not\models D$, hence $S \gg FEMALE(t_1)$.

Thus this theory predicts that S presupposes both $MALE(t_1)$ and $FEMALE(t_1)$ which is a contradiction.

Karttunen and Peters (1979)[6]

$$\begin{aligned}(A \text{ or } B)^P &= (A^T \vee B^P) \wedge (B^T \vee A^P) \wedge (A^P \vee B^P) \\ &= (BACHELOR(t_1) \vee FEMALE(t_1)) \\ &\quad \wedge (SPINSTER(t_1) \vee MALE(t_1)) \\ &\quad \wedge (FEMALE(t_1) \vee MALE(t_1)) \\ &= BACHELOR(t_1) \vee SPINSTER(t_1)\end{aligned}$$

But this would mean that the sentence presupposed itself — a very undesirable situation. The reason that it is so undesirable becomes obvious when this sentence is embedded in a larger construct where a presupposition is generated but where obviously none exists. For example, if (4.11) presupposed itself (4.13) would presuppose '*My teacher is a bachelor or a spinster.*' because the rule for conditionals promotes all presuppositions from the antecedent. But the conversational implicature for conditionals states that the speaker is not assuming the truth of the antecedent.

If my teacher is a bachelor or a spinster then . . . . (4.13)

4.1.1.2 Example 2 — Presuppositions cancelled by conversational implicatures

Example (4.14) is appropriate for this discussion.

It is possible that John has children and it is possible that his children are away. (4.14)

The presuppositions generated by these theories are:

Karttunen (1973)

$S = A$ and B

If $A \gg C$ then $S \gg C$ hence there is nothing of interest for this example that is presupposed by the first clause of this sentence. If $B \gg D$ then $S \gg D$ unless $X \cup \{A\} \models D$, where $X \not\models \neg A$ and $X \not\models D$.

[6] I have added the extra conjunct that Soames (1982) demonstrated was necessary, although in this example it makes no difference.

B hence $S \gg$ '*John has children.*'.

Therefore S presupposes '*John has children.*'.

However we have the problem that the sentence conversationally implicates that it is possible that John doesn't have children (a scalar implicature of the '*possibly*' in A). Therefore the presupposition generated in this manner is incorrect.

Karttunen and Peters (1979)

$A^P \wedge (A^T \supset B^P)$

A^T: $\Diamond$John has children.

B^P: John has children.

But in addition to this we have $S \models A^T$ (the first conjunct) hence $S \models B^P$ (by modus ponens). But this is false for the reason presented in the previous paragraph.

4.1.1.3 Example 3 — Presuppositions cancelled by conversational implicatures

The example in (4.15) demonstrates that the filtering conditions for '*if* ... *then* ...' do not work properly if there are conversational implicatures which cancel the proposed presupposition. It is important to realize in this example that '*I*' refers to the speaker.

If I realize later that I have not told the truth, I will confess it to everyone. (4.15)

Karttunen (1973)

$S =$ If A then B

If $A \gg C$ then $S \gg C$ hence $S \gg$ '*I have not told the truth.*'.

If $B \gg D$ then $S \gg D$ unless $X \cup \{A\} \models D$, where $X \not\models \neg A$ and $X \not\models D$. No presupposition of importance to this example is generated by B.

Thus S presupposes that '*I have not told the truth.*'

But this is not a valid presupposition since the conversational implicature generated by '*realize*' is that if the speaker is speaking about himself then the speaker does not know that he has not told the truth.

Karttunen and Peters (1979)

$A^P \wedge (A^T \supset B^P)$

Since A^P is part of the presupposition then we can use the same argument as that in the previous paragraph to show that this presupposition is incorrect.

4.1.2 Methodological Problems

There are a number of methodological problems with the theory presented in Karttunen and Peters (1979). Since this is the latest version of their evolutionary theory, I will only concern myself with this theory. Two problems have been discussed previously in Gazdar (1979). Firstly, the categories of plugs, holes, and filters are unnatural in the sense that there exists no criteria other than the presuppositional one to define the classes. Secondly, Karttunen and Peters (1979) are forced to accept an ambiguous account of negation since internal negation is classified as a hole, whereas external negation is classified as a plug.

Although these are substantial methodological problems, the one of greatest concern here is the rule which allows the detachment of the B^P in the presupposition rules for conjuncts and conditionals. This detachment under certain conditions allows $A^P \wedge (A^T \supset B^P)$ to become $A^P \wedge B^P$. Although Gazdar points out the methodological problems with Karttunen and Peters' filtering rule, it is done on the basis of the necessity of adding extra ad hoc conversational principles to an already ad hoc system. Also the counterexamples that Gazdar provides have been disputed in Soames (1982). In addition, Soames has used the filtering conditions with the detachment feature as an integral part of his theory of presuppositions. Therefore I find it necessary to refute on more fundamental grounds the arguments given by Karttunen and Peters to support their ad hoc detachment rule. I will give the discussion in the context of conditionals but an appropriately modified argument is available for the context of conjuncts. In section 4.4.1 I will discuss Soames' disagreement with Gazdar's counterexamples.

The Filter for 'If ϕ then ψ'

A problem for any theory of presupposition occurs when the antecedent of an indicative conditional entails the presupposition of the consequent. The solution proposed in Karttunen and Peters (1979) is to "cancel" the presupposition found in the consequent by subordinating it in a larger logical form, specifically, $\phi^T \supset \psi^P$. The result in the problematic cases is that the

consequent generates a tautology which is regarded as being a non–substantive presupposition. But by parcelling ψ^P up in a larger logical form, Karttunen and Peters are faced with a different problem: how to explain the apparent presupposition, ψ^P, generated by the consequent, ψ. To their theory they add some conversational principles which "uncancel" ψ^P. Doing so they maintain that $\phi^T \supset \psi^P$ is the correct form of the presupposition generated by the consequent and that the conversational principles create the illusion that the presupposition is ψ^P. In the remainder of this section I will criticize the reasoning which supports their conversational principles.

I will proceed with three separate arguments: first that the definition of presupposition (for '*if* ... *then* ...' at least) cannot be defended as being necessary (as in necessary and sufficient), second, that under one plausible interpretation the definition just disintegrates, and third, that their reasoning if used in other similar situations leads to inappropriate conclusions.

I will first look at Karttunen and Peter's argument regarding their definition of the filter for 'if ϕ then ψ'. Their argument basically is if a certain entailment relation holds between a set of sentences S (called the common ground) and some logical form which includes the presuppositions of all the parts of the sentence (that is, the antecedent and consequent in this case) then we can equate the presuppositions of the sentence with this logical form. In order for this equating to be valid the constraints defined by the logical form in question must be both necessary and sufficient; otherwise, some presuppositions will be overlooked (unnecessary restrictions) or incorrect "presuppositions" will be produced (insufficient restrictions).

Sufficiency. The following argument is an adaptation[7] of the one given in Karttunen and Peters (1979)[8] which is based partly on earlier work by Karttunen (1973, 1974). The conclusion reached in this earlier work was that the common ground, S[9], assures the truth of

[7]In addition to modifying their argument, I have changed their notation slightly: their ϕ^e is written here as ϕ^T, and their ψ^i as ψ^P.

[8]The argument given there is incorrect. It was essentially the following:

1. $S \cup \{\phi\} \models \psi^P$ Premise
2. $S \models \phi \supset \psi^P$ 1,Propositional Logic
3. $S \models \phi^T \supset \psi^P$ 2,$\phi \supset \phi^T$,Propositional Logic

Step 3 is unsound.

[9]In the introduction to this section I state that although I disagree with the premise that presuppositions are *entailments* of the *common ground*, S, I still feel that it is important to make a much stronger argument against the foundations of Karttunen and Peter's detachment rule. Except for a parenthetical remark about what S could be, they say nothing about, and their reasoning does not depend on, any particular composition

the presuppositions of '*if* ϕ *then* ψ' just in case

1. S assures that the presuppositions of ϕ are true.

2. $S \cup \{\phi\}$ assures that the presuppositions of ψ are true.

I will only be interested in item 2 since this is the controversial part of their definition. The following is an argument which given their premise proves their conclusion.

1.	$S \models \phi^P$	Premise	
2.	$\phi = \phi^T \wedge \phi^P$	Premise (not quite true (the meaning of the sentence may include more than the truth–conditions and the presuppositions) but any additional information will be conjunctive and can be eliminated as in steps 5 and 6 below)	(4.16)
3.	$S \cup \{\phi\} \models \psi^P$	Premise	
4.	$S \models \phi \supset \psi^P$	3,Propositional Logic	
5.	$S \models (\phi^T \wedge \phi^P) \supset \psi^P)$	2,4,Propositional Logic	
6.	$S \models \phi^P \supset (\phi^T \supset \psi^P)$	5,Propositional Logic	
7.	$S \models \phi^T \supset \psi^P$	1,6,Propositional Logic	

Although given their premise their conclusion is valid, it is not necessary to have a special rule to generate the presupposition as they have suggested since $S \models \phi^T \supset \psi^P$ is derivable just using propositional logic and some simple nonlogical facts.

1.	$\models \phi^T \supset \psi^T$	Premise (truth–conditions of statement uttered	
2.	$S \models \psi^T \supset \psi^P$	entailment relation holding between ψ^T and ψ^P[10]	(4.17)
3.	$S \models (\phi^T \supset \psi^T) \wedge (\psi^T \supset \psi^P)$	1,2,Propositional Logic	
4.	$S \models \phi^T \supset \psi^P$	3,Propositional Logic	

So, to reiterate, it is a valid inference from their premises that $S \models \phi^T \supset \psi^P$, although it is redundant to require a special presupposition generation rule, given that the same inference can be derived only from the uttered statement and no extra premises.

of S (except that it doesn't contain ϕ). So, if my arguments are correct, any attempt to repair their reasoning by finding a different set S would be futile.

[10]Note the same argument used to defend $S \models \phi^T \supset \psi^P$ can be used to argue that $S \models \psi^T \supset \psi^P$. S and $\{\psi^T\}$ guarantees that ψ^P is true (uttering the simple sentence ψ) hence it is an entailment relation, therefore $S \cup \{\psi^T\} \models \psi^P$, hence $S \models \psi^T \supset \psi^P$.

Necessity. It is on this half of the argument that their definition fails. They themselves admit that the addition of ϕ^T to S is not necessary to assure the truth of ψ^P. They give some examples. Before looking at this in detail, I will look at a more basic flaw in their argument.

They note that proof (4.16) shows that $S \models \phi \supset \psi^P$ can be derived from $S \cup \{\phi\} \models \psi^P$. They then conclude that this means that $\phi^T \supset \psi^P$ is the presupposition generated by the consequent clause of 'if ... then ...'. However, by propositional logic

$$\begin{array}{ll} \text{if} & S \cup \{\phi^T\} \models \psi^P \\ \text{then} & S \models \phi^T \wedge (q_1 \wedge \ldots \wedge q_n) \supset \psi^P \end{array}$$

for any sentences $q_1, \ldots, q_n$. Using Karttunen and Peter's argument, the consequent clause generates the presupposition

$$\phi^T \wedge (q_1 \wedge \ldots \wedge q_n) \supset \psi^P.$$

So it is not necessary to choose the particular form that they chose.

Now that I have shown that there are reasonable arguments against their conclusion that the consequent clause in '*if* ϕ *then* ψ' generates the presupposition '$\phi^T \supset \psi^P$', I will now turn to their argument concerning the "uncancelling" of the presupposition ψ^P. I will argue on two fronts: first that their use of the entailment relation leads to a contradiction with Grice's conversational maxims (which they assume), and second, all of their arguments lead to the conclusion that $S \models \psi^P$, which is the more natural conclusion, anyway.

Karttunen and Peters note that even though $S \models \phi^T \supset \psi^P$, on many occasions (as it happens, the *usual* cases) ψ^P is the sentence that is more desirable as the presupposition than is $\phi^T \supset \psi^P$. I will now show that if the entailment relation is to be adhered to strictly, then a contradiction with the Gricean maxims arises.

If Karttunen and Peters want to argue that they can derive $S \models \psi^P$ from $S \models \phi^T \supset \psi^P$ then they must presume $S \models \phi^T$.[11] But if $S \models \phi^T$ then either

1. $\phi^T \in S$, or

2. $\exists q_1, \ldots, q_n \in S$, $(n \geq 0)$, such that $\models (q_1 \wedge \ldots \wedge q_n) \supset \phi^T$.

Given the Gricean maxims, the use of '*if* ϕ *then* ψ' commits the speaker to not knowing the truth or falsity of ϕ^T, hence $\phi^T \notin S$ (and $\neg\phi^T \notin S$) nor is it possible that $\exists q_1, \ldots, q_n \in S$ such

[11] Note they do not make their argument as precise as this, but if they want the presupposition relation to be entailment they would have to subscribe to this statement.

that $\models (q_1 \wedge \ldots \wedge q_n) \supset \phi^T$ (or $\neg\phi^T$) otherwise the speaker would know whether ϕ^T were true or false (the use of '*know*' is reasonable here since it is assumed that S, the common ground, represents what is known). This contradicts the original premise that $S \models \phi^T$.

I will now look at their argument in more detail. The sentences (4.18) and (4.19), are their sentences (53b) and (55). I will use the new numbering in the quoted passages. I have changed ***conventional implicature*** to ***presupposition*** wherever it occurs. Also note that even though I consider '*too*' to be a presupposition generating environment in a way which is significantly different than what is given here (see section 4.5.3) I am concerned only with the structure of their argument and not the particular example that they use in their discussion. The capitalized '*JOHN*' is meant to signify that John is the focus of '*too*'.

If the bottle is empty, then JOHN drinks too. (4.18)

If the bottle is empty, then there is someone other than John who drinks. (4.19)

Their argument essentially is that the proper representation of the presupposition generated from the consequent is $\phi^T \supset \psi^P$ and that to maintain that it should be ψ^P is partly illusory. I maintain that all of their arguments lead to only one conclusion: the presupposition generated from the consequent is ψ^P.

Their argument begins

> What of our feeling that (4.18) indicates that John is not the only drinker? Does our technical conclusion that (4.18) [presupposes] the proposition expressed by (4.19) agree with this intuition? The answer seems to us affirmative. We believe that the naive feeling that (4.18) [presupposes] that someone else besides John drinks is partly illusory, stemming from the tendency to assess what commitments inhere in a sentence by the method of imagining the sentence asserted in various contexts. Let us examine more closely what commitments a speaker actually does make by asserting the indicative conditional sentence (4.18). One of those commitments is to have adequate grounds for believing the [presuppositions] of (4.18) to be true, which according to our analysis includes having adequate grounds for believing that, if the facts should turn out to be such that the antecedent clause is true, then the [presuppositions] of the consequent clause will also be true. What could those grounds be? One conceivable ground might be that the speaker knows that the

> antecendent clause is false, and knows therefore that this obligation is an empty one. This is eliminated as a possiblility, however, by the fact that the speaker of (4.18) commits himself to not knowing the antecedent clause to be false. (Karttunen and Peters (1979) pp 37–8)

I agree with this conclusion. They continue

> It follows, then, that the speaker must allow for the possibility that the antecedent clause could turn out to be true and must have adequate reasons for thinking that, if it does, then the [presuppositions] of the consequent will likewise be true. We can divide this possibility into two cases:
>
> **I** The speaker has reasons independent of what the antecedent clause says for thinking that the consequent's presuppositions are true.
>
> **II** The speaker knows enough about facts attending the particular occasion of utterance to be morally certain that, for the various ways in which the antecedent might turn out to be true (i.e., ways consistent with everything the speaker knows), all of them would also make the [presuppositions] of the consequent clause true. (p38)

They then give two examples of Case II. I maintain that both of these cases are actually arguments for $S \cup \Gamma \models \psi^P$, where Γ is the set of *extra* facts required in Cases I and II. Note that the arguments also point out that $\phi \notin \Gamma$. They continue their argument

> For many sentences, though, including Sentence (4.18), it is highly implausible that the speaker could have the kind of knowledge which Case II requires; then the only way he could be meeting his obligations in speaking is to have adequate grounds for believing the [presuppositions] of the consequent clause to be true, independent of the truth or falsity of the antecedent clause. *It is this fact which leads one to feel that (4.18) [presupposes] not the proposition expressed by (4.19), but the stronger proposition that someone else besides John drinks.* (My italics.) Thus the rule [for presuppositions] of '*if* ϕ *then* ψ' is evidently the correct one. (pp 38–9)

I continue to maintain that this argues for $S \models \psi^P$. Since every possible context of assertion has been given (I assume that these cases are exhaustive) and since Karttunen and Peters associate presuppositions with entailment, then the only conclusion that can be drawn is that

$S \models \psi^P$ contradicting their conclusion. To have a reasonable argument Karttunen and Peters would have to show a situation in which $S \models \phi^T \supset \psi^P$ and $S \not\models \psi^P$.

I will now present my third argument. Since Karttunen and Peter's complex argument is compounded by the use of imprecise terms (for example, *having adequate grounds to believe*) this argument uses analogical reasoning to show that their conclusions are inappropriate. Given any indicative conditional sentence, (4.20) for example, what conclusions can be reached using Karttunen and Peters' reasoning about presuppositions?

If it rains I will need my umbrella.[12] (4.20)

The reasoning would proceed as follows: What commitments does a speaker make by asserting this indicative conditional? One of those commitments is to have adequate grounds for believing the sentence to be true which according to any reasonable analysis includes having adequate grounds for believing that, if the facts should turn out to be such that the antecedent clause is true then the consequent clause will also be true. Going through the three subarguments would provide the conclusion that '*I will need my umbrella.*' But this conclusion is false.

A somewhat glib, but reasonably accurate rendition of Karttunen and Peters' arguments is the following: The truth of a conditional sentence can be guaranteed if both clauses are false or both clauses are true. Since the first choice is inappropriate for the truth of a conditional in natural language then this leaves the only conclusion that the consequent must be true. They make two errors: First they confuse truth with the speaker's knowledge (the first choice is inappropriate *only if the speaker knows that these are the truth conditions* — actually both choices are inappropriate if they represent the speaker's knowledge). Second these two choices are sufficient but not necessary conditions for the truth of a conditional statement. They have argued on the premise that there are only three situations that can guarantee the truth of $\phi^T \supset \psi^P$. Since their argument essentially refutes each of the three situations, their conclusion depends crucially on this premise. But there is a fourth situation which they haven't considered. The truth of a conditional can be guaranteed by guaranteeing the truth of the consequent whenever the antecedent is true. Hence their argument is unsound.

I have been very detailed in my arguments since Soames in section 4.4.1 has used this exact same technique to cancel presuppositions in certain situations not covered by Gazdar's filtering

[12]It is important to note that Karttunen and Peters use $\phi^T \supset \psi^T$ as the representation for '*if ϕ then ψ*'. So this sentence has the same logical form as the presupposition generated from the consequent of an indicative conditional.

rules. So, since Karttunen and Peters' rule for filters has been refuted, Soames' system is now without methodological foundations.

4.2 Gazdar

Gazdar's system for determining the presuppositions of a natural language sentence provides some important concepts for the theory of presuppositions. A major contribution is the inclusion of conversational implicatures into the projection rule paradigm. Basically, Gazdar's system is composed of the following three parts.

1. A set of presupposition-bearing functions which, when applied to a sentence, generate all the presuppositions of all the presuppositional environments contained in the sentence.

2. A trivial projection rule projects all of the presuppositions generated in item 1 as *potential presuppositions* of the sentence.

3. A filter, based on the maxims of conversation, can delete some of the potential presuppositions. This deletion is sanctioned because the conversational rules suggest that the speaker is not committed to the truth of the deleted potential presupposition.

A major contribution of Gazdar's theory is his notion of the conversational context and the role the utterance plays in incrementing it. An utterance increments the context with its complete meaning (the sentence itself, plus all of its implicatures and presuppositions) providing a new context in which the next utterance is interpreted. By defining this contextual incrementation in a particular way, Gazdar incorporates the filter mentioned in item (3) above as part of this process. Since this is the main part of his theory, I now turn to its description.

The context in Gazdar's sense is a set of consistent propositions. And in the usual tradition a proposition represents the (possibly) infinite set of possible worlds in which it is true. A set of propositions, X, is consistent if $\cap X$ is not empty. The incrementation of this context is done in a way which not only preserves consistency, but does so in a conservative fashion. No member of a set of two or more mutually inconsistent propositions is allowed to increment the context. This concept is precisely captured in the definition of 'the satisfiable incrementation of a consistent set X of propositions by a set Y of propositions', denoted $X \cup! Y$. The definition is shown in (4.21). The notation 'con(A)' means the set A is consistent.

$$X \cup! Y = X \cup \{y \in Y : \forall Z \subset (X \cup Y).\mathrm{con}(Z) \supset \mathrm{con}(Z \cup \{y\})\} \tag{4.21}$$

So the satisfiable incrementation of X by Y is that set consisting of all of X plus only those elements of Y which can in no way make any subset of $X \cup Y$ inconsistent. One consequence of this definition is to exclude two elements of Y, the propositions Q and R say, which are mutually inconsistent or which lead to the condition that some entailment of $X \cup Q$ is inconsistent with some entailment of $X \cup R$.

This definition of satisfiable incrementation is then used to define Gazdar's notion of context incrementation. Given the notation shown in (4.22), and that $[a]$ means the proposition a, the definition of the new incremented context, C', is shown in 4.23).

$$\begin{aligned} f_c(q) &= \text{set of potential clausal implicatures of } q \\ f_s(q) &= \text{set of potential scalar implicatures of } q \\ f_p(q) &= \text{set of potential presuppositions of } q \end{aligned} \tag{4.22}$$

$$C' = (((C \cup [\mathsf{K}_S q]) \cup ! f_c(q)) \cup ! f_s(q)) \cup ! f_p(q) \tag{4.23}$$

In otherwords the new context C' is the old context C plus the proposition that the speaker knows that which he has just asserted, plus those potential clausal implicatures which satisfiably increment this new set, plus those potential scalar implicatures which satisfiably increment this newer set, plus those potential presuppositions which satisfiably increment this last set. The set of potential presuppositions is just the set of all propositions generated from all the presuppositional environments contained in the sentence using the appropriate presupposition generating functions. Satisfiable incrementation is discussed more fully in the examples, below.

Using the definition of the new context, Gazdar defines the presuppositions of a sentence as the intersection of the new context and the set of potential presuppositions. What this is basically saying is that the presuppositions of a sentence are those potential presuppositions which pass through the filter. In section 4.2.1 I will discuss the problem that this definition causes. The most serious problem is that a potential presupposition will be considered as a presupposition even if it is entailed by the sentence. Duly mentioned by Gazdar, the order of context incrementation shown above is not supported by any evidence other than that it works. This one feature has been the most criticized aspect of his theory. I will discuss these problems more fully and provide a summary of the counterexamples to this method in the following sections, but now I will turn to some examples to show how Gazdar's system works.

The more interesting sentences with which Gazdar's theory can deal are ones which contain the filters, '*or*' and '*if ... then ...*'. I will give examples only from this category since these

are the sentences that give any projection method the most problems. Gazdar (1979) contains many other examples.

Example 1

(4.24) is an example of a disjunctive sentence which receives all of the potential presuppositions from both of the disjunctive clauses. $\mathbf{A}^{\mathrm{P}}$ and $\mathbf{B}^{\mathrm{P}}$ designate the potential presuppositions from the first and second clauses, respectively. It can be assumed that this sentence has been uttered in a context which does not contain information which would cancel either $\mathbf{A}^{\mathrm{P}}$ or $\mathbf{B}^{\mathrm{P}}$; otherwise, this sentence would be inappropriate for that context (the offending clause would be known by the speaker to be false hence could be removed, hence the conversational maxims would enforce the removal). No implicatures exist which block either presupposition and the presuppositions are not conflicting. Hence the sentence presupposes both potential presuppositions. I have shown this as the conjunction, P.

S: Jack stopped beating the rug or Mary stopped beating the egg.

$\mathbf{A}^{\mathrm{P}}$: Jack has been beating the rug.

$\mathbf{B}^{\mathrm{P}}$: Mary has been beating the egg. (4.24)

P: Jack has been beating the rug and Mary has been beating the egg.

Example 2

(4.25) is an example of a disjunctive sentence which receives only the non–conflicting potential presuppositions from the disjunctive clauses. Since the purpose of this example is to demonstrate how Gazdar's theory copes with conflicting potential presuppositions none of the surviving ones are shown (for example, '*My teacher exists.*' and '*My teacher is an adult.*' are projected as presuppositions of the sentence).

S: My teacher is a bachelor or a spinster.[13]

$\mathbf{A}^{\mathrm{P}}$: My teacher is male.

$\mathbf{B}^{\mathrm{P}}$: My teacher is female. (4.25)

P: *My teacher is male.

P: *My teacher is female.

P: *My teacher is male and female.

The explanation for cancelling the two potential presuppositions, denoted $\mathbf{A}^{\mathrm{P}}$ and $\mathbf{B}^{\mathrm{P}}$, is as follows.[14] Let C^* be the old context satisfiably incremented with the appropriate implicatures. Now it is time to satisfiably increment C^* with the two potential presuppositions $\mathbf{A}^{\mathrm{P}}$ and $\mathbf{B}^{\mathrm{P}}$. (The other potential presuppositions would also be used in this operation but I am not interested in them here. That they actually do become part of the new context can be corroborated using similar arguments.) The definition given in (4.21) states that all subsets of the potentially enlarged context must be consistent and that any new elements that "cause" a subset to be inconsistent are not part of the new context. I will assume that the old context, C, contains (4.26). The potential new context is $C^* \cup \{MALE(t), FEMALE(t)\}$, where t represents '*my teacher*'. I will call this set, $C^\dagger$. Now there exists a consistent subset of $C^\dagger$, namely $\{(4.26)^{15}, MALE(t)\}$ which becomes inconsistent when one of the potential presuppositions, namely $FEMALE(t)$, is added. Hence, $FEMALE(t)$ is not a member of the new context. Similarly, because $MALE(t)$ makes the consistent subset$\{(4.26), FEMALE(t)\}$ inconsistent, $MALE(t)$ is not a member of the new context. Since neither of $MALE(t)$ and $FEMALE(t)$ are members of the new context, neither are presuppositions of the sentence.

$$\forall x MALE(x) \supset \neg FEMALE(x) \tag{4.26}$$

Example 3

This example demonstrates the use of conversational implicatures to cancel a potential presupposition. Cancellation, of course, is accomplished by not allowing the potential presupposition's membership in the new context. Here I need to be more precise than was required in the previous two examples.

Gazdar's theory stipulates that the speaker is responsible for knowing that the presuppositions of the sentence used in the utterance are true. This concept is represented in the following

[13]This sentence is to be interpreted as having an underlying structure that is equivalent to

My teacher is a bachelor or my teacher is a spinster.

[14]This is an informal discussion based on the definition of satisfiable incrementation. The discussion given in Gazdar (1979) contains more formal derivations for some examples.

[15]I am using the equation number here to refer to the statement itself.

way: if $S \gg P$ then if a speaker utters S he knows P, denoted $\mathsf{K}_S P$[16] In the previous two examples I did not need to be concerned about the modal operators because the style of incrementation that was shown is blind to whether the statements are first order or modal. In the case of conversational implicatures, Gazdar's theory proposes that in an indicative conditional of the form '*If A then B*' four clausal implicatures are generated: $\mathsf{P}_S A$, $\mathsf{P}_S \neg A$, $\mathsf{P}_S B$, and $\mathsf{P}_S \neg B$. Suppose the speaker utters sentence (4.27). The four potential implicatures P_S*John is married*[17], $\mathsf{P}_S \neg$*John is married*, P_S*John's wife is no longer living with him*, and $\mathsf{P}_S \neg$*John's wife is no longer living with him* are generated, and the potential presupposition K_S*John has a wife* is generated from the possessive found in the consequent clause. The context is now satisfiably incremented with these modal propositions in the manner specified by definition (4.21). I will assume for purposes of this example that all four of the potential implicatures satisfiably increment the context. Next is that part of the definition of context incrementation in which the potential presuppositions attempt to satisfiably increment the set of propositions, which I will call C^*. In this case C^* is now composed of the original context, the proposition representing (4.27), and the four implicatures. There exists a consistent subset of C^*, namely $\{\mathsf{P}_S \neg \textit{John is married}, \forall x \textit{MARRIED}(x) \supset \textit{HAS-WIFE}(x)\}$, which becomes inconsistent when K_S*John has a wife* is added to it.[18] Hence, the proposition '*John has a wife.*' is not found in the new context, so it is not a presupposition of the sentence.

S: If John is married then his wife is no longer living with him.

P: *John has a wife. (4.27)

4.2.1 Empirical Counterexamples

The empirical counterexamples that have been previously published fall into three main categories distinguished by the following symptoms:

1. Statements are mislabelled as presuppositions if they can also be inferred from the sentence as entailments.

[16] Although Gazdar uses the notation K and P, I will remain consistent with the notation introduced earlier, that is, K_S and P_S. The interpretation that he gives his symbols is the same as that I have given mine.

[17] I am leaving the propositions in their sentence form.

[18] The modal identity

$$\mathsf{P}_S \neg \textit{John is married} \equiv \neg \mathsf{K}_S \textit{John is married}$$

is used to derive the inconsistency.

2. Potential presuppositions are not cancelled because the conversational implicatures that are present in the sentence are not strong enough to contradict them.

3. Potential presuppositions generated from *'if... then...'* sentences that contain sentential adverbs, for example *too* and *again*, are not cancelled.[19]

Items 1 and 2 are discussed below in sections 4.2.1.1 and 4.2.1.2, respectively. Because I believe that item 3 is not just a problem specific to Gazdar but rather is a problem for all projection methods, discussion of this item is postponed until section 4.5.3. There I will discuss the problem in the context of all projection methods.

There is another problem with Gazdar's method. The completeness[20] of satisfiable incrementation which excludes *all* inconsistencies from entering the new context depends crucially on a situation in which the lexemes in the language are defined using binary features. This problem will be discussed in section 4.2.1.3.

4.2.1.1 Entailments Mislabelled as Presuppositions

These mislabellings are critical errors in any projection method. The effect of mislabelling entailments as presuppositions is noticed when the incorrectly processed sentence is embedded in an environment which projects its presuppositions but which does not project its entailments.

The example given in (4.28) is from Gunji (1982). It indicates that Gazdar's method incorrectly suggests that the sentence in question presupposes *'Jack is bald.'*. The statement, *'Jack is bald.'*, is generated as a potential presupposition from the factive verb environment found in the second conjunct. It is also entailed by the sentence since it occurs as the first conjunct. No matter what happens to the potential presupposition, that the statement *'Jack is bald'* enters the new context is assured because all entailments of the sentence uttered are in the new context.[21] The definition of presupposition of the sentence states that the presuppositions

[19] I will argue later that although these are counterexamples to Gazdar's method they are counterexamples to all projection methods which generate presuppositions from presuppositional environments in a contextually insensitive manner. I have already argued at some length that other projection methods which claim to treat these examples correctly (Karttunen and Peters' and consequently Soames' because it incorporates the former method) use a method which is unsupportable.

[20] I am using the term *complete* in a sense analogous to its logical usage; that is, a presupposition generation method is complete if it generates all of the possible presuppositions from any natural language sentence.

[21] A simplifying assumption is made that no contradictory statements are uttered in the conversation.

of a sentence are those statements found in the intersection of the new context and the set of potential presuppositions. Since *'Jack is bald.'* is found in this intersection, it is a presupposition of the sentence according to Gazdar's theory.

S: Jack is bald and he regrets that he is bald.
P: *Jack is bald. (4.28)

What may appear to be only a minor problem, an entailment mislabelled as a presupposition, is really quite serious. The reason that this mislabelling is so deleterious is demonstrated by the examples found in (4.29) and (4.30). Since presuppositions from the antecedent of a conditional are projected untouched by every theory and *'It is possible that'* is either treated as a hole or does not affect the projection of subordinate presuppositions, the mislabelled presupposition that Jack is bald must be projected as a presupposition of the sentence in both examples. However, it is not the case that either sentence presupposes that Jack is bald.

If Jack is bald and he regrets that he is bald, then he will suffer from a common form of depression. (4.29)

It is possible that $_S$[Jack is bald and he regrets that he is bald]$_S$. (4.30)

4.2.1.2 Uncancelled Presuppositions

This class of counterexamples, first presented in Soames (1982), is composed of sentences that fall into two major subclasses.[22] Both subclasses consist of sentences which have potential presuppositions that are more general than any of the possible cancelling implicatures. The first subclass is composed of *if... then* sentences in which the antecedent clause which generates the implicature has a modifiying phrase that makes the implicature more specific than the potential presupposition from the consequent. The second subclass consists of *if... then* sentences with complex antecedents (or embedded *if... then* sentences which are dealt with in the same manner). Examples (4.31) and (4.34) typify the two subclasses.

In (4.31) the antecedent clause produces the clausal implicature (4.32). This implicature is not able to cancel (what Soames claims would be produced by Gazdar's potential presupposition

[22]This presentation differs from Soames. In his presentation the sentential adverbs are included in the first subclass. Because I have dealt with the sentential adverbs in a different manner, the first subclass can be narrowed down to include only the type of sentence presented here.

generating rules as) the consequent clause's potential presupposition (4.33)[23]. In section 4.5.4 I will argue that any reasonable semantic representation of these kinds of sentences must have the appropriate modifying phrase in the clause that contains the presuppositional environment.

If France has an intelligent king then the King of France is the only intelligent monarch in Europe.[24] (4.31)

$$\mathsf{P}_S \neg \exists x.KING\text{-}OF\text{-}FRANCE(x) \wedge INTELLIGENT(x) \tag{4.32}$$

$$\mathsf{K}_S \exists x.KING\text{-}OF\text{-}FRANCE(x) \tag{4.33}$$

(4.34) demonstrates what happens when the antecedent is a compound clause. Here the clausal implicature that is generated is (4.35). Again this implicature is not sufficient to cancel the potential presupposition, (4.36), that is generated from the consequent.

If the dress Mary bought is powder blue and the dress Susan bought is, too, then Mary will regret having bought a dress that is the same colour as Susan's. (4.34)

$$\mathsf{P}_S \neg \textit{Mary bought a powder blue dress} \wedge \textit{Susan bought a powder blue dress} \tag{4.35}$$

$$\mathsf{K}_S \exists x \exists y.\textit{Susan bought an } x\textit{-coloured dress} \wedge \textit{Mary bought a } y\textit{-coloured dress} \wedge x = y \tag{4.36}$$

Even if recourse to appropriate semantic representations can rescue Gazdar's method from examples like (4.31), nothing short of completely redefining potential clausal implicatures can save it from the class of sentences exemplified by this example. An attempt to remedy the inability of Gazdar's method to deal with sentences of this type has been proposed in Landman (1981). I will summarize this attempt in section 4.2.3 and give some reasons for its unacceptability.

[23]This potential presupposition is generated from a surfacey semantic representation of the sentence. Gazdar is quite vague about the potential presupposition generating rules and the potential implicature generating rules in his theory. The vagueness arises because these rules depend on the semantic representation used to represent the natural language sentences. Since it is not evident what the semantic representation of (4.31) is, it is impossible to say with certainty that Soames' claim is correct. It could be that the modifying phrase '*intelligent*' is "recoverable" in the consequent clause, thereby allowing the adequate potential implicature to be generated. Since this extra burden placed on the semantic theory seems to be against Gazdar's philosophy, I will give the benefit of the doubt to Soames.

[24]It is important that this sentence be read with no contrastive stress placed on '*intelligent*' or on '*king*' in the antecedent clause.

4.2.1.3 Non–Binary Features

This sort of counterexample has not to my knowledge been given anywhere else. In addition to being counterexamples to Gazdar's method, they also provide a set of counterexamples to Soames' method as well. Soames' two–staged method takes as input to the second stage the remaining potential presuppositions of the sentence. Since all the remaining potential presuppositions originally come from individual clauses, the presuppositions which are generated from non–binary features will not be captured since these have the form of disjunctions of the clausal presuppositions.

A simple example should suffice to show the importance of this class of counterexamples. The example is fictitious, but it demonstrates the essence of any counterexample of this type.[25] Suppose that the context that is to be incremented contains the information that is displayed in (4.37)–(4.44).

$$\forall x.HUMAN(x) \equiv WHITE(x) \vee COLOURED(x) \vee BLACK(x) \tag{4.37}$$

$$\forall x.PRINCIPAL(x) \equiv WHITE(x) \wedge CHIEF\text{-}ADMINIST'R(x) \tag{4.38}$$

$$\forall x.V\text{-}PRINC'L(x) \equiv COLOURED(x) \wedge SUB\text{-}ADMINIST'R(x) \tag{4.39}$$

$$\forall x.JANITOR(x) \equiv BLACK(x) \wedge CLEANER(x) \tag{4.40}$$

[25] I thank Jay Glicksman for suggesting the three racial groups as dictated by the apartheid policy of South Africa: whites, coloureds, and blacks. By law, some jobs are only open to whites, coloureds, or blacks. I have created some fictitious job specifications, but that should not affect the argument. The right to vote in South Africa is also determined by race. The whites vote for candidates who become members of the ruling parliament, the coloureds vote for candidates who become members in an essentially powerless parliament, and the blacks are disenfranchised. Other examples exist, as well. I thank Mitch Marcus for suggesting the following one. Lebanon has a large number of distinct religious groups (7 major ones, including the Maronites, Sunnis, and Shiites, and at least as many minor ones). The National Pact of 1943 provides that the president of Lebanon must be a Maronite; the premier, a Sunni; and the speaker of the parliament, a Shiite (Smock and Smock (1975)). Another example is the appropriate use of words like *spay* and *castrate* which require the appropriate value for the feature 'sex'. In the case of domesticated animals the feature 'sex' is non–binary with at least the values male, female, and neuter. When the word *castrate* is used in

If Farmer MacDonald did not have the white horse castrated then ...

the preferred meaning of horse ('horse' is a term which is vague regarding the feature 'sex') is stallion (male horse) rather than mare (female horse) or gelding (neutered horse (formerly male)). Further discussion of non–binary features is found in section 4.5.

$$PRINCIPAL(x) \gg WHITE(x)^{26} \tag{4.41}$$

$$V\text{-}PRINC'L(x) \gg COLOURED(x) \tag{4.42}$$

$$JANITOR(x) \gg BLACK(x) \tag{4.43}$$

$$\begin{aligned} &\forall x. WHITE(x) \supset \neg COLOURED(x) \\ &\forall x. WHITE(x) \supset \neg BLACK(x) \\ &\forall x. COLOURED(x) \supset \neg BLACK(x) \end{aligned} \tag{4.44}$$

The three other implications given by the contrapositives of the three sentences in (4.44) complete the six possible combinations among the three legal race categories.

Before continuing with this example it is important to defend the choice of the presupposition relations given by (4.41)–(4.43). The standard test for a presupposition relation is the ***negation test***, which has been previously described in Chapter 2. I will describe this test for the concept *PRINCIPAL*. Similar results occur when this test is applied to the concepts *V–PRINC'L* and *JANITOR*. If the word '*principal*' is used in a negative environment in such a way that it is given its natural or preferred interpretation, then I claim that what is negated is that part of the definition which refers directly to the kind of work that is performed by someone who is designated as a principal. So the sentence (4.45) has the preferred interpretation (4.46).

Mr. Jones is not a principal. (4.45)

$$WHITE(Jones) \wedge \neg CHIEF\text{-}ADMINIST'R(Jones) \tag{4.46}$$

Justification for this claim is similar to that given for the preferred interpretation of ***bachelor*** and ***spinster*** in Chapter 3. There I suggested that the preferred interpretation of a conjunctively defined term corresponded to a minimal change in an *IS–A* hierarchy. Likewise, here the situation would be that the races, 'white', 'coloured', and 'black', would be immediately subordinate to the concept 'human' and then below that would be the occupations in which each race can legally be employed. The usual negation would then be at the occupation level rather than at the race level.

Suppose that the sentence shown in (4.47) is uttered. What presuppositions would be generated from this sentence using Gazdar's method?

Mr. Jones is the principal or the vice–principal. (4.47)

[26] In the description of Gazdar (1979) I am not precise about the potential presupposition generating functions. Continuing this imprecision, I give only the relationship that exists between the predicates. The symbol $\gg$ should be read here as 'potentially presupposes'.

Using the same sort of analysis which worked in the bachelor–spinster example, this sentence generates the two statements found in (4.48) as potential presuppositions. Now when these two potential presuppositions are to be added to the context using the $\cup!$ operator, both of the potential presuppositions are cancelled. The reason is that they are mutually inconsistent.

$$\begin{array}{l} WHITE(Jones) \\ COLOURED(Jones) \end{array} \tag{4.48}$$

However, I claim that there is a presupposition[27], (4.49), that should be generated from this sentence.

$$WHITE(Jones) \vee COLOURED(Jones) \tag{4.49}$$

The default logic method developed in Chapter 3 is a hearer–based theory. So, if the information displayed in (4.37)–(4.44) represents the relevant *contents* of the Knowledge Base of some hearer, the default logic method will generate presuppositions which are not generated by Gazdar's method.

Actually, it could be said in the bachelor–spinster case as well that the disjunction of the inconsistent potential presuppositions is generated. In this case it is just a tautology. But in the case shown above the disjunction is not a tautology because the features in question do not cover the whole set of possible humans.

The question still remains — could there be an easy modification to Gazdar's method to allow this sort of presupposition. The answer is possibly, but the projection method would have to be abandoned, and the elegance of his method would be destroyed.

4.2.2 Methodological Problems

A close examination of the default theory presented in Chapter 3 should indicate that I have been greatly influenced by Gazdar's work. I believe that the major deficiency in Gazdar's theory is that conjunctions and disjunctions (in the underlying logical representation) are treated in

[27] I am using the term 'presupposition' in its projection method sense. (In Gazdar's theory it is entailed as well as being presupposed.) In the default logic method (4.47) entails (4.49). In the default logic sense it would be more precise to say (4.47) when embedded in an appropriate subordinate context presupposes the presupposition (4.49). An example of being embedded in an appropriate subordinate context is

> If Mr. Jones is the principal or the vice–principal of Little Lord Fauntleroy School I will send my children there.

the same way by the projection method. I believe that Soames (1982) has also realized this deficiency but views the problem differently and has proposed a different solution (see section 4.4). However, the basic idea that presuppositions should be based on consistency remains germane to my theory as is exemplified in the use of defaults.

Gazdar (1979) points out one serious reservation with the projection method that is presented there. The ordering of context incrementation given by definition (4.23) has no defendable basis. It turns out that this is probably the most criticized point (Gunji (1982) and Soames (1982)). These problems do not occur in the default logic method that I have presented because ordering of a derivation is dictated only by the rules of the proof theory. So, the derivation of presuppositions can take place only after the derivation of the implicatures.

Gazdar's method depends crucially on the use of the modal operators, K_S and P_S. The theory demands that the speaker have a consistent knowledge base (which for purposes of this discussion would be an S4 theory), and in order to accomplish this consistency, potential inferences that the hearer can generate from the utterance are cancelled in a precisely defined manner. However, if the method incorporates a more plausible set of sentential operators, namely '*the speaker believes that*' and '*it is consistent with the beliefs of the speaker that*', then the cancellation method fails because the speaker is allowed to have inconsistent beliefs. Considering consistent belief spaces might circumvent this problem. Default logic provides logical tools to manipulate consistent beliefs. However, I have not attempted to break completely with the K_S–P_S approach.

Gazdar's method does not allow presuppositions to be cancelled by knowledge added to the context by later utterances. (4.50), an example from Gunji (1982), demonstrates that this process is required. The first sentence in (4.50) presupposes that Jack is bald, and Gazdar's method correctly adds it to the context. However, in the last sentence of (4.50) Jack's baldness is denied. Gazdar's method has no ability to remove information from the context, it only allows additions.

Jack doesn't regret being bald. I can show that quite easily. Look at the man in the corner. He is Jack, though it's a bit too dark to see him clearly. But look at him carefully. Now you know what I mean. He isn't bald; he only regrets being gray–haired. (4.50)

Disallowing removal of statements from the context seems a reasonable simplification for non–cancelable statements, but as (4.50) demonstrates, presuppositions can remain cancelable for

some time after being added to the context.

4.2.3 Landman's Proposal

Landman (1981) makes a simple modification to the definition of clausal implicature given in Gazdar (1979). The new definition generates not only $\mathsf{P}_S\psi$ and $\mathsf{P}_S\neg\psi$ from every non–entailed clause ψ found in the sentence, but also $\mathsf{P}_S\xi$ and $\mathsf{P}_S\neg\xi$ for every entailment, ξ, of the ψ's.

With this modification Landman claims two gains. The first improvement is that the sentences containing sentential adverbs, proposed by Soames as counterexamples to Gazdar's theory, are no longer counterexamples in this revised theory. Recalling the discussion in section 4.2.1.2, we note that the reason that the unwanted potential presupposition remains uncancelled is that the relevant clausal implicature is too weak to cancel it. However, if $\psi \models \xi$, then the relevant implicature becomes $\mathsf{P}_S\neg\xi$ which is stronger than $\mathsf{P}_S\neg\psi$ which is available in the original theory. In the case of the sentential adverb counterexamples there is a ξ which gives a sufficiently strong implicature to cancel the potential presupposition. The second gain that Landman's modification provides is that Gazdar's modified theory would formalize Soames' principle that a speaker who utters a truth–functional compound, question, or epistemic modal indicates that he is presupposing all of the presuppositions of its constituents, unless he conversationally implicates (or explicitly states) otherwise (Soames (1979)). This formalization is not forthcoming from Gazdar's original theory because there are occasions in which conflicting potential presuppositions cancel each other. By including the stronger clausal implicatures generated in Landman's modified theory, the conflicting potential presuppositions are cancelled by clausal implicatures. The part of definition (4.23) dealing with the potential presuppositions can be weakened to correspond to Soames' notion.

These claims by Landman are weakened somewhat by two issues. Firstly, there are counterclaims that Landman's modifications do not produce a reasonable theory, and secondly, the default logic approach gives some indication that any definition which incorporates the notion of projecting presuppositions from subordinate structures (Soames' definition is an exemplar) is based on an illusion which should not be modelled in a theory of natural language presuppositions. I have discussed the second point elsewhere, so I will briefly discuss only the first issue below.

What seems to be a simple, yet powerful, modification to Gazdar's theory flounders on a

number of problems. Soames (1982) argues against the proposal on four[28] grounds.

1. The new method produces a number of nonexistent clausal implicatures.

2. Landman's method, like Gazdar's, does not use the form of the sentence to generate potential presuppositions, and is subject to similar counterexamples.

3. There are examples for which Landman's proposal fails to cancel the unwanted potential presupposition. Soames (1982) gives (4.51) as a sentence for which the new procedure cannot derive the correct presuppositions.

   If the dress Mary bought is powder blue, then if the dress Susan bought is also powder blue, Mary will regret having bought a dress that is the same colour as Susan's. (4.51)

   The reasons are that no clause exists in (4.51) that can provide the necessary implicature, (4.52), to cancel the potential presupposition that occurs in the consequent clause.

   $P_S \neg$Mary bought a dress that is the same colour as Susan's. (4.52)

4. The new method eliminates genuine presuppositions.

Landman attempts to overcome the deficiencies in Gazdar's method by increasing the strength of the cancellation devices. Interestingly, Soames' putative solution similarly attempts to repair a Gazdar–like method by increasing the method's cancellation abilities — but in a much different way. Details are given in section 4.4. In marked contrast to both Landman and Soames, the default logic approach does not propose a stronger cancellation method that is better able to cancel over–produced potential presuppositions. Rather its production of presuppositions is more conservative. The constraints on production are more context–dependent than a Gazdar–like method.

4.3 Gunji

The important contribution that Gunji (1982) makes is to propose a general computational model for pragmatics from which (is claimed) a natural explanation emerges for presuppositions, implicatures, and anaphora. The main thrust of his idea is to augment the normal model theoretic semantics with a computational component to produce a *computational model–theoretic*

[28]Soames (1982) gives five arguments but the first and last talk about the same problem.

pragmatics. This model theory is heavily influenced by the Gricean methodology: classical model theory is sufficient to explain the semantic aspects of a natural language utterance, and is to be augmented with extra pragmatic components that add those parts of the meaning of the utterance that are associated with *what is implicated* by the utterance.

To capture the notion of pragmatics in this special brand of model theory, good use is made of some computer analogies: sequential execution, databases, and computational side effects. Sequential execution provides a natural method to handle ordering in natural language sentences. Databases are the underlying foundation for his Universe of Discourse (UD). And semantic components of the system, which can only examine the UD's, are distinguished from the pragmatic components, whose execution generates side effects in the UD's by adding, deleting, or modifying information.

The method proposed in Gunji (1982) relies heavily on his method of evaluating sentences in his language, called Extended Intensional Lisp (EIL). EIL is a logical programming language used as an intermediate language between English and the set of denotations. The use of an intermediate language is done to simplify the semantic rules which map natural language to semantic meaning. The parser which translates the natural language sentence into the intermediate language sentence is not described in Gunji (1982).

The system described in Gunji (1982) is not proof–theoretic; rather it computes denotations of natural language sentences. In the case of indicatives the denotation is the truth value of the sentence in a model. Because this approach is used, a basic component of the system must be the model, or simply 'a view of the world'. What is actually implemented is a partial model which is called the Universe of Discourse (UD). Gunji states that this component is similar to *assumed facts* (Karttunen (1973)), *common background* (Stalnaker (1974)), *linguistic context* (Karttunen (1974)), *common or mutual knowledge* (Lewis (1975)), *Pragmatic Universe of Discourse* (Kempson (1975)), *common ground* (Karttunen and Peters (1979)), and *contextual domain* (McCawley (1979)). Because the model is partial, V[Φ] for any Φ whose denotation is a truth value can be any of **T**(rue), **F**(alse), or **U**(ndefined). Another feature of the UD is its hierarchical structure. Gunji acknowledges the contribution of McCawley (1979) to this structure. Each natural language sentence in a conversation adds a layer to the UD–structure and may affect lower levels in the hierarchy. Although this feature is crucial in the proposed method for anaphora resolution, it is not of direct importance to the following discussion.[29]

[29]It does help out indirectly with presuppositions found in structures that include indefinite noun phrases. I

Information in the UD's can be categorized using a degree of cancelability scale: *nc–info* is noncancelable information, such as stated facts and inferences like conventional implicatures; *c–info* is cancelable information such as presuppositions and conversational implicatures; and *a–info* is transitory information (like Gazdar's pre–suppositions and im–plicatures) which exists only during the evaluation of the sentence. Depending on its context, a–info is processed in one of two possible ways. If it is in the scope of a cancellability–inducing operator (such as '*not*') then one of the following three actions are taken: the a–info is absorbed because it already exists in the UD, or it is aborted because it conflicts with something in the UD, or if neither of these conditions hold it is created as c–info (the formation of a presupposition). If a–info remains after the evaluation of the sentence concludes (it is not subordinate to a cancellability–inducing operator) then the super–interpreter deals with it in the following manner. The a–info is compared to the information in the UD. If it is contradictory, the utterer is notified. If it is repeated, the a–info is deleted (absorption). If neither of these conditions hold, the a–info is changed to nc–info (creation).

Gunji (1982) contains a complete description of the syntax and semantics of EIL. I will only point out the more important features in this discussion. Firstly, EIL is a higher order intensional quantificational language with modal and tense operators. Therefore the evaluation function, $\mathcal{V}$, evaluates the EIL constant or variable with respect to a world, w, a time, t, a variable assignment function, f, in a particular UD_i. This UD_i may have been modified by pragmatic PREC procedures before the evaluation by $\mathcal{V}$. This and other pragmatic issues are discussed in more detail later. The interpreter which embodies $\mathcal{V}$ computes the semantic evaluation of a sentence as follows: To evaluate a proposition p in world w at time t with the variable assignment function f, the EIL super–interpreter invokes the EIL interpreter to evaluate the proposition according to the semantic definition of the EIL constants. Since a proposition is defined recursively this evaluation is a recursive one. (4.53) shows the definition

have left this as an open problem in the default logic approach.

of the EIL constant AND.

If p and q are formulae, then

$$\begin{aligned}\mathcal{V}[(\text{AND } p\ q), w, t, f, n, i] \stackrel{\text{def}}{=} \{&val = \mathcal{V}[p, w, t, f, n, i];\\ &\text{if } (val)\ \mathcal{V}[q, w, t, f, n, i];\\ &\text{else if } (\neg val)\ \mathbf{F};\\ &\text{else if } (\neg \mathcal{V}[q, w, t, f, n, i])\ \mathbf{F};\\ &\text{else } \mathbf{U}\}\end{aligned} \tag{4.53}$$

The recursive evaluation is grounded upon reaching an EIL constant corresponding to a real world concept, BACHELOR, say. The meanings of these constants, referred to as DEN procedures, are given as functions that search UD_i to see if the individual in question is a member of the true list or the false list associated with the concept. In the case of (BACHELOR John) this search may require the search of the lists associated with MALE, ADULT, and MARRIED.[30] The interpreter is invoked by the super–interpreter to search UD_i for all i, $0 \leq i \leq n$, or until a **T** or an **F** is returned. For (BACHELOR John) the EIL interpreter returns a **T** if John is on the true list of BACHELOR in UD_i, **F** if John is on the false list of BACHELOR in UD_i, and **U** if John is on neither list. As soon as the interpreter returns a **T** or an **F**, the super–interpreter stops the evaluation with the proposition p having the appropriate denotation, **T** or **F**. If the value **U** is returned by the interpreter for all i, $0 \leq i \leq n$, then the truth value for p is **U**.

Secondly, EIL has a compositional semantics but not in the same sense as a classical logic. The evaluation function needs to evaluate only as much of the sentence as is required to ascertain its denotation. Thus all parts of the expression need not be evaluated. (4.54) provides an example of this left–to–right suspendable evaluation. Given the definition of AND in (4.53) and a UD which contains the fact that (P X) is false then (4.54) is evaluated without having to evaluate (Q X). This lazy–evaluation has no effect on the semantic meaning of the natural language sentence. However, it has important repercussions for the pragmatic meaning.

(AND (P X) (Q X)) (4.54)

All of the real world concepts are captured as lexical items in the EIL lexicon. Each lexical item has three procedures associated with it. The DEN procedure which has been

[30]This reference to what appears to be an equivalence between the concepts 'BACHELOR' and 'MALE, ADULT, and MARRIED' is the most that Gunji mentions about inferencing in his method. The extent of the inferencing capabilities is not discussed.

described above provides the semantic meaning of the lexical item which is used compositionally to form the semantic meaning of the sentence. The other two procedures, the PREC and POSTC procedures modify the UD and these modifications are to be interpreted as conventional implicatures, presuppositions, and conversational implicatures depending on the feature vector associated with the piece of information. For example, presuppositions have the feature vector [−said, +conventional, +cancelable]. The evaluation function for EIL constants is given in (4.55). It indicates the order of execution of the three procedures.

If p is a function of m arguments and $q_1 \ldots, q_m$ are values of the appropriate type for p, then

$$
\begin{aligned}
\mathcal{V}[(p\ q_1 \ldots q_m), w, t, f, n, i] \stackrel{\text{def}}{=} \{ & g = \mathcal{V}[p, w, t, f, n, i]; \\
& \text{if } (g \text{ is defined}) \\
& \quad \left.\begin{array}{l} d_1 = \mathcal{V}[q_1, w, t, f, n, i]; \\ \quad\vdots \\ d_m = \mathcal{V}[q_m, w, t, f, n, i]; \end{array}\right\} (\dagger) \\
& \quad \left.\begin{array}{l} \text{PREC}(p)(d_1, \ldots, d_m) \\ val = g(d_1, \ldots, d_m) \\ \text{POSTC}(p)(d_1, \ldots, d_m) \\ \text{return } (val) \end{array}\right\} (\ddagger) \\
& \text{else U}\}
\end{aligned}
\tag{4.55}
$$

Definition (4.55) means: g is the valuation of p in world w, at time t, using variable assignment function f, in UD_i. g, which is a λ–function, has been referred to earlier as the DEN procedure. The part of the definition which is labelled (†) is the evaluation of the constants. The denotations of these constants are objects in the domain, that is individuals or intensions. Next, in the part labelled (‡) the PREC procedure is performed (possibly modifying the UD–structure), the DEN procedure is applied to the domain elements $d_1, \ldots, d_m$ (this computes the value of $(p\ q_1 \ldots q_m)$ in world w, at time t, with variable assignment function f, in the possibly modified UD_i, and the POSTC procedure is performed in that order. The value of $(p\ q_1 \ldots q_m)$ or U is returned.

Other pragmatic aspects are performed by a super–interpreter after the compositional semantic interpretation has been accomplished. The actions of the super–interpreter depend on the truth value of the statement and the mood of the sentence (indicative, interrogative, or imperative). For instance, if the mood of the sentence is indicative, the super–interpreter interrupts the interpretation process if contradictory nc–info is about to be added to the UD.

Another task is to convert any remaining a–info into nc–info (the creation of *conventional implicatures*) and to add it to the UD. A precise description of how the super–interpreter operates is not important here. However it is noteworthy that it is firmly based on Lewis's (1975) *convention of truthfulness and trust* and Grice's Cooperative Principle. Gunji discusses his method's useful applications to problems of definite noun phrase referencing, anaphora resolution, tense, and modalities of necessity and possibility. The areas of interest to the present task are presuppositions and implicatures. Problems with capturing these two areas are discussed further in section 4.3.1. To assist with the discussion of the problems that Gunji (1982) encounters, three examples are provided: a PREC procedure of a factive verb, a POSTC procedure of a cancellability–inducing operator, and the operation of Gunji's method.

Factive verbs, such as *regret*, are represented in EIL as predicates, REGRET[31] in this case, that take two arguments, a person, corresponding to the subject of the verb, and an intension which corresponds to the complement of the verb. The EIL representation for (4.56) is shown in (4.57).

Jack regrets being bald. (4.56)

(REGRET J (INT (BALD J))) (4.57)

The PREC procedures for factive verbs produce the extension of the second argument of the EIL representation of the factive verb. So in the case of (4.57) the effect of the PREC procedure would be to produce (BALD J). This information is added to the UD, (J is put on the true–list of BALD) with an a–info marker attached which means that this information is abortable.

One lexical category that is very important in Gunji's method is the set of cancellability–inducing operators which includes negation, verbs of propositional attitude (for example, *suspect, think*), and verbs of saying (for example, *say, claim*).[32] POSTC procedures of cancellability–inducing operators perform the following tasks. If a piece of a–info produced by PREC procedures of presupposition–generating EIL terms is contradictory to the model (that is, there exists some nc–info which contradicts the a–info) then the a–info is deleted. This procedure is called *abortion*. If the a–info is repeated by some nc–info in the model then the a–info is

[31] The terms of the EIL language have not been italicized to differentiate them from the terms of the first order language used elsewhere.

[32] Although it's not made explicit, the cancellability–inducing operators seem to coincide with Karttunen's plugs.

deleted, but in this case the process is termed *absorption*. If the a–info is not affected by either of the other two procedures, then the a–info marker is modified to become a c–info marker. This procedure is called *creation*.[33]

With the appropriate use of PREC and POSTC procedures and the super–interpreter, Gunji claims that the EIL system captures a computational model of presuppositions and conventional implicatures. I defer my disagreement to sections 4.3.1 and 4.3.2. Here however, I reproduce an example from Gunji (1982) to demonstrate the utility of the EIL system.

The presuppositions of (4.58) are computed in the following manner. The EIL interpreter attempts to evaluate the outer most EIL term in (4.59), the EIL representation for (4.58). This term is 'NOT'. In order to evaluate this term, the EIL interpreter must evaluate the inner term, which is the REGRET predicate with its two arguments. Before the evaluation of the REGRET predicate takes place, the PREC procedure for REGRET produces (BALD J) as a–info.[34] Assuming for purposes of this example that there is no contradictory nc–info in the UD, this a–info is modified to become c–info by the POSTC procedure of the cancelability–inducing operator, NOT. Since c–info results from the evaluation of (4.59), this c–info is called the presupposition of (4.58).

Jack doesn't regret being bald. (4.58)

(NOT (REGRET J (INT (BALD J)))) (4.59)

(4.61) is evaluated in the following manner. The production of (BALD J) as c–info is performed in the manner described in the previous paragraph. The second EIL representation in (4.61) is evaluated and results in (NOT (BALD J)) being entered into the UD as nc–info (it is a statement of fact). Since the new nc–info contradicts c–info that already exists in the UD, the c–info is deleted by a process called cancellation.

Jack doesn't regret being bald, in fact he isn't bald. (4.60)

[33]Two other processes are involved in the complete specification of the EIL system, *cancellation* and *consolidation*. The first removes c–info if contradictory nc–info enters the model later. The second removes c–info if confirming nc–info enters the model later. Gunji gives no details for either of these processes.

[34]The evaluation of REGRET is done by the DEN procedure. This evaluation consists of looking in the appropriate data structure to see if J is in the REGRET relation with the fact that he is bald.

(NOT (REGRET J (INT (BALD J))))
(NOT (BALD J))[35] (4.61)

In summary, the pragmatic meaning is viewed as the side–effects in the UD caused by the execution of the super–interpreter, and the PREC and POSTC procedures of various lexical items. Interaction between the compositional semantic interpretation and the pragmatic aspects of meaning is a by–product of the lazy–evaluation procedure. If parts of the sentence are not evaluated, any side–effects that would have been produced by evaluating these portions of the sentence will not be realized.

4.3.1 Empirical Counterexamples

Even though Gunji's suggested model for pragmatics seems promising — the computational approach is well–motivated, and many of the elements necessary for a pragmatic theory are included — claims that the theory adequately captures the pragmatic notions of presuppositions and implicatures are not justified. Before giving my reasons for this critical statement I should reiterate that his other goals of anaphora resolution and definite noun phrase reference assignment may be captured by his theory. It is outside the scope of this thesis to make any comment about these issues.

Gunji makes two claims about his method: that the sequential processing of natural language sentences espoused by his method captures Karttunen's filters as corollaries, and that his method does not have the difficulties displayed in his analysis of Gazdar's method. Below, I reject the first claim outright, and suggest that the second is without value. Even though the argument given to diminish the importance of the second claim contains evidence of an inherent weakness in Gunji's method, and the discussion in the previous section points out problems with Karttunen's filters, I will also discuss Gunji's first claim since it by itself would have theoretical interest (an explanation of Karttunen's filters based on EIL could motivate improving EIL) if it were a valid claim. Like most theories, the major problem is Gunji's attempt to deal with the sentential connectives, 'or', and 'if ... then ...'. These connectives are translated into the EIL constants OR and IMP, respectively. I will use these EIL terms in the remainder of this section.

Claim 1. Gunji claims that Karttunen's filters for 'AND', 'OR', and 'IMP' are natural

[35] For some reason Gunji treats (4.60) as two sentences. This treatment has no undesirable consequences.

consequences of a single unified EIL evaluation process for these statements. Gunji further claims that this desirable property makes the filters corollaries of the semantics of EIL not independently motivated pragmatic rules. It is further argued that the sequential evaluation of EIL provides an explanation for the filtering rules.

Gunji gives the cases outlined below and proceeds to explain how his system works. I will use Gunji's examples so that the quoted passages from his report will match with the examples. The examples are 7.6(a)–(b) renumbered as (4.62), 7.6(c)–(f) renumbered as (4.63), 7.9(a)–(d) renumbered as (4.64) and 7.10(a)–(d) renumbered as (4.65) (from pp 75–77). I have used the appropriate renumberings in the quoted passages.

(a) Jack doesn't regret being bald.

(b) Jack regrets being bald. (4.62)

(a) Baldness is hereditary and Jack doesn't regret being bald.

(b) Baldness is hereditary and Jack regrets being bald.

(c) Jack is bald and he doesn't regret it. (4.63)

(d) Jack is bald and he regrets it.

(a) Either baldness isn't hereditary or Jack doesn't regret being bald.

(b) Either baldness isn't hereditary or Jack regrets being bald.

(c) Either Jack isn't bald or he doesn't regret it. (4.64)

(d) Either Jack isn't bald or he regrets it.

(a) If baldness is hereditary, then Jack doesn't regret being bald.

(b) If baldness is hereditary, then Jack regrets being bald.

(c) If Jack is bald, then he doesn't regret it. (4.65)

(d) If Jack is bald, then he regrets it.

The three semantic definitions given for AND, OR, and IMP, given in Gunji (p15) as 2.4(k)–

(m) respectively, are also needed here and are renumbered as (4.66)–(4.68).

If p and q are formulae, then

$$\begin{aligned}\mathcal{V}[(\text{AND } p\ q), w, t, f, n, i] \stackrel{\text{def}}{=} \{&val = \mathcal{V}[p, w, t, f, n, i];\\ &\text{if } (val)\ \mathcal{V}[q, w, t, f, n, i];\\ &\text{else if } (\neg val)\ \mathbf{F};\\ &\text{else if } (\neg\mathcal{V}[q, w, t, f, n, i])\ \mathbf{F};\\ &\text{else } \mathbf{U}\}\end{aligned} \tag{4.66}$$

If p and q are formulae, then

$$\begin{aligned}\mathcal{V}[(\text{OR } p\ q), w, t, f, n, i] \stackrel{\text{def}}{=} \{&val = \mathcal{V}[p, w, t, f, n, i];\\ &\text{if } (val)\ \mathbf{T};\\ &\text{else if } (\neg val)\ \mathcal{V}[q, w, t, f, n, i];\\ &\text{else if } (\mathcal{V}[q, w, t, f, n, i])\ \mathbf{T};\\ &\text{else } \mathbf{U}\}\end{aligned} \tag{4.67}$$

If p and q are formulae, then

$$\begin{aligned}\mathcal{V}[(\text{IMP } p\ q), w, t, f, n, i] \stackrel{\text{def}}{=} \{&val = \mathcal{V}[p, w, t, f, n, i];\\ &\text{if } (val)\ \mathcal{V}[q, w, t, f, n, i];\\ &\text{else if } (\neg val)\ \mathbf{T};\\ &\text{else if } (\mathcal{V}[q, w, t, f, n, i])\ \mathbf{T};\\ &\text{else } \mathbf{U}\}\end{aligned} \tag{4.68}$$

The explanation for AND proceeds as follows:

The point in (4.66) is that the second conjunct q is evaluated only when the first conjunct p evaluates to **T** (the fourth line of (4.66)), or it is undefined (the sixth line). In either case, the evaluation of q follows that of p, not vice versa nor are they evaluated at the same time. This means that, in (4.64c) and (4.64d), the second conjuncts, (NOT (REGRET J (INT (BALD J)))) and (REGRET J (INT (BALD J))) respectively, are evaluated only after the first conjuncts, (BALD J) for both sentences are evaluated. Thus, if Jack is bald in the model, then the second conjuncts are evaluated according to the fourth line of (4.66). Since Jack's baldness exists in the model as nc–info, the a–info produced by the second conjuncts is deleted (absorbed by the duplicate nc–info), hence no presupposition or conventional

implicature is created by these sentences. If on the other hand, Jack is not bald in the model, the interpreter immediately concludes that the conjunction is false according to the fifth line of (4.66), without ever bothering to evaluate the second conjuncts, hence there will be no creation of new information, either. (Remember that, according to (4.66), q is not evaluated if p evaluates to **F**.) If Jack's baldness is undefined in the model, it will be added to the model as nc–info by the super–interpreter according to [the definition of the super–interpreter given in Gunji (1982) p 25 (4.1c)], which is based on the truthfulness of the utterer, immediately after the processing of the first conjunct. Thus, by the time the second conjunct is evaluated, Jack's baldness exists as nc–info in the model and it absorbs the a–info produced by the second conjunct. In this way, in any case, no new information is added to the model as a presupposition of (4.63c) or as a conventional implicature of (4.63d).

This is in fact the case and he is justified in concluding that the filter for AND is a corollary of EIL semantics. What is of importance here is that he invokes the super–interpreter after the first subexpression of the AND is evaluated by the interpreter. (Note that this is inconsistent with the method specified for the super–interpreter on p24.) So if he is claiming that the unified EIL process is capturing the filters he cannot then invoke the super–interpreter differently for each of AND, OR, and IMP; otherwise he too would have different rules for each. (It is alright to have different PREC and POSTC procedures however, because this difference occurs at a level of representation different than the EIL interpretation level.)

Like most other theories of presupposition, the greatest difficulties are encountered with the two connectives OR and IMP, which I now discuss. Gunji's description for OR follows:

> ... the evaluation procedure for OR, (4.67), evaluates the second disjunct only after the first disjunct is evaluated. Thus, if Jack is bald[36], the second disjuncts in (4.64c) and (4.64d) are evaluated in a model where Jack is bald and naturally no

[36]It is important to realize here that there are some crucial errors that allow this analysis to proceed as stated. Since Gunji claims to adhere to Grice's conversational maxims, disjuncts and indicative conditionals are inappropriate if the truth–values of the clauses are known by the speaker. Since the UD is intended to be mutual knowledge of the speaker and hearer, if the evaluation of the EIL expression representing the clause leads to the truth–values **T** or **F**, then the speaker must know the truth–value of the clause. Thus, if Grice's maxims are being adhered to and if the UD represents mutual knowledge, the analysis given here is inappropriate, because it all depends on the truth–value being **T** or **F**. Also of importance is the absence of the truth–value **U** in the analysis. Its absence lends credence to the conclusion that the UD is not mutual knowledge but rather a subset

presupposition or conventional implicature is created as new information; the a–info that Jack is bald is absorbed by the nc–info. If Jack isn't bald, then the interpreter concludes that the sentences are true without evaluating the second disjuncts, hence no new information is added to the model. Either way, (4.64c) and (4.64d) don't implicate that Jack is bald.

How IMP is processed is described as follows:

According to our rule (4.68), the consequent of the conditional IMP is evaluated only after the antecedent is evaluated. Thus, if Jack is bald, the consequents of (4.65c) and (4.65d) are evaluated in a model where Jack is bald, leading to no creation of the presupposition or conventional implicature that Jack is bald. If Jack isn't bald, the sentences become true without the consequents being evaluated, i.e., without new information being created. Thus no implicature comes from (4.65c) or (4.65d) in this case, either.

Interpreting what Gunji is doing is most difficult. One way to interpret his method is that the super–interpreter is being invoked after the first subexpression in each of the OR and IMP expressions. According to the discussion following AND this would be the most appropriate interpretation. But one would have to be very generous to interpret his explanations as given above in this manner since if the first subexpressions don't already appear as **T** or **F** in the model he would have to be doing some form of case analysis. (The super–interpreter cannot just add the first subexpression to the model (that is, changing **U** to **T** or **F**) as it did in the case of AND.) Unfortunately, this concept is never introduced as part of the EIL evaluation cycle, so it would require a most generous interpretation. Even if this were the desired interpretation, I will point out later in connection with the comparison to Gazdar's work that the case analysis doesn't work in the non–cancellation cases (it does in the cancellation cases as the quotes from Gunji demonstrate). Another interpretation is that the first clauses, if not in the model as **T** or **F**, are given the value **U**. This crucial case is left out of Gunji's argument. But if the first subexpression of OR or IMP evaluates to **U**, line 5 in both (4.67) and (4.68) evaluates the second subexpression. Hence the EIL evaluation process would generate (4.69) for both (4.64c)

of the truth–values in the "world". The status of **U** is then suspect. I will continue the discussion as if there were no errors. The criticism that I give later ultimately hinges on the absence of **U** in Gunji's analysis.

and (4.65c).

Jack is bald. (4.69)

Recalling Karttunen's filtering rules from section 4.1, these rules don't generate this presupposition because the negation of the first clause entails the presupposition of the second clause. However, for Gunji's system if the first clause evaluates to **U** the second clause is evaluated, and the pragmatic information would be generated. Even if Gunji's negation is used, the result using Karttunen's filtering rules would not change since $\mathcal{V}(\text{NOT } p) = \mathbf{T}$ if $\mathcal{V}(p) = \mathbf{U}$.

In addition to the problems just described, Gunji's method does not coincide with Karttunen's method on sentences like (4.64a), (4.64b), (4.65a), and (4.65b), either. Since Karttunen's method generates the presuppositions found in the second clauses regardless of the truth–value of the first clause, Gunji's method is required to do the same in order to capture Karttunen's rules as corollaries. However, Gunji's method generates the presuppositions (or conventional implicatures) in these clauses only if the truth–value of the first clause does not decide the truth–value of the sentence. So, the first claim is refuted under both interpretations of Gunji. Either he must have different rules for the different filters or the results don't agree with Karttunen on the examples given.

Claim 2. Gunji implicitly claims that he has captured the essence of Gazdar's system and explicitly claims that he has overcome a defect in it. Example (4.70) shows a situation in which Gazdar's system incorrectly generates a presupposition. Gunji's system absorbs the presupposition found in the second conjunct and does not produce it as a presupposition of the sentence. What may initially seem to be only a trivial categorization problem (the **P**–sentence is an *entailment* of the **S**–sentence), sentences such as (4.71) indicate that the categorization of presuppositions and entailments is crucial for projection methods. Since '*It is possible that*' is a *hole*, all of the presuppositions of the subordinate clause will be presuppositions of the sentence. But since (4.71) does not presuppose '*Jack is bald.*', this sentence, if it is a presupposition of the subordinate clause (as Gazdar's system predicts), must be cancelled. Hence the subordinate clause (the **S**–sentence in (4.70)) must not presuppose '*Jack is bald.*'. It is consistent that '*Jack is bald.*' is an entailment of the subordinate clause and not an entailment of the sentence, because holes project presuppositions, not entailments.

S: Jack is bald and he doesn't regret being bald.

P: *Jack is bald. (4.70)

It is possible that $_S$[Jack is bald and he doesn't regret being bald]$_S$. (4.71)

Because Gunji's method can capture absorption and intersentential cancellation, and Gazdar's cannot, Gunji claims that his method has corrected a defect in Gazdar's. This claim is significant only if Gunji's method is able to perform at least as well as Gazdar's on other data. On the contrary, it can be argued that his method fails on data on which Gazdar's succeeds. Gunji's method fails to generate the appropriate presuppositions for (4.72) which has been used by both Wilson (1975) and Gazdar to show an inadequacy that has prevailed from Karttunen (1973) through to Karttunen and Peters (1979). The generic case, exemplified by (4.72), is the disjunction of two statements having contradictory presuppositions (or, as Gunji would describe them, conventional implicatures).

My teacher is a bachelor or a spinster. (4.72)

I will go through the argument, again using both interpretations of Gunji: one in which the super–interpreter is invoked at each disjunct and one in which the super–interpreter is not invoked until the complete EIL expression is evaluated. That BACHELOR $\gg$ MALE and SPINSTER $\gg$ FEMALE is assumed for purposes of this discussion.[37] Since the presuppositions[38] are contradictory the sentence as a whole presupposes neither. For purposes of this discussion it can also be assumed that the UD has no information about the sex of the teacher.

First, the method using the invocation of the super–interpreter after the evaluation of each disjunct is given. Whether (BACHELOR TEACHER) is **T**, **F**[39], or **U** in the UD, the evaluation of this disjunct produces (MALE TEACHER) as a–info. The super–interpreter, after finding

[37]Even though none of Gunji's filter examples demonstrate lexical presuppositions, it seems a reasonable assumption that his system incorporates this idea. (An example describing the true and false–lists uses BACHELOR. It is not necessary to use lexical presuppositions. A similar example could be devised using '*regret*'. For example

Either Jack regrets being bald or he isn't bald.

[38]Another problem with Gunji's method, which I defer to section 4.3.2, is that because there are no cancelability–inducing operators, Gunji's method must treat MALE and FEMALE as implicatures.

[39]I will assume for the purposes of the discussion that (BACHELOR TEACHER) is false because TEACHER is on the false list of BACHELOR but TEACHER is either on the true list of MALE or on neither the true nor false list of MALE. This is only one way that (BACHELOR TEACHER) can be false but it is one case that must be treated.

no contradictory information in the UD, would change the a–info marker to an nc–info marker. If the disjunct evaluates to **T** then evaluation halts. If it is **F** or **U**, then the second clause is evaluated. Whichever is the case, (MALE TEACHER) exists as nc–info in the UD. If evaluation continues, then whether (SPINSTER TEACHER) is **T**, **F**[40], or **U** in the UD,[41] the evaluation of this disjunct produces (FEMALE TEACHER) as a–info. According to the definition of the super–interpreter, the processing is interrupted because a–info, (FEMALE TEACHER), which is about to be converted to nc–info, is contradictory to nc–info, (MALE TEACHER), already in the UD. This situation is definitely incorrect since the sentence is not anomalous.

The second interpretation of Gunji is to have the super–interpreter act only after the EIL evaluation has finished. Exactly the same analysis as in the previous paragraph would occur if the first disjunct is evaluated as **T**. So, the remainder of this discussion assumes that the first disjunct evaluates to **F** or **U**. A side–effect of the evaluation of the first disjunct would be to produce (MALE TEACHER) as a–info. Since the first clause has evaluated to **F** or **U** the second disjunct is evaluated. The side–effect of this computation would be the production of the a–info (FEMALE TEACHER). Now the super–interpreter begins its operation. It chooses one of the items marked as a–info and after not finding any contradictory nc–info, adds it to the UD. Now the super–interpreter takes the remaining a–info and in a manner similar to that presented in the first interpretation aborts the processing of the EIL expression because a–info which is contradictory to some nc–info is to be converted to nc–info. And, like the first interpretation, this situation is definitely incorrect.

In contrast to both of these interpretations of Gunji's method, Gazdar's system correctly cancels out both potential presuppositions and accepts the sentence as meaning the teacher in question is married, adult, and the sex remains unknown. A modification to Gunji's system would be to allow contradictory a–info to cancel each other. This modification would work under the second interpretation. But this kind of modification would falter on the same counter–

[40] An argument similar to footnote 39 is used.

[41] It is not evident from Gunji's description whether his system has any inferencing capability. So, it is not necessarily the case that the addition of TEACHER to the true list of MALE would add TEACHER to the false list of FEMALE. Although not having any form of inferencing would be disastrous, I have produced the discussion as if there is none. The addition of inferencing and the appropriate real would knowledge would only disallow some truth value combinations (for example, (MALE TEACHER) and (FEMALE TEACHER) would not be allowed to have the same non–U truth values). The problem with contradictory presuppositions would remain.

examples as Gazdar's method does (for instance, the non-binary features). Additionally, the discussion rejecting claim 1 indicates that Gunji's method cannot properly handle the evaluation of 'OR' and 'IMP' if the truth value U is allowed.

4.3.2 Methodological Problems

One of the most notable problems confronting Gunji's method is the handling of disjunctive information. Since sentences of the form '*A or B*' must be handled by his system in order for it to be seriously considered, the information found in the sentence must be used to update the UD. But, no discussion of how this would be done is provided. Consequently, the affect on his algorithm is unknown. Some form of UD splitting would be required, but problems with this kind of solution are already documented (Moore (1979)).

The problem of not being able to negate every feature of a lexical item has plagued a number of previous methods. Although it is not explicitly stated in Gunji's presentation, it seems that the lexical items in the EIL lexicon are defined in a manner that prevents certain features being in the scope of the negation.

Gunji's method as presented only considers lexical presuppositions (for example, '*bachelor*') and some other constructs such as factive verbs. His method does not generalize, in any obvious way, to syntactic presuppositions such as those produced by noun phrases and cleft constructions.

Another problem concerns the labelling of the inferences as implicatures or as presuppositions. If the inference is generated as a–info by a PREC procedure it can be changed in one of two ways. If the POSTC procedure of a cancelability–inducing operator performs the transformation the a–info is turned into c–info and the inference is labelled as a presupposition. If the inference remains marked as a–info when the super–interpreter resumes control (after the complete EIL statement has been evaluated) then the a–info is changed into nc–info and the inference is labelled as an implicature. So most theories[42] would generate the **P**–sentence in (4.73) and label it as a presupposition. But Gunji (1982) labels it as an implicature. No POSTC procedures of cancelability–inducing operators are available to transform the statement into c–info, so the super–interpreter changes it into nc–info.

[42]Karttunen and Peters (1979) is the exception, but there is no confusion between implicatures and presuppositions because there is no notion of presupposition in their theory.

S: Jack regrets losing his book or Mary regrets losing her book.

P: Jack lost his book and Mary lost her book. (4.73)

What seems to be a small problem of mislabelling is really a major problem. Because conventional implicatures are represented as nc–info information (4.64b) and (4.65b) would have (4.69) as nc-info rather than as c–info. This mislabelling does not cause any harm immediately but later nc–info which is inconsistent with (4.69) will be treated incorrectly. For example, both (4.64b) and (4.65b) can be followed by '*But Jack isn't bald.*'. Instead of cancelling the presupposition as would be expected, EIL would treat this sentence as anomalous because it contradicts nc–info. And no recourse to equivalent representations that contain cancelability–operators is available since NOT does not have the same properties as '¬' has in ordinary two–valued logics. For example, (IMP a b) is not equivalent to (OR (NOT(a) b)) in EIL.

In addition to all of these refuted claims, Gunji gives a rather vague description of some of the important components of his system. As mentioned earlier, the extent of the inferencing capability is not discussed.[43] In some cases a limited inferencing ability would only limit the utterances that could be handled. But in other cases it would be possible to generate inconsistencies. Gunji is also somewhat vague about the Universe of Discourse. Since this component is crucial for much of the cancellation it is impossible to ascertain the full extent of its abilities. Although he indicates that it represents common knowledge, he also says that UD_0 (the total UD) represents knowledge from the beginning of time. Whether these notions mean that the UD represents common knowledge from the beginning of the conversation or common real world knowledge known by the speaker and the hearer would limit its cancellation abilities. This is a minor point, however. A major concern is how disjunctive information is treated in the UD. No discussion of this issue is found in Gunji (1982).

4.4 Soames

Soames (1979) is Soames' first attempt to solve the projection problem. The procedure developed is similar to but not as precisely defined as the one described in Gazdar (1979).

[43]In the discussion in Gunji (1982) the only mention of inferencing is in relation to the searching of the true and false lists of ADULT, MALE, and MARRIED when the truth value for BACHELOR is required. This information could be contained in instructions in the BACHELOR entry in the lexicon. No other mention of inferencing is noticed.

Soames (1979) concludes that the approach found there and therefore the approach taken by Gazdar (1979) is limited in its adequacy. Soames (1982) is an attempt to remedy these shortcomings.

The important insight in Soames (1982) is that the two major competing strategies for determining presuppositions succeed on those examples on which the other fails. The proposed solution is to synthesize the two filtering strategies so that all the unwanted potential presuppositions are screened out. I show later in section 4.4.1 that counterexamples to this dual filtering system still remain. I also discuss in section 4.4.2 the methodological problems that Soames' method has. These problems include those associated with Karttunen and Peters' method since this method forms part of the synthesis. Here, however, I will summarize Soames' method.

Cancellation projection methods use post–filters to discard the unwanted potential presuppositions which are generated from all of the presuppositional environments in the sentence. Gazdar (1979) and Soames (1979) are cancellation projection methods. What follows next has already been discussed in section 4.2.1, but I include it here for completeness. The main difficulty faced by cancellation methods are sentences of the form '*if A then B*' which have the following properties.

1. B^P is compatible with the conversational context.

2. The utterance, in this context, does not conversationally implicate that the speaker does not take B^P for granted (that is, it is not cancelled by a conversational implicature).

3. The context plus A^T entails B^P though the context alone does not.

Cancellation methods predict that an utterance satisfying these conditions presupposes B^P. But Soames has provided a number of examples satisfying these conditions which do not presuppose B^P.

S: If the Poles defeat the Russians, then the Hungarians will defeat the Russians, too. (4.74)

B^P: Someone other than the Hungarians will defeat the Russians.

S: If Andy met with the PLO last week to discuss diplomatic recognition, then he will probably meet with them again this week. (4.75)

B^P: Andy has met with the PLO.

S: If France has an intelligent king, then the King of France is the only intelligent monarch in Europe. (4.76)

B^P: There is a King of France.

S: If the dress Mary bought is powder blue and the dress Susan bought is, too, then Mary will regret having bought a dress that is the same colour as Susan's. (4.77)

B^P: Mary bought a dress that is the same colour as Susan's.

Inheritance projection methods, exemplified by Karttunen and Peters (1979), filter the unwanted potential presuppositions as the sentence is interpreted. These methods do not allow any role to be played by conversational implicatures in the cancellation of presuppositions. Soames provides example (4.78) as evidence for the need of conversational implicatures. This example is, of course, analogous to the bachelor–spinster example given in section 4.2.

S: Either Bill has just started smoking or he has just stopped smoking.

A^P: Bill hasn't smoked in the recent past. (4.78)

B^P: Bill has smoked in the recent past.

In the standard inheritance methods the inheritance condition for a disjunction '*A or B*' is that given in (4.79).

$$(A^T \vee B^P) \wedge (B^T \vee A^P) \wedge (A^P \vee B^P) \tag{4.79}$$

But if A^P and B^P are inconsistent as **A^P** and **B^P** are in the example above and if each clause entails its presuppositions, which all theories predict for the positive case, then the inheritance condition is equivalent to the original statement. This result is, of course, undesirable because sentences don't presuppose themselves.

For each counterexample given in Soames (1982) one of the two projection strategies handles it correctly. Recognizing this condition, Soames suggests that a synthesis of the two strategies is a reasonable way to solve the projection problem. The two most natural methods for synthesizing the two stategies are investigated. One synthesis, applying inheritance conditions first to obtain potential presuppositions followed by cancellation, does not produce the appropriate presuppositions. The other ordering, first applying cancellation techniques to obtain a set of potential presuppositions followed by an invocation of the inheritance conditions which only

look at the remaining potential presuppositions as inheritable presuppositions, is, according to Soames, a descriptively adequate theory for producing all and only the presuppositions of the sentences.

In some detail then the following is Soames' definition of the presuppositions of a sentence.

P is a *remaining potential presupposition* of S relative to U *iff*

1. P is a potential presupposition of S;
2. P is not contextually cancelled;
3. P is not conversationally cancelled.

P is an *actual presupposition* of S relative to U, represented as $S^{AP/U}$, *iff*

1. If S is an affirmative, single-clause sentence, then the actual presuppositions of S relative to U are those entailed by the remaining potential presuppositions of S relative to U.
2. If S = '$\neg$A', 'KA' or 'PA', or '*It is* verb$_{[+\text{hole}]}A$', then the actual presuppositions of S relative to U are the actual presuppositions of A relative to U.
3. If S = 'A *and* B', or '*If* A *then* B', then the actual presuppositions of S relative to U are those entailed by

$$(A^{AP/U} \wedge (A^T \supset B^{AP/U})$$

where $\phi^{AP/U}$ represents a maximal actual presupposition of ϕ relative to U — one equivalent to the set of actual presuppositions of ϕ relative to U.[44]

4. If S = 'A *or* B', then the actual presuppositions of S relative to U are those entailed by

$$(A^{AP/U} \vee B^T) \wedge (B^{AP/U} \vee A^T) \wedge (A^{AP/U} \vee B^{AP/U}).$$

[44] A problem occurs here. If $A^{AP/U}$ is the set of propositions entailed by the remaining potential presuppositions of A relative to U, as suggested in item 1, then $A^{AP/U}$ is an infinite set, making the logical statement for the actual presuppositions of S relative to U ill-formed. If only a finite subset of the entailed sentences is wanted, how this subset is chosen has not been specified. Although Soames states that this is only a descriptively adequate theory, to lack this important part of the theory is a critical omission. If the entailment process is not carried out at each stage of the recursive definition, then some presuppositions are lost to this theory. Examples of these lost presuppositions include (4.84) which is described in section 4.4.1 and (4.47) discussed in section 4.2.1.

And finally, an utterance U of a sentence S presupposes a proposition P, if P is an actual presupposition of S relative to U.

To end this introduction to Soames' method for determining presuppositions, two examples are given. (4.78), rewritten here as (4.80), demonstrates a sentence which is improperly treated by inheritance méthods. (4.74), rewritten here as (4.82), is incorrectly dealt with by cancellation methods.

Conversational arguments can be used to support the statement that neither $\mathbf{A}^{\mathrm{P}}$ nor $\mathbf{B}^{\mathrm{P}}$ are among the remaining potential presuppositions of **S** in (4.80). The argument would proceed: if the speaker knows that $\mathbf{A}^{\mathrm{P}}$ is true then **B** would be false, but then the speaker would have been in a position to make a much stronger statement, namely **A**. A similar argument is given to deny that the speaker knows that $\mathbf{B}^{\mathrm{P}}$ is true. Since Soames represents the lack of presuppositions by a tautology, $\top$, (4.81) is the result of applying part 4 of the definition above. (4.81) is a tautology hence the sentence has no substantive presuppositions.[45]

S: Either Bill has just started smoking or he has just stopped smoking.

$\mathbf{A}^{\mathrm{P}}$: Bill hasn't smoked in the recent past. (4.80)

$\mathbf{B}^{\mathrm{P}}$: Bill has smoked in the recent past.

$$(\top \vee \mathbf{B}^{\mathrm{T}}) \wedge (\top \vee \mathbf{A}^{\mathrm{T}}) \wedge (\top \vee \top) \tag{4.81}$$

Substituting appropriately into the definition given in part 3, the actual presupposition of **S** in (4.82) is given in (4.83). Since the right conjunct is trivially true given the nonidentity of Poland and Hungary then the only presuppositions will come from **A**, blocking the undesirable presupposition $\mathbf{B}^{\mathrm{P}}$.

S: If the Poles defeat the Russians, then the Hungarians will defeat the Russians, too. (4.82)

$\mathbf{B}^{\mathrm{P}}$: Someone other than the Hungarians will defeat the Russians.

$$\mathbf{A}^{\mathrm{P}} \wedge (\mathbf{A}^{\mathrm{T}} \supset \mathbf{B}^{\mathrm{P}}) \tag{4.83}$$

[45]The point being made here is that neither '*Bill hasn't smoked in the recent past.*' nor '*Bill has smoked in the recent past.*' survive as actual presuppositions of **S** relative to U. Being more precise, A^P is $\mathbf{A}^{\mathrm{P}} \wedge$ '*Bill exists*' and B^P is $\mathbf{B}^{\mathrm{P}} \wedge$ '*Bill exists*'. Substituting appropriately into part 4 of the definition and making the necessary reductions, '*Bill exists*' survives as the actual presupposition of **S** relative to U.

Contrary to his claim, Soames' method does not always generate the appropriate presuppositions. In section 4.4.1 four kinds of counterexamples are given. In section 4.4.2 problems of a methodological nature are discussed.

4.4.1 Empirical Problems

There exist at least four kinds of counterexamples to Soames' method for generating presuppositions. The first category is a problem that is similar to the non–binary feature problem, first discussed in section 4.2.1. (4.84), which appears in Soames (1979) (p655) but which doesn't appear in Soames (1982), is an example from this category. This example, similar to the non–binary feature problem, produces from two different clauses two contradictory presuppositions that disjunctively do not form a tautology.

S: Either the loan company repossessed Bill's only car, or they repossessed his second car.

A: The loan company repossessed Bill's only car.

B: The loan company repossessed Bill's second car. (4.84)

$\mathbf{A}^{\mathrm{P}}$: Bill had exactly one car.

$\mathbf{B}^{\mathrm{P}}$: Bill had at least two cars.

$\mathbf{A}^{\mathrm{P}} \vee \mathbf{B}^{\mathrm{P}}$: Bill had at least one car.

In footnote 65 to this example in Soames (1979) it is stated that each disjunct of $(\mathbf{A} \vee \mathbf{B})$ presupposes $(\mathbf{A}^{\mathrm{P}} \vee \mathbf{B}^{\mathrm{P}})$. No explanation of the process which generates this presupposition is given. This omission is crucial. One of the aims of any theory of natural language presupposition must be to explain the relationship between presuppositional environments and the potential presuppositions that they bear. Since it is not explicitily stated, a reasonable assumption is that this disjunctive presupposition is a result of taking the entailments of each clause–generated presupposition. (These presuppositions cannot come from the projection method since the projection methods are conjunctive.) Under this interpretation each disjunct must generate $\mathbf{A}^{\mathrm{P}} \vee \mathbf{B}^{\mathrm{P}}$ in isolation as well. But the sentence '*The loan company repossessed Bill's only car.*' does not presuppose '*Bill has at least one car.*'.[46] As a result, if the theory can produce

[46]In Chapter 3 I have been very careful to point out that if $X \vee Y$ is derivable as a presupposition from the sentence in question, it is not necessarily the case that this logical statement translate directly into the natural language statement '*X or Y*'. Only if X and Y can be proved to be possible is this translation allowed.

disjunctive presuppositions using entailments, the theory must also take into account how these disjunctions are to be interpreted. It is not evident in Soames (1979) that this problem has been noticed. This omission may be a result of Soames (1979) not being intended to propose a particular theory, but rather to show the limitations of the theory proposed in Karttunen and Peters (1975).

Whether or not Soames (1979) can deal with the problem of contradictory presuppositions that disjunctively form a tautology is a moot point since Soames (1982) takes precedence over Soames (1979). However, my belief, expounded in the previous paragraph, that Soames does not realize that a problem exists here is further enhanced by Soames (1982) lacking an example similar to (4.84) and by the fact that Soames (1982) cannot deal with non–binary features. Soames (1982) is unable to deal with (4.84) because the set of *remaining potential presuppositions* that results from the first half of the method does not contain either $\mathbf{A}^{\mathrm{P}}$ or $\mathbf{B}^{\mathrm{P}}$. These presuppositions are cancelled conversationally by the maxim of quantity in a manner similar to that described in connection with (4.78). Since only the second stage of the method (defining the *actual presuppositions*) allows taking entailments of the presuppositions, neither $\mathbf{A}^{\mathrm{P}}$ nor $\mathbf{B}^{\mathrm{P}}$ is available to generate the presupposition $\mathbf{A}^{\mathrm{P}} \vee \mathbf{B}^{\mathrm{P}}$ by entailment.

The second category consists of sentences of the form '*if A then B*' in which $B^P = (C \wedge D)$, and $A^T \models C$ but $A^T \not\models C \wedge D$. (Actually a criticism of Karttunen and Peter's detachment rule, it is included here because of the importance that Soames attaches to the ability to include all entailments of the inheritance rules as presuppositions at each stage.) This situation causes a problem because there is a point in the derivation which allows the application of more than one rule, application of different rules leads to different results, and there is no meta–rule in the theory to indicate which of the various rules is appropriate. And even if there were such a meta–rule, I do not know how its inclusion in the theory would be defended.

In order to demonstrate the difficulty, first the appropriate presupposition is generated: $A^P \wedge A^T \supset B^P$. Because the A^P–part can be ignored in the following discussion and the identity for B^P can be used, the presupposition can be rewritten as $A^T \supset (C \wedge D)$. Now two rules can be applied: either the detachment rule or a simple propositional logic rule (which provides an entailment). If the detachment rule is applied ($A^T \supset (C \wedge D)$ is true only for truth–conditional reasons) $C \wedge D$ is derived. Since all entailments are also presuppositions, both C and D are presuppositions of the original sentence. On the other hand, if propositional logic is used to change $A^T \supset (C \wedge D)$ into the *logically equivalent* statement $(A^T \supset C) \wedge (A^T \supset D)$

followed by the "triviality rule" being applied to the first conjunct (since $A^T \models C$, $A^T \supset C$ is trivially true) to produce no substantive presupposition, and the detachment rule applied to the second conjunct (since $A^T \models C$ and $A^T \not\models C \wedge D$, only a truth–conditional connection between A and D exists) to produce D.

The two situations are allowed by the theory because there is no process to decide which rule to apply first. The case in which only D is derivable is to be preferred over the one in which both C and D are derivable since C is not a presupposition of the sentence. An example of a sentence which falls into this category is (4.85).

If Mary came to the party and caused a disturbance then Jack regrets that both Mary and Sally came to the party. (4.85)

The third category of sentences which is not properly dealt with includes sentences like (4.86).

S: My teacher is not a bachelor and not a spinster.
P: Possibly my teacher is male and possibly my teacher is female. (4.86)

None of the projection methods deal properly with this type of sentence because the appropriate potential presuppositions (the two conjuncts in the **P**–sentence) are not generated. In section 4.5.5.2 I demonstrate that the appropriate presupposition is obtained in a natural way in the default logic approach. Even if the necessary potential presuppositions were available, Soames' method would not project them properly. Using the inheritance rule for '*and*', (4.87) would result.

possibly my teacher is male $\wedge$
(*my teacher is married* $\supset$ *possibly my teacher is female*) (4.87)

Whether the consequent in the implication in (4.87) detaches is not obvious. Part of the problem occurs because the detachment rule is so imprecise. Since the connection between '*married*' and '*possibly female*' seems more than just truth–conditional (for x to be married, x must be human, hence possibly x is female) the consequent does not detach. However, it might be possible to argue that the connection is only truth–conditional since '*possibly male*' is ruled out. But (4.88) is an example that defeats this argument.

If my teacher is married then my teacher is not a bachelor and not a spinster. (4.88)

If the detachment is allowed in (4.87) then the inheritance rule for '*if* ... *then* ...' produces

(4.89)[47].

$$\textit{my teacher is married} \supset \\ (\textit{possibly my teacher is male} \wedge \textit{possibly my teacher is female}) \tag{4.89}$$

Now the argument used to allow the detachment in (4.87) is not available here. Since the sex of the teacher is unknown the connection between '*married*' and '*possibly male and possibly female*' must be more than truth–conditional.

The fourth category of sentences which cannot be correctly processed by the presupposition generating method described in Soames (1982) is exemplified by (4.90).[48] This sentence is typical of this category: the antecedent A is a simple proposition, and the consequent is another indicative conditional, *if B then C*, which contains a presupposition–generating environment which is not being used in its normal presupposition–generating sense.

If Mary bought a powder blue dress then if Susan bought a dusty red dress then Mary won't regret having bought a dress that is the same colour as Susan's. (4.90)

Assuming that C^P is a remaining potential presupposition (see my reservations in footnote 48), (4.91) captures the actual presuppositions of (4.90) given the recursive definition from section 4.4.

$$\begin{aligned}
&(\textit{if } A \textit{ then if } B \textit{ then } C)^{AP/U} \\
&\quad = A^{AP/U} \wedge (A^T \supset (\textit{if } B \textit{ then } C)^{AP/U} \\
&\quad = A^{AP/U} \wedge (A^T \supset (B^{AP/U} \wedge (B^T \supset C^{AP/U}))) \\
&\quad = A^{AP/U} \wedge (A^T \supset B^{AP/U}) \wedge (A^T \supset (B^T \supset C^{AP/U})) \\
&\quad = A^T \supset (B^T \supset C^{AP/U})^{49} \\
&\quad = (A^T \wedge B^T) \supset C^{AP/U}
\end{aligned} \tag{4.91}$$

But $A^T \wedge B^T$ equals $\neg C^{AP/U}$. Hence $(A^T \wedge B^T) \supset C^{AP/U}$ is just $C^{AP/U}$ (by propositional logic). But $C^{AP/U}$ is just '*Mary bought a dress that is the same colour as Susan's.*'. But (4.90) does not presuppose this statement.

[47]The consequent of (4.88) is just (4.86). The inheritance rule for '*and*' is used to first derive (4.87) and because the detachment rule is allowed *possibly my teacher is male* $\wedge$ *possibly my teacher is female* is derived and appears as the consequent in (4.89).

[48]I am not completely convinced that this is a counterexample to Soames' method. I hesitate only because Soames provides an imprecise algorithm for determining the remaining potential presuppositions. However, Soames uses a similar example as a counterexample to Gazdar's method. If the remaining potential presuppositions are determined using a Gazdar–like procedure (*it* is precisely defined) then (4.90) is a counterexample to Soames' method.

[49]This transformation makes the following assumption: no presuppositions of any consequence (for this discussion) result from A or B, hence $A^{AP/U}$ and $B^{AP/U}$ can be considered as tautologies, thus the first two conjuncts drop out.

Because I have stated my reservations about this counterexample, it is worthwhile demonstrating some support for my assumption that C^P is a remaining potential presupposition in (4.90). The form of the support is to contrast (4.90) with a similar sentence, (4.92),[50] in which C^P is not a remaining potential presupposition.

If Mary bought a powder blue dress and Susan bought a dusty red dress then Mary won't regret having bought a dress that is the same colour as Susan's. (4.92)

The argument for blocking C^P in (4.92) is the following: C^P contradicts the antecedent. Hence if C^P is true (hence known to be true by the speaker), then the antecedent must be false (and known to be false by the speaker). But if the speaker knows that the antecedent is false then the situation is such that the maxim of quantity forces the use of a non–conditional statement. Since a conditional has been used, the speaker is not in a position to know that the antecedent is false. The assumption that C^P is a remaining potential presupposition must be false.

The conjunctive antecedent found in (4.92) is not available to cancel the presupposition, C^P, found in (4.90). In (4.90) C^P can be true (and known to be such by the speaker) without the speaker knowing which of A true and C false, A false and C true, or A false and C false is the case, unlike the situation described above for (4.92).

4.4.2 Methodological Problems

The methodological soundness of Soames' method depends critically on the sanctity of its two subparts. However, if the arguments given in section 4.1.2 are correct, the second stage, which is based on Karttunen and Peters' method, fails to demonstrate this fundamental requirement. Summarizing the three points against the detachment rule given previously in section 4.1.2: the method used to detach the sometimes desirable presupposition B^P from the derived presupposition $A^T \supset B^P$ is motivated by a need to undo the inappropriate results of an overly zealous projection rule, it is supported by a misinterpretation of Grice's maxims, and it is correctly used only for the phenomenon for which it has been developed but is applicable to other similar situations. If the methodologically unsound detachment mechanism is removed, then Soames' method is unable to deal with examples such as (4.93) and (4.94).

If Haldeman is guilty then Nixon is, too. (4.93)

[50] For the discussion (4.92) has the form '*If A and B, then C*'.

If Andy met with the PLO last week to discuss diplomatic recognition, then he will probably meet with them again this week. (4.94)

In addition, if '*too*' and '*again*' are to pass the negation test then the analysis given for these kinds of presuppositional environments must be more complex than what has been previously given. Such an analysis is given in section 4.5.3. On the other hand, Soames' and Karttunen and Peters' methods require only the standard superficial analysis. That this mechanism can produce the desired results from too simple a representation adds independent support to the argument given in section 4.1.2 that the mechanism is too strong.

Even with the detachment mechanism allowed, Soames needs to resort to further unblocking mechanisms in some instances. Gazdar gives (4.95) as a counterexample to Karttunen and Peters.

S: If gold is missing from Fort Knox, then the crooked accountants in the US Treasury will be worried.

P′: *Gold is missing from Fort Knox* $\supset$ *There are crooked accountants in the US Treasury* (4.95)

P: *There are crooked accountants in the US Treasury*

Karttunen and Peter's method (and hence Soames', as well) generates the **P′**–sentence as the presupposition of the **S**–sentence whereas Gazdar claims that the presupposition is the **P**–sentence. Because there could exist a non–truth–conditional link between the antecedent and the consequent in **P′**, Karttunen and Peters' detachment mechanism cannot be used to derive **P**. To circumvent this problem, Soames invokes some additional devices. First he claims that it is up to the hearer to decide which is the most plausible presupposition of **S**. Unfortunately, he is begging the question. The mission is to provide a method to derive the presuppositions of an utterance. Leaving some of the method undefined, to be decided arbitrarily is not appropriate. In a footnote to this claim, possibly expecting such criticism, Soames suggests why a hearer would probably choose the **P**–sentence instead of the **P′**–sentence. However, the suggestion includes recourse to other factors (the possibility that the guards stole the money and that there is widespread cynicism about government officials). The constraints placed on these other devices are not made explicit in his method. In marked contrast, the **P**–sentence is the only choice in Gazdar's method and the default logic approach. And, no recourse to ad hoc devices is required in either of these methods.

One of the criticisms of Gazdar's work is that the order of the rules remains unexplained. The same criticism can be levelled against Soames' theory as well. The only reason that Soames gives for applying the cancellation rules before the inheritance rules is that this ordering gives the desired results (which is essentially the reason that Gazdar gives for his ordering). An associated criticism is that the subparts of the final presuppositions are tested for consistency against the context and the rules of conversation. Unlike Gazdar who doesn't have presuppositions like $A^T \supset B^P$, Soames must have good reasons for applying the cancellation rules to the subparts of the presuppositions. Again, the only reason would be that it works. (In his presentation Soames discusses the first criticism, but never are the issues concerning the second criticism discussed.)

4.5 A Default Logic Approach

The purposes of this section are varied. Firstly, it is intended to highlight the basic methodological features of the default logic approach by comparing this approach with the four approaches discussed in sections 4.1 to 4.4. Secondly, a summary of empirical evidence that demonstrates the superiority of the default logic approach is given. In addition to being a summary of the correct processing by the default logic approach of some other method's counterexamples, the purpose of this summary is again to emphasize the importance of how disjunction is treated in the representational language and the techniques that manipulate the representations. Thirdly, the earlier–promised discussion of the presuppositional character of sentential adverbs and modified phrases is presented. And lastly, some partial results and the present limitations of the default logic approach is discussed. The description provided in sections 3.2 and 3.3 together with the discussion below is, at present, the complete view of the default logic approach to natural language presuppositions.

4.5.1 Methodological Similarities and Differences

In this section the methodological similarities and differences that exist between the default logic approach that is presented in Chapter 3 and the four previous approaches which have been discussed in some detail in the sections 4.1–4.4 are described. The discussion is also intended to highlight the important ideas that are elucidated by the default logic approach.

Foremost among the differences between the default logic approach and most of the previous

approaches is that it is not a projection method. Discussion in Chapter 3 emphasized my belief that many of the problems experienced by the projection methods are due to the misconception that "presuppositions of the underlying phrases" are somehow projected, possibly with some cancellation, as the presuppositions of the sentence. In marked contrast, this proposal considers presuppositions as inferences derived from the utterance using an appropriate proof theory. Unlike my predecessors I have had the benefit not only of their experiences but also of the existence of default logic.

Another difference between the previous methods and the one presented here concerns negation. For the previous methods negation either played no role in the projection process, or it had to be treated ambiguously, either lexically or syntactically (using Karttunen's metaphor, sometimes '*not*' is a hole and sometimes it is a plug). For the default logic approach, negation plays a central role in the generation of presuppositions. All of the default rules which act as presupposition generators have the presuppositional environment negated in the antecedent position. The second item is a criticism that has been levelled at the presuppositional theories of Karttunen and Karttunen and Peters (Gazdar (1979)).[51] The default logic approach has circumvented this problem by advocating a vague, as opposed to an ambiguous, representation of negation. Unlike the previous advocates of the vague representation (Kempson (1975) and Atlas (1977)), the default logic approach seems able to explain how the various interpretations of the vague representation arise.[52]

[51] Although the ambiguity of '*not*' is not explicitly addressed in Soames (1982), I do not see how Soames can escape this criticism as well.

[52] A few caveats are in order. What is meant by *explain* is in the context of the derivation of the various interpretations. A proof theoretic version of this explanation has been given and a model theoretic version has been sketched. A better understanding of appropriate model theories for default logic is required in order that a reasonable model theoretic interpretation of presuppositions can be given. This inability to give a complete model theoretic definition is why I say *seems able* rather than *is able*. *Explain* should not be interpreted as meaning an explanation of why certain linguistic structures and lexemes produce presuppositions. Throughout this thesis I have assumed the existence of presuppositional environments. However, in the discussion of the lexical presuppositions I conjectured a possible reason for the nature of lexical presuppositions based on the structure of an *IS-A* hierarchy. Nor should any psychological or linguistic reality about default rules be construed. However, after providing these warnings, I do want to emphasize that, although the thesis deals mainly with the derivational aspects of natural language presuppositions, implicit in the assumptions are, I think, some important conjectures: Basic to the whole theory is the idea that most unnegated basic linguistic constructs are conjunctive in nature. Negated, they form disjunctions. Because various interpretations are available for the disjunctive representations, negation would run counter to Grice's maxims of conversation, which under one reading state

It should now be quite obvious that this work has been greatly influenced by Gazdar (1979). Basic to both approaches are the notions that presuppositions are inferences of an utterance and that the inference relation is not entailment but rather one of consistency. (Gazdar does not prohibit a statement from being both an entailment and a presupposition, however.) Of great importance to both approaches is the inclusion of the implicatures of the utterance in its representation, especially the clausal implicatures. Lastly, Gazdar's definition of the presuppositions of an utterance relative to the context influenced my decision to consider a *hearer–based* theory of presupposition. So, rather than having to defend a Platonic view of meaning (that is, one in which concepts have a single true meaning), the default logic approach predicts presuppositions relative to a hearer's knowledge base. Not only is it easier to defend theoretically, but a hearer–based theory is also closer to reality and can provide a model for inappropriate interpretations by the hearer.

Unlike Gazdar's approach the default logic approach does not consider an inference to be a presupposition if it is an entailment also. This point has been discussed in Chapter 3. The definitions and logical theories of entailment and presupposition are more perspicuous if the two notions are treated as non–intersecting. Also, I have speculated that the *only* reason that the previous approaches have treated the two notions as overlapping is because of the manner in which the projection methods work. On the other hand, the default logic approach assumes that the representation of the sentence contains underlying representations (negated presuppositional environments) that produce presuppositions and representations that produce entailments.

Intimately connected with the problem of overlapping definitions is the problem of correctly labelling inferences as presuppositions and as entailments. Because projection methods project presuppositions in some situations in which entailments are not projected, the correct labelling is crucial for generation of the correct sentential presuppositions. Although I have also been particularly careful to label the two kinds of inferences correctly, the reason for doing so is different. Since the default logic method is not a projection method, it could just as well label both entailments and presuppositions simply as inferences. The derivation process as far as sentential inferences are concerned is unaffected. Where the effect of mislabelling is noticed

that utterances should contain as much information as needed to make them unambiguous. The default rules, if taken as universally held parts of the definition of the linguistic structures in question, fill the role of being the necessary knowledge used to disambiguate the utterance.

is in the ability to cancel presuppositions in later conversation. I have suggested earlier that this cancellation would be handled by a Truth Maintenance System. The correct labelling of the inference allows the TMS to distinguish between inconsistencies (a statement that is the negation of some previous entailment) and cancellation (a statement that is the negation of some previous presupposition).

The default logic approach, unlike Gazdar's, is not subject to the criticism that Gazdar's cancellation rules must be ordered in a certain way for them to work as desired. This same criticism can be made about Soames (1982) as well. Both authors are aware of their inability to defend the strict ordering of the rules with an explanation other than that the methods work (at least for the examples cited). Since the default logic approach uses a quasi–logical proof procedure, the ordering of the application of the rules depends only on what premises are available at any point in the proof. If rules were added to the theory to produce the clausal implicatures, this approach would still not succumb to the ordering criticism that plagues Gazdar and Soames. At each point in the proof any rule that *may* be used *can* be used. The order of the rule application is just a by–product of the proof. So, the ordering is not imposed on the approach as is done by Gazdar and Soames, rather it is intrinsic to the approach itself. Up to this point all of the examples have only involved default theories with single extensions. What has been said about the order of rule application is correct as stated for these examples. However, in theories with multiple extensions, the choice of default rules does affect the inferences that are made. So, does the rule ordering problem arise again? The answer is no. Later in section 4.5.5.2, an example is given in which a consensus regarding the truth of a presupposition is required among all extensions. Hence, in reality rather than making a choice among defaults, parallel proofs are undertaken, and the presupposition must be provable in the various proofs. Thus ordering is again of no consequence.

Although the default rules which produce the presuppositions look similar to Gazdar's potential presupposition generating functions, there is a subtle difference between the two. In Gazdar's approach the potential presupposition generating functions are not dealt with directly. Rather, they generate the potential presuppositions and it is these potential presuppositions that the method uses. On the other hand, the default rules take part directly in the default logic proofs. The default rules can be viewed as intensional representations of Gazdar's potential presupposition generating functions. Unlike Gazdar's situation in which he must make a philosophical handwave about the ontological (in)significance of the potential presuppositions (the

extensions[53] of the potential presupposition generating functions), the default logic approach does not have these entities lurking in the theoretical closet. Only if the default theory can derive the consequent of the default (which is the "potential presupposition") is it derived.

Karttunen and Peters (1975, 1979) and Soames (1982) realize that the surface structure of the sentence, which may or may not be reflected in the semantic representation, can affect the cancellation of the "presuppositions" that arise from the subordinate structures. This structural significance is captured in two ways. Firstly, Karttunen and Peters' filtering rules (which are implicit in Soames' definition of the actual presuppositions of a sentence relative to an utterance) have structural information embedded in them. The rule for *and* is not symmetric so the presuppositions for '*A and B*' could be different than for '*B and A*'. The rules for '*If A then B*' and '*A or B*' are different even though the two sentences have very similar underlying representations. In addition, Soames postulates a separate rule for '*B, if A*' to reflect the surface order of the clauses. This is in marked contrast to Gazdar who treats sentences as being structurally flat as far as any treatment of the potential presuppositions is concerned. That is, all potential presuppostions are treated equally no matter what their origins may have been. The only influence (vis à vis presuppositions) that structure has in Gazdar's method is via the clausal implicatures which can cancel potential presuppositions. The clausal implicatures for '*If A then B*' and '*A or B*' can include $\mathsf{P}_S\neg A$ and $\mathsf{P}_S\neg B$, whereas these cannot be included in the set of clausal implicatures for '*A and B*'.

Although the default logic approach also takes into account the surface structure of the sentence, the method for accomplishing this feat is quite different than all of the previous approaches. Besides there being some weak links to many–valued logic, the only motivation for the filtering rules presented in the Karttunen and Peters paradigm seems to be empirical evidence. Other linguistic evidence to support the rules is not forthcoming. Also, the seemingly ad hoc repairs to the rules, which have been argued against in section 4.1.1, bely the unnaturalness of the method suggested. The motivation in the default logic approach comes from two sources: directly from the logic (case analysis is one of the tools available to the proof procedure), and in a more subtle manner from the linguistic interpretation given to the derivation procedure (this interpretation leads to the use of the presuppositional default rules in the case analysis only in situations that have a linguistic basis). Later in section 4.5.3.3 how the clausal ordering can influence the default logic approach in ways which parallel Soames' rule for '*B, if A*' is

[53] Used here in the intension/extension sense of the word, not its default logic sense.

discussed. Even though the default logic approach has only the clausal implicatures that are present in Gazdar's method, the implicatures plus the surface structure information given by the semantic representation gives a better result than Gazdar's structurally flat approach.

In connection with the Karttunen and Peters' approach, and consequently with Soames' approach as well since it embodies the former, are two problems which have been discussed previously in Gazdar(1979). Firstly, the categories of plugs, holes, and filters are unnatural in the sense that there exists no criteria other than the presuppositional one to define the classes. I believe that the default logic approach cannot be criticized on these grounds, since there is no filter category and the plugs and holes are defined in a fashion parallelling the entailment analysis which I is taken as predefined. The filtering conditions exist in the default logic method as side effects of the inferencing process. Holes are holes because the entailment relation holds, for example, factive verbs entail their complements when used in affirmative sentences. Plugs are plugs because the affirmative usage of these words does not entail the inferences which the subordinate structure would generate if not embedded under the plug. I strongly suspect that a proper understanding of these plugs, which are essentially the class of propositional attitudes, will provide the theoretical evidence to support this lack of entailment. Karttunen points out that in some cases the plugs can "leak". I also conjecture that the "scoping problem for negation" will find an analogous "scoping problem for propositional attitudes" which may also have a default logic solution. Secondly, the problems associated with an ambiguous '*not*', required by the Karttunen and Peters approach and hence by the Soames approach too, are not present in the default logic approach.

An interesting similarity to Gunji's method is seen in the capturing of the five kinds of cancellation. *Abortion* and *creation* are captured by the proof theory of default logic and by representing presuppositional environments as default rules. The non–overlapping definition of entailment and presupposition provided in the default logic approach capture the two kinds of presupposition cancelling found in Gunji's approach called *absorption* and *cancellation*. *Consolidation* requires the use of a Truth Maintenance System (TMS). The default logic approach provides the means for marking those inferences which can be consolidated by a TMS. Other similarities with Gunji's method include the desire to have a model theoretic view of presuppositions and the importance that sentence structure (as reflected in the semantic representation) has on the presupposition generating process. Although there are similarities in the fundamental concepts, the details differ greatly. Section 4.3.1 contains a detailed description of what

I believe to be some very serious problems in Gunji's implementation of these fundamental concepts.

The default logic approach includes not only what is captured in the projection methods but it also captures a definition of presupposition as well, similar in style to Gazdar's approach. Although only a preliminary version of the appropriate proof–theoretic and model–theoretic definitions of presupposition have been given, a long–term goal of this research is to find appropriate definitions.

4.5.2 Empirical Evidence

Although an extensive list of defaults is not given in Chapter 3, the theory presented there is easily applied to any of the presuppositional environments. A lengthy but not exhaustive list of presuppositional environments is presented in Chapter 2. Using the descriptively adequate terms from Karttunen (1973), the different projective categories of plugs, holes, and filters have been captured. Plugs, in the affirmative, do not have representations that generate vague representations when negated. Hence no presuppositions are forthcoming from these lexemes or syntactic structures. For the most part, holes are most naturally treated as presuppositional environments. The only hole that is treated differently by the default logic approach is '*possible*'. Two examples in Chapter 3 demonstrate the handling of this environment in a natural way. And, because they present the majority of the problems for presupposition theories, filters have been the dominant topic of discussion from the latter part of Chapter 3 to this point. Some of the examples presented in Chapter 3 demonstrate the ability of the default logic approach to generate the correct presuppositions in some of the (what are now considered) standard test cases. These examples include the filters '*or*' and '*if* ... *then* ...' in which the clauses contain no conflicting potential presuppositions and the same filters in which the clauses contain conflicting potential presuppositions.

Now I turn to the example described as a counterexample to Gazdar's method and presented in section 4.2.1. This example deals with the problem of lexemes that are defined using non–binary–valued features. This example is also a problem for Soames' method since that method also requires a cancellation step to rid itself of conflicting potential presuppositions. The problems of sentential adverbs and modified phrases are dealt with in later sections.

4.5.2.1 A Default Logic Approach to Non–Binary–Valued Features

In section 4.2.1 (4.47), renumbered here as (4.96), was given as a counterexample to the method proposed by Gazdar and hence also the one by Soames. In this section a demonstration of the default logic method is given to show that it does not succumb to the same empirical problems. (4.96) cannot be used directly to demonstrate the presupposition generating capacity of the default logic method. According to the definition of presupposition given in Chapter 3, an inference is considered to be a presupposition only if it cannot be derived using first order techniques alone. The inference (4.97) is derivable from an appropriate representation of the utterance using first order principles only.

However, in order to demonstrate the capabilities of the default logic approach, it is necessary to assume a result concerning multiple extensions that is sketched in section 4.5.5.[54] The additional assumption is: a case generates a statement if all extensions of that case generate the statement.[55] With this caution, the derivation of (4.97) as a presupposition of (4.98) is now demonstrated.

Mr. Jones is the principal or the vice–principal. (4.96)

Mr. Jones is white or coloured. (4.97)

If Mr. Jones is the principal or the vice–principal of Little Lord Fauntleroy School I will send my children there. (4.98)

The default theory (4.99) is the meaning given by an appropriate hearer, H, to an utterance of the sentence (4.98). The representation of (4.98) itself is the first statement in (4.99). In this representation the proposition ϕ is used to represent the consequent clause, '*I will send my children there*'. Since it plays no role in the discussion, it has not been expanded into a first order formula. The next four statements provide the information about the racial categorization in South Africa (the contrapositives of the third, fourth, and fifth statements can be derived). The default rules given for the non–criterial parts of the meaning of *principal* and *vice–principal*

[54]This result remains incomplete for only those situations that do not have a multiple extension concensus concerning a particular inference (that is, all extensions do not agree on the truth–value of the statement in question). No problem exists for situations that generate a multiple extension consensus. (4.98) is in this latter category.

[55]It is only an artifact of default logic that requires this extra assumption.

are just appropriate substitution instances of the default schema (3.49) given in Chapter 3.

$$\left\{\begin{array}{c}
\mathsf{K}_S((PRINCIPAL(Jones) \vee V\text{-}PRINC'L(Jones) \supset \phi)^{56} \wedge \\
LF(PRINCIPAL, Jones) \wedge LF(V\text{-}PRINC'L, Jones) \\
\mathsf{P}_S PRINCIPAL(Jones) \\
\mathsf{P}_S \neg PRINCIPAL(Jones) \\
\mathsf{P}_S\, V\text{-}PRINC'L(Jones) \\
\mathsf{P}_S \neg V\text{-}PRINC'L(Jones) \\
\forall x. HUMAN(x) \equiv WHITE(x) \vee COLOURED(x) \vee BLACK(x) \\
\forall x. WHITE(x) \supset \neg COLOURED(x) \\
\forall x. WHITE(x) \supset \neg BLACK(x) \\
\forall x. COLOURED(x) \supset \neg BLACK(x) \\
\forall x. PRINCIPAL(x) \equiv WHITE(x) \wedge CHIEF\text{-}ADMINIST'R(x) \\
\forall x. V\text{-}PRINC'L(x) \equiv COLOURED(x) \wedge SUB\text{-}ADMINIST'R(x) \\
\forall x. JANITOR(x) \equiv BLACK(x) \wedge CLEANER(x) \\
NONC(PRINCIPAL, WHITE) \\
NONC(V\text{-}PRINC'L, COLOURED) \\
\dfrac{\neg PRINCIPAL(Jones) \wedge LF(PRINCIPAL, Jones \wedge NONC(PRINCIPAL, WHITE) : WHITE(Jones)}{WHITE(Jones)} \\
\dfrac{\neg V\text{-}PRINC'L(Jones) \wedge LF(V\text{-}PRINC'L, Jones \wedge NONC(V\text{-}PRINC'L, COLOURED) : COLOURED(Jones)}{COLOURED(Jones)} \\
\vdots
\end{array}\right\} \tag{4.99}$$

The default logic approach can derive the appropriate presupposition (4.100) using the previously mentioned modification to the standard case analysis technique discussed in Chapter 3. The case analysis operates on the two cases given by the statements in (4.101).

$$WHITE(Jones) \vee COLOURED(Jones) \tag{4.100}$$

$$\begin{array}{c}
(PRINCIPAL(Jones) \vee V\text{-}PRINC'L(Jones)) \wedge \phi \\
\neg(PRINCIPAL(Jones) \vee V\text{-}PRINC'L(Jones)) \wedge \neg\phi
\end{array} \tag{4.101}$$

Details of the derivation follow:

Case 1: Assume (4.102). Each conjunct is derivable, in particular, (4.103). Using (4.103), (4.104), and (4.105), two applications of universal instantiation, two applications of modus

[56] It is of some interest to note that the same result is obtained if the sentence is given the equivalent representation

$$\mathsf{K}_S((PRINCIPAL(Jones) \supset \phi) \wedge (V\text{-}PRINC'L(Jones) \supset \phi))$$

ponens, two applications of discharging the conjunct, and the fact that $c \vee d$ is a tautologous consequence of

$$(a \vee b) \wedge (a \supset c) \wedge (b \supset d),$$

(4.100) can be derived.

$$(PRINCIPAL(Jones) \vee V\text{-}PRINC'L(Jones)) \wedge \phi \tag{4.102}$$

$$PRINCIPAL(Jones) \vee V\text{-}PRINC'L(Jones) \tag{4.103}$$

$$\forall x. PRINCIPAL(x) \equiv WHITE(x) \wedge CHIEF\text{-}ADMINIST'R(x) \tag{4.104}$$

$$\forall x. V\text{-}PRINC'L(x) \equiv COLOURED(x) \wedge SUB\text{-}ADMINIST'R(x) \tag{4.105}$$

Case 2: Assume (4.106). Each conjunct can be derived. The first conjunct is equivalent to (4.107). Each of the conjuncts in (4.107) is derivable, giving (4.108) and (4.112). Using (4.108), the default rule (4.109), statement (4.110), and default proof theory, but not using first order proof techniques alone, (4.111) can be proved.

$$\neg(PRINCIPAL(Jones) \vee V\text{-}PRINC'L(Jones)) \wedge \neg\phi \tag{4.106}$$

$$\neg PRINCIPAL(Jones) \wedge \neg V\text{-}PRINC'L(Jones) \tag{4.107}$$

$$\neg PRINCIPAL(Jones) \tag{4.108}$$

$$\frac{\begin{array}{l}\neg PRINCIPAL(Jones) \wedge LF(PRINCIPAL, Jones \wedge \\ \qquad NONC(PRINCIPAL, WHITE) : WHITE(Jones)\end{array}}{WHITE(Jones)} \tag{4.109}$$

$$NONC(PRINCIPAL, WHITE) \tag{4.110}$$

$$WHITE(Jones) \tag{4.111}$$

Using (4.112), the default rule (4.113), statement (4.114), and default proof theory, but not using first order proof techniques alone, (4.115) can be proved.

$$\neg V\text{-}PRINC'L(Jones) \tag{4.112}$$

$$\frac{\begin{array}{l}\neg V\text{-}PRINC'L(Jones) \wedge LF(V\text{-}PRINC'L, Jones \wedge \\ \qquad NONC(V\text{-}PRINC'L, COLOURED) : COLOURED(Jones)\end{array}}{COLOURED(Jones)} \tag{4.113}$$

$$NONC(V\text{-}PRINC'L, COLOURED) \tag{4.114}$$

$$COLOURED(Jones) \tag{4.115}$$

It is now most important to note that (4.111), (4.115), and (4.116) are inconsistent. Recalling the default logic interpretation of this situation, this case has created two orthogonal extensions, one in which (4.111) is true and one in which (4.115) is true. More importantly though, (4.100) is true in both extensions. Since all extensions of this case have (4.100) true, this case contributes (4.100) to the case analysis.

$$\forall x. WHITE(x) \supset \neg COLOURED(x) \tag{4.116}$$

Since both cases derive the same statement, (4.100), and at least one of the cases must use default proof theory in the derivation, (4.100) is a presupposition of (4.98).

I have argued that Gazdar's method cannot properly generate the presuppositions of sentence/knowledge combinations such as (4.99) because his method must assume that all lexemes (including those that provide the lexical environments from which the presuppositions are to be generated) are defined using binary features. Although it is difficult to imagine how Gazdar's method would be re–defined to accept non–binary knowledge as it is given in (4.99), an objection to the radical departure from his method, suggested by the default logic approach, might be that it is more sensible to modify the structure of the knowledge. Briefly, I turn my attention to this potential resolution.

Any attempt to create a binary *IS–A* hierarchy from an intrinsically non–binary knowledge structure will encounter the following problems. Firstly, since any possible combination of principal, vice–principal, and janitor can be used, the knowledge that is initially structured as a tree must now be structured as a lattice. A lattice structure has many problems that a tree structure does not. For instance in this example, the original ternary structure that naturally arises from the composition of the *HUMAN* predicate (the three incompatible predicates that designate the three races) is replaced by an less natural binary structure. Although there is nothing logically undesirable about this new structure, standard *IS–A* hierarchy functions such as property inheritance may be lost.[57] Secondly, even if the property inheritance problem

[57] If the properties of the nodes in the hierarchy are inherited from nodes higher in the hierarchy, because a node can have more than one parent in a lattice, a problem arises when trying to decide from which node to inherit a property which has a different value in the various parents. Because the only feature that differentiates the original predicates is race, then all of the new predicates that are created to form the binary structure must differ only on this feature. This would require the creation of new feature values which correspond to the disjunction of previous feature values. For instance, instead of just the three original values *white*, *coloured*, and *black*, there would be three other values, x, y, and z, which would correspond to the three possible pairwise disjunctions of

can be resolved, transforming the non–binary tree into a binary lattice may not solve the presupposition problem. If the representation is augmented with extra nodes the logical or of the "presupposition" justs returns a tautology. Thirdly, others have voiced concern about the utility of binary features to capture the meaning of words (Lehrer (1974)).

4.5.3 Sentential Adverbs

The intriguing counterexamples to Gazdar's theory of natural language presuppositions, provided in Soames (1982), include the two sentential adverbs '*too*' and '*again*'. Assuming the validity of the arguments against Soames' proposal, no projection method can deal with these presuppositional environments. Because one of the defining properties of a presuppositional environment is indicating positive to the negation test[58], I will first investigate the nature of each adverb in the presence of a natural language negation. The interesting property displayed by sentential adverbs is that in addition to any interaction between negation and the underlying logical form, there is also an interaction between negation and the adverb. This latter interaction can be captured as two different logical representations. Only one of the representations allows for the generation of presuppositions. As with all other cases of presupposition generation, this representation is the one in which the presuppositional environment, the sentential adverb, is in the scope of the negation.

Another feature that makes this category so interesting is that in addition to its first being presented as a collection of problems for Gazdar's presuppositional machinery, I believe that it also requires a radically different approach regarding the generation of presuppositions. This second property lends extra weight to the suspicion that has already been addressed in section 4.1 and section 4.4 regarding the inappropriateness of both Karttunen and Peter's method and Soames' method, because they have absolutely no problem treating these presuppositional environments defined in the conventional manner. Below, I argue that the usual context insensitive method for generating presuppositions from these environments is inadequate.

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the three original values. No others would exist. The same problem now exists for property inheritance, unless the definitions of the new values are available to the property inheritance mechanism. Whether the definitions of the new feature values are available, so that it could take the intersection of feature values, depends on the implementation.

[58] A positive indication to the negation test means that a sentence, S, containing the purported presuppositional environment and the preferred interpretation of *not* S both have the same inferences arising from the environment in question.

4.5.3.1 Too

Sentential adverbs have a most peculiar attribute when they interact with natural language negation. The adverb can be either inside or outside the scope of the negation. Sentences (4.117) and (4.118) point out the two possible interpretations[59] in the case of '*too*'. The italicized portions of the sentences indicate the portion which is in the scope of '*too*'. (4.117) is to be interpreted as: Although someone else kicked the ball, Bill didn't. (4.118) is to be interpreted as: Both Bill and someone else did not kick the ball.

BILL didn't *kick the ball*, too. (4.117)

BILL didn't kick the ball, too. (4.118)

The representations of '*kick too*' are shown in (4.119) and (4.120). These two representations convey the various foci of the adverb '*too*', the subject and the object of '*kick*', respectively.[60] Of interest in the following discussion is the representation which focuses on the subject, that is (4.119). The explanations for presuppositions that arise from the adverb focussing on the verb and the object are similar.

$$\forall x \forall y. KICK\text{-}SUBJ\text{-}TOO(x,y) \equiv KICK(x,y) \wedge \exists z. KICK(z,y) \wedge x \neq z \tag{4.119}$$

$$\forall x \forall y. KICK\text{-}OBJ\text{-}TOO(x,y) \equiv KICK(x,y) \wedge \exists z. KICK(x,z) \wedge y \neq z \tag{4.120}$$

The representations for the unnegated '*BILL kicked the ball, too.*' and the sentences (4.117) and (4.118) are shown in (4.121)–(4.123), respectively. The right–hand side equivalents of the appropriate representations are shown to contrast the two different negations. As proposed in Kempson (1975) and Wilson (1975), the representation of the simple negation of the sentence '*BILL kicked the ball, too.*' is just the wide–scoped negation (4.122).

$$KICK(Bill, ball) \wedge \exists z. KICK(z, ball) \wedge z \neq Bill \tag{4.121}$$

$$\neg(KICK(Bill, ball) \wedge \exists z. KICK(z, ball) \wedge z \neq Bill) \tag{4.122}$$

[59] '*Too*' also has the added complication that it can take any part of the sentence as the focus of the adverb. In this case the focus of the adverb is '*Bill*' and the word has been capitalized to indicate this fact.

[60] Using an event–based representation, the focusing of the verb is easily represented as well.

$$\neg KICK(Bill, ball) \wedge \exists z.\neg KICK(z, ball) \wedge z \neq Bill \tag{4.123}$$

What is important for the presuppositional analysis is that only (4.122) can be a candidate for the negation test. One of the prerequisites of this test is that the supposed presuppositional environment is within the scope of the logical negation in the logical representation of the sentence. The logical representation of (4.123) does not meet this requirement.

4.5.3.2 Again

The situation for the sentential adverb, *again*, is somewhat similar to that described above for *too*. The adverb can be inside or outside the scope of the negation. Accordingly, the adverbs found in (4.124) and (4.125) are the presuppositional and non–presuppositional environments with respect to the positive sentence '*Fred called again.*'. (4.124) is to be interpreted as: At some time in the past Fred called and during some interval of time which is important to the context in which the sentence is uttered, Fred didn't call. (4.125) is to be the following interpretation: At some time in the past Fred didn't call and during some interval of time which is important to the context in which the sentence is uttered, Fred didn't call.

FRED didn't call again. (4.124)

FRED didn't call again. (4.125)

The representation for '*call, again*' is shown in (4.126)[61].

$$\begin{aligned} &\forall x \forall y \forall z. CALL\text{-}SUBJ\text{-}AGAIN(x, y, z) \equiv \\ &\quad CALL(x, y, z) \wedge \exists t_1. CALL(x, y, t_1) \wedge t_1 < z \end{aligned} \tag{4.126}$$

The representations for the unnegated '*Fred called again.*' and the sentences (4.124) and (4.125) are shown in (4.127)–(4.129), respectively. As in the case of '*too*', the representation of the simple negation of the sentence '*Fred called again.*' is just the wide–scoped negation (4.128). The right–hand side equivalents of the appropriate representations are shown to contrast the two different negations. Only (4.128) sanctions a presuppositional analysis.

$$CALL(Fred, you, t) \wedge \exists t_1. CALL(Fred, you, t_1) \wedge t_1 < t \tag{4.127}$$

[61] This representation conveys only one foci of the adverb, '*again*', in this case, the subject. The object of '*call*', which in this case would have to be recovered from contextual cues (it would probably be *you* or *us*, though it could be a third party) can be focussed as well. Since the discussion is similar to that given for '*too*', it is omitted.

$$\neg(CALL(Fred, you, t) \wedge \exists t_1.CALL(Fred, you, t_1) \wedge t_1 < t) \tag{4.128}$$

$$\neg CALL(Fred, you, t) \wedge \exists t_1.\neg CALL(Fred, you, t_1) \wedge t_1 < t \tag{4.129}$$

4.5.3.3 Deriving Presuppositions of Sentential Adverbs Using the Default Logic Approach

The default rule schemata which capture the presuppositional inferences for the adverbs, '*too*' and '*again*', are (4.130) and (4.131), respectively. In the case of '*kick too*' and '*call again*' the appropriate instances of these schemata are shown in (4.132) and (4.133), respectively.

$$\frac{\neg(\phi(x,y) \wedge \exists z.\phi(z,y) \wedge x \neq z) \wedge LF(\phi, z, y) : \exists z.\phi(z,y) \wedge x \neq z}{\exists z.\phi(z,y) \wedge x \neq z} \tag{4.130}$$

$$\frac{\neg(\phi(x,y,t) \wedge \exists t'.\phi(x,y,t') \wedge t < t') \wedge LF(\phi, x, y) : \exists t'.\phi(x,y,t') \wedge t' < t}{\exists t'.\phi(x,y,t') \wedge t' < t} \tag{4.131}$$

$$\frac{\neg KICK\text{-}SUBJ\text{-}TOO(x,y) \wedge LF(KICK\text{-}TOO, x, y) : \exists z.KICK(z,y) \wedge x \neq z}{\exists z.KICK(z,y) \wedge x \neq z} \tag{4.132}$$

$$\frac{\begin{array}{r}\neg CALL\text{-}SUBJ\text{-}AGAIN(x,y,t) \wedge \\ LF(CALL\text{-}AGAIN, x, y) : \exists t'.CALL(x,y,t') \wedge t' < t\end{array}}{\exists t'.CALL(x,y,t') \wedge t' < t} \tag{4.133}$$

Given simple statements such as (4.134), the preferred interpretations can be derived from the representation of the sentence and the appropriate default rules. The representation for (4.134), originally given as (4.122) is rewritten here in its familiar disjunctive form (4.135). Since (4.135) is equivalent to the antecedent of default rule (4.132), this rule can be applied. Assuming that the rule derives its consequence, the first disjunct in (4.134) can be derived. (4.136), the preferred interpretation of (4.134), is just the conjunction of these derived statements.

Bill didn't kick the ball, too. (In the sense of (4.117).) (4.134)

$$\neg KICK(Bill, ball) \vee \forall z.\neg KICK(z, ball) \vee Bill = z \tag{4.135}$$

$$\neg KICK(Bill, ball) \wedge \exists z.KICK(z, ball) \wedge Bill \neq z \tag{4.136}$$

The preferred interpretation of (4.137) has a similar representation.

Fred didn't call again. (In the sense of (4.124).) (4.137)

Given the appropriate representations and default rules, the sentential adverbs can be observed in more complex situations, in particular, examples similar to those provided in Soames (1982). To show the important points, the two examples shown in (4.138) and (4.139) will suffice.

If JOHN kicked the ball, then BILL kicked the ball, too. (4.138)

If FRED called yesterday, then he will call again. (4.139)

The situation which is presented in examples (4.138) and (4.139) is more complex. The complexity arises because the presuppositional theory presented in Chapter 3 requires a case analysis in those situations which contain a logical or in the representation of the sentence[62]. The case analysis operates on two of the three cases normally generated by a logical or. The two cases for the sentence $a \vee b$ are $a \wedge \neg b$ and $\neg a \wedge b$. The reasons for not considering $a \wedge b$ are given in Chapter 3. It so happens that this extra case would not affect the presupposition generation procedure anyway. A sentence, S', which is derivable from all of the cases is derivable from the original sentence, S. S' is a presupposition of S if the derivation in at least one of the cases requires the use of a default rule.

In the case of sentential adverbs being in either the antecedent or consequent clause of the '*if* ... *then* ...' sentence the negation can be done in two possible ways. If the negation of the consequent clause does not put the sentential adverb in the scope of the negation, the default rule which generates the presupposition cannot be used. The case $\neg a \wedge \neg b$ does not infer the presupposition. Consequently, the case analysis cannot generate the presupposition as an inference from the sentence.

How is the appropriate method of negation justified in the case analysis? A slight modification of an argument by Stalnaker (1973) that '*if* ... *then* ...' sentences are to be interpreted in a manner that is similar to conjunctive sentences is used. Stalnaker's view of conjunctions is that the second sentence is affected by the presence of the first sentence. I will modify this view to include the way the sentence is represented. Therefore if there is a sentential adverb in the second conjunct, it should interact with any negations in such a way as to have the same

[62]The representation of '*if a then b*' is not equivalent to $a \supset b$. However $a \supset b$ can be derived from standard representations for '*if a then b*' such as Stalnaker's conditional logic representation, $a > b$ (Stalnaker (1968)). The theory presented in Chapter 3 defines presuppositions as inferences derivable from a theory which includes the representation of the sentence. Therefore the logical form $a \supset b$ will be available to the deductive machinery.

interpretation as in the first clause. For example, (4.140) should have the representation given in (4.141), whereas (4.142), because there is no previous clause to affect the representation of the first conjunct, should have the representation given in (4.143).

JOHN didn't kick the ball and BILL didn't kick the ball, too. (4.140)

$$\begin{aligned}&\neg KICK(John, ball)\\&\quad \wedge \neg KICK(Bill, ball) \wedge \exists z.\neg KICK(z, ball) \wedge Bill \neq z\end{aligned} \tag{4.141}$$

BILL didn't kick the ball, too and JOHN didn't kick the ball. (4.142)

$$\begin{aligned}&\neg(KICK(Bill, ball)\\&\quad \wedge \exists z.\neg KICK(z, ball) \wedge Bill \neq z) \wedge \neg KICK(John, ball)\end{aligned} \tag{4.143}$$

Similarly, the clauses in indicative conditionals will be affected in the same way. In the representation of $a \supset b$ one of the cases is $\neg a \wedge \neg b$. If '*If a then b, too.*' is the sentence from which this representation is generated, then the representation of $\neg a \wedge \neg b$ will be in the same form as (4.141).

Unfortunately, this methodology does not work for sentences like '*B, if A*'. Soames (1982) predicts that no presupposition is derived from sentences of this form regardless of which clause contains the '*too*'. Unlike Soames, who generates yet another *ad hoc* rule to cope with this sentential form, I believe that a better understanding of the underlying syntactic relationship between '*not*' and the sentential adverbs will provide the solution within the default logic framework.

4.5.4 Modified Phrases

Soames (1982) gives (4.144) as a counterexample to Gazdar's theory.

S: If someone at the conference solved the problem then it was Julian (who solved it).[63]

A^I: $P_S\neg$Someone at the conference solved the problem (4.144)

B^P: K_SSomeone solved the problem

[63]It is important that this sentence be read with no contrastive stress placed on the phrase '*at the conference*'. The contrastively stressed reading is discussed later.

Landman (1981) and Soames (1979, 1982) realize that Gazdar's method encounters the following problem with sentences containing modified phrases in an implicature generating environment and the same but unmodified phrase in a presupposition generating environment. The logical statements that are available to do the cancelling are not strong enough to cancel the potential presupposition that is being added to the context. (The cancelling statements are more specific than the potential presuppositions.) Here, the antecedent clause in S produces the clausal implicature denoted $\mathbf{A}^{\mathrm{I}}$. The consequent clause produces the potential presupposition denoted $\mathbf{B}^{\mathrm{P}}$. Because the antecedent clause contains the modifying phrase '*at the conference*', $\mathbf{A}^{\mathrm{I}}$ is more specific than the more general $\mathbf{B}^{\mathrm{P}}$. Hence the implicature does not cancel the potential presupposition and $\mathbf{B}^{\mathrm{P}}$ is allowed to enter the context where it becomes a presupposition of S.

Both of their putative solutions suggest increasing the strength of the cancellation process. Landman proposes to accomplish this strengthening by generating stronger (that is, less specific) cancelling statements. Soames considers strengthening the cancellation mechanism by augmenting a Gazdar–like method with a Karttunen and Peters–like method, thereby sending all potential presuppositions through two filters. Arguments that these methods are lacking for a variety of reasons have been given in sections 4.1.1, 4.2.3, and 4.4.1.

The course taken by the default logic approach is to weaken the potential presupposition appropriately (that is, make it more specific), rather than to strengthen the cancellation side. The method proposed to make the potential presuppostion weaker is to recover the necessary restriction that has been deleted in the surface form of the sentence. If the natural language sentences which form the category exemplified by (4.144) have representations like the one suggested here, then from a mechanistic point of view the default logic approach is able to explain the data. It is necessary to provide unrelated evidence to support the choice of representation suggested here. There is some evidence but it is in this respect that the proposed solution requires more study.

The proposed solution requires that the clause without the modifying phrase in the surface form have the modifying phrase represented in its semantic representation. The modifying phrase can be represented as a type on the existential quantifier or the λ–variable or as an extra conjunct. So, using the extra conjunct method the S–sentence in (4.144) can be given

the representation (4.145).

$$\begin{aligned}&\exists x.[AT\text{-}CONF(x) \wedge SOLVE\text{-}PROB(x)] \supset \\ &\quad \lambda x[AT\text{-}CONF(x) \wedge SOLVE\text{-}PROB(x)]Julian^{64}\end{aligned} \tag{4.145}$$

With this representation the solution to the modified phrase puzzle is trivial. The "potential presupposition" that is derived from the cleft construction in the consequent clause has the same body as the antecedent clause (for Gazdar's method, the clausal implicature that is generated by the antecedent clause). The appropriate cancellation can now take place. It is noteworthy that this solution is not dependent on using the default logic approach as indicated by the parenthetical remark above. Rather it comes from an appropriate choice of semantic representation for the natural language sentence.

The following are the independent justifications supporting the plausibility of the semantic representation described above.

1. The modified Stalnaker view, discussed earlier with respect to the sentential adverbs, can be used to justify the recovery of the extra information in the consequent clause. The first clause talks about someone at the conference so without any indication to the contrary probably the second clause does, too.

2. A natural interpretation of the S–sentence in (4.144) would include as part of the meaning that if someone solved the problem then Julian is the *unique* individual who solved it. If a material implication is used to represent the conditional then if the sentence is true because the antecedent and consequent are true, then the antecedent forces the person who solved the problem to be at the conference. Given the uniqueness criterion, Julian must be at the conference. Since one way to make the sentence true requires Julian to be at the conference, it seems that the speaker is committed to Julian's being at the conference. A similar argument can be used if the Stalnaker conditional (>) is used to

[64]On occasion it may be desirable to make explicit the fact that Julian is the unique individual who solved the problem. This is done by making the consequent a conjunct, as is shown here.

$$\begin{aligned}&\exists x.[AT\text{-}CONF(x) \wedge SOLVE\text{-}PROB(x)] \supset \\ &\quad (\lambda x[AT\text{-}CONF(x) \wedge SOLVE\text{-}PROB(x)]Julian \wedge \\ &\quad (\forall y(\lambda x[AT\text{-}CONF(x) \wedge SOLVE\text{-}PROB(x)]y) \supset y = Julian))\end{aligned}$$

This does not present a problem since the default logic method allows normal logical derivation to take place. Noting that the consequent is a conjunction of two propositions and using a rule of derivation available from propositional logic (from $A \supset (B \wedge C)$ derive $A \supset B$ and $A \supset C$) the logical statement (4.145) is obtained and processing continues as described.

represent the conditional. $A > B$ is interpreted as meaning if there is a world in which A is the case and B is also the case then the conditional is true. Given the uniqueness criterion, the truth of the S–sentence in (4.144) requires Julian to be at the conference.

3. A gloss of the S–sentence in (4.144) might be '*If someone at the conference solved the problem then of those at the conference it was Julian who solved it.*'[65]

4. Another justification, motivated by a combination of points 1 and 3, is that even though the *it* in the consequent clause is part of the cleft construction it seems to refer back to the event mentioned in the antecedent clause. That is, if someone satisfies the conjunctive relation of being at the conference and having solved the problem then Julian satisfies the conjunctive relation of being at the conference and having solved the problem. This interpretation is represented exactly by (4.145).

What is missing from the supporting evidence above is a good syntactic argument that would require the consequent clause in the semantic representation to contain the extra information. Using these four arguments, the missing phrase can be recovered and put in the semantic representation. If the evidence above is correct, then the extra information does not change the semantic meaning of the natural language sentence and it helps the presuppositional analysis.

A problem arises with the present representation when there is contrastive stress in the antecedent as indicated in (4.146). (Contrastive stress is indicated by italics.)

If someone *at the conference* solved the problem then it was Julian. (4.146)

The default logic approach requires the contrastively stressed item, part of the antecedent in this case, to be represented as a λ–expression. The problem here is that what is contrastively stressed in the natural language sentence corresponds to part of a quantified formula in the representation. What is required by the default logic approach is that the contrastively stressed item correspond to a term in the representation. A possible solution to this problem is the use of Hilbert's ε–terms which are terms created from quantified formulae. For instance, the term $\varepsilon x AT\text{-}CONF(x)$ represents '*somebody at the conference*'. This term is used anywhere that an ordinary term (that is, a constant, a variable, or a function) can be used. The representation

[65]Compare this with the sentence '*If someone at the conference solved the problem then Julian solved it, too.*'. This sentence seems to indicate that Julian is not at the conference. The sentence '*If someone at the conference solved the problem then Julian solved it.*' seems to be ambiguous regarding Julian's conference attendance.

of (4.146) using ε–terms would be (4.147). Using (4.147) and the appropriate default rule for contrastive stress, (4.148) can be derived as a presupposition of (4.146). This presupposition is a result of the stress in the antecedent clause.

$$\begin{aligned}&\lambda x[SOLVE\text{-}PROB(x)]\varepsilon x AT\text{-}CONF(x) \supset \\ &\quad \lambda x[AT\text{-}CONF(x) \wedge SOLVE\text{-}PROB(x)]Julian\end{aligned} \tag{4.147}$$

Someone solved the problem. (4.148)

Of course this new representation generates a number of questions. Would a skolemized version of (4.145) allow (4.148) to be derived? Would the skolemized version have the same meaning as (4.147)? It is noteworthy that the use of the ε–term discards not only the quantifier but the conjunction also. A detailed analysis of this situation is required, but the representations as presented seem reasonable as well as promising.

4.5.5 Problems Requiring Further Analysis

Three[66] kinds of sentences that create problems for the default logic approach as it is presently constituted are discussed below. Complex indicative conditionals (those with conjunctive antecedents and those with an embedded indicative conditional as the consequent, and sentences that contain the form $\neg A \wedge \neg B$ in their semantic representations, where A and B contain presuppositional environments with conflicting potential presuppositions, are discussed in some depth in sections 4.5.5.1 and 4.5.5.2. Straightforward mechanisms to deal with both cases are provided. What is missing are solid supporting arguments for the mechanisms. Sketches of arguments are provided.

But before proceeding with these in–depth discussions, a brief diversion is made to discuss the third kind of sentence, ones that contain *indefinite noun phrases.* No attempt has been made to incorporate this type of sentence into the default logic approach. Two quite well–known examples (4.149) and (4.150) demonstrate the presuppositional character of indefinite noun phrases.

If Nixon invites George Wallace's wife to the White House, then the president will regret having invited a black militant to his residence. (4.149)

If Nixon invites Angela Davis to the White House, then the president will regret having invited a black militant to his residence. (4.150)

[66]This should not be construed as a complete list of problems, rather a list of the ones of which I am aware.

The main problem with these two sentences is that '*a black militant*' refers to different people in the two sentences. Given the appropriate background information[67], '*a black militant*' in (4.149) refers to someone not mentioned in the sentence, whereas in (4.150) it refers to Angela Davis. So, (4.149) presupposes (4.151) whereas (4.150) does not.

The president will have invited a black militant to the White House. (4.151)

4.5.5.1 Complex Indicative Conditionals

In all prior examples (with the already noted exception of the non–binary feature example) the default theories representing the meaning of the utterances produce single layer case analyses. A type of sentence which produces a case analysis within a case analysis is the complex indicative conditional. Two examples given in Soames (1982) are reproduced here as (4.152) and (4.153). The representation for both of these sentences is (4.154).[68]

If the dress Mary bought is powder blue and the dress Susan bought is, too, then Mary will regret having bought a dress that is the same colour as Susan's. (4.152)

If the dress Mary bought is powder blue then if the dress Susan bought is also powder blue, Mary will regret having bought a dress that is the same colour as Susan's. (4.153)

$$\begin{aligned}
&[BUY(Mary, dress_1) \wedge COLOUR(dress_1, blue) \wedge \\
&\quad BUY(Susan, dress_2) \wedge COLOUR(dress_2, blue)] \supset \\
&\quad REGRET(Mary, \\
&\qquad BUY(Mary, dress_1) \wedge COLOUR(dress_1, colour_1) \wedge \\
&\qquad BUY(Susan, dress_2) \wedge COLOUR(dress_2, colour_2) \wedge \\
&\qquad colour_1 = colour_2)
\end{aligned} \tag{4.154}$$

The potential presupposition that is of particular interest is the one generated by the consequent clause, that is, '*Mary bought a dress that is the same colour as Susan's.*'. Neither (4.152) nor (4.153) presupposes it. Since all of the logical connectives in (4.154) that correspond to the natural language connectives in (4.152) and (4.153) connect propositions, then without loss of

[67]Note that given different background knowledge, for instance, one black militant is all right, but get two of them together and they create a disturbance, (4.150) also presupposes (4.151).) What is required is a representation that provides the appropriate anaphoric referent for the indefinite noun phrase. Although Gazdar (1979) suggests an appropriate representation, I have not followed it up.

[68]Since (4.153) has a representation whose form is $A \supset (B \supset C)$, by propositional logic this representation is equivalent to $(A \wedge B) \supset C$ which is the form of the representation of (4.152).

generality propositional letters can be used in the discussion below. A will be the first proposition in (4.154) and B and C will be the second and third, respectively. The representation using these propositional letters is simply $(A \wedge B) \supset C$. If the standard case analysis approach is used on (4.154) the following is the result.

Case 1: $A \wedge B \wedge C$

In this case all of the entailments of A, B, and C are entailed. In particular '*Mary bought a dress that is the same colour as Susan's.*' is entailed from C and from $A \wedge B$.

Case 2: $\neg(A \wedge B) \wedge \neg C$

In this case the appropriately configured default can infer that '*Mary bought a dress that is the same colour as Susan's.*' if it is consistent with this case. Unfortunately there is one truth–value combination for A and B (both false) that makes '*Mary bought a dress that is the same colour as Susan's.*' consistent. (A and B can be made false just by denying that they purchased powder blue dresses without specifying the actual colour. That Mary's dress and Susan's dress are the same colour is consistent.)

It is important to note though, that this case is not completely conjunctive. Since $\neg(A \wedge B) \wedge \neg C$ is equivalent to $(\neg A \vee \neg B) \wedge \neg C$ there seems to be another case analysis lurking in the representation. There are three subcases of case 2.

Case 2.1: $\neg A \wedge B \wedge \neg C$

In this subcase '*Mary bought a dress that is the same colour as Susan's.*' is not consistent so the default rule that would infer this statement is unable to do so.

Case 2.2: $A \wedge \neg B \wedge \neg C$

This subcase is similar to case 2.1.

Case 2.3: $\neg A \wedge \neg B \wedge \neg C$

This is the subcase mentioned in the discussion of case 2, above. The pertinent statement is derivable using an appropriate instance of the default rule for cleft sentences.

Since at least one of the subcases of case 2 does not allow the derivation of the putative presupposition, under the subcase analysis neither (4.152) nor (4.153) presupposes the statement in question.

The aspect which is not absolutely certain is whether the subcases are to be interpreted in this manner. Since the connection back to logic and the connection with the clausal implicatures exists just as they do in the standard case analysis, all that is required to confirm this interpretation is a careful study.

4.5.5.2 Multiple Extensions

In all examples to this point the default theories representing the meaning of the utterances have single extensions. Default theories representing the meaning of utterances that contain the form $\neg A \wedge \neg B$ in their semantic representations, where A and B contain presuppositional environments that generate conflicting inferences, have multiple extensions. (4.98), which is discussed in some detail in section 4.5.2.1, is an example of a natural language sentence that contains this form in its semantic representation. Another exemplar of this set is (4.155).

My teacher is not a bachelor and not a spinster. (4.155)

The two issues brought forth by multiple extensions, what inferences are to be considered presuppositions and what linguistic interpretation is to be given to the mutiple extensions, are partially analyzed below.

The first issue is relatively straightforward. The theory (4.156) represents a typical meaning given by a hearer upon hearing (4.155) uttered.

$$\left\{\begin{array}{c} \mathsf{K}_S(\neg BACHELOR(t_1) \wedge \neg SPINSTER(t_1)) \wedge \\ LF(BACHELOR, t_1) \wedge LF(SPINSTER, t_1) \\ \forall x. MALE(x) \supset \neg FEMALE(x) \\ \dfrac{\neg BACHELOR(t_1) \wedge LF(BACHELOR, t_1) \wedge \\ NONC(BACHELOR, MALE) : MALE(t_1)}{MALE(t_1)} \\ \dfrac{\neg SPINSTER(t_1) \wedge LF(SPINSTER, t_1) \wedge \\ NONC(SPINSTER, FEMALE) : FEMALE(t_1)}{FEMALE(t_1)} \\ \vdots \end{array}\right\} \tag{4.156}$$

Both $MALE(t_1)$ and $FEMALE(t_1)$ have default logic proofs given the theory (4.156). In classical logic this situation would also allow a derivation of $\perp$ meaning that the theory is inconsistent. However, in default logic this situation means that there are (at least) two orthogonal extensions, one in which $MALE(t_1)$ is true and one in which $FEMALE(t_1)$ is true. In addition, (4.157) is true in both extensions. This derived sentence is not such a startling result since one

property of default logic is that all tautologies are true in all extensions.

$$MALE(t_1) \vee FEMALE(t_1) \tag{4.157}$$

However, the analogous situation for (4.98) is more exciting. Recalling from section 4.5.2.1, (4.158) is true in all extensions of the theory in question, (4.99).

$$WHITE(Jones) \vee COLOURED(Jones) \tag{4.158}$$

(4.158)'s truth in all extensions is exciting for two reasons. Firstly, unlike (4.157), it is not a tautology. Recalling the definition of presupposition from Chapter 3, (4.158) is a presupposition since it is derivable only with the use of one of the presupposition–generating defaults, whereas (4.157) is an entailment (hence not a presupposition) because it is derivable using only first order techniques (it is a tautology). Secondly, although the proof–theoretic definition for presupposition becomes slightly more cumbersome, the model–theoretic definition continues to provide the close analogy to entailment that is desired. In particular, the presupposition is true in all models of the default theory (which are meant to correspond to the preferred models of the natural language sentence). Detailed examination of the two definitions and of the correspondence between the two kinds of models has not been undertaken.

The second issue that emerges is the linguistic interpretation to be given to the multiple extensions. What is most interesting about this issue is that not only has the default logic approach forced an analysis of this situation (none of the previous methods considered it) but the default logic approach provides some guidance also.

Using a Gricean argument, the hearer should be able to infer that one conjunct in (4.155) is being used in its preferred sense. Otherwise, two extra clauses would be needed to deny the preferred interpretation of each conjunct. Lest a contradiction occur, the other conjunct is being used in one of its non–preferred senses. Its preferred sense is blocked by the other conjunct. Additionally, the hearer should be able to infer that the speaker does not have sufficient information to say which of the two conjuncts is being used in its preferred sense. Otherwise, the speaker could have used only that conjunct. Using the notation '$\mathsf{P}^*_S A$' to mean '*for all the speaker knows the preferred meaning of A is possible*', this analysis is captured as follows: the hearer is able to deduce that the speaker knows (4.159). But (4.159) together with the inference $ADULT(t_1)$, which is derivable from the default theory, generate (4.160) as a consequence.

$$\mathsf{P}^*_S \neg BACHELOR(t_1) \wedge \mathsf{P}^*_S \neg SPINSTER(t_1) \tag{4.159}$$

$$\mathsf{P}_S MALE(t_1) \wedge \mathsf{P}_S FEMALE(t_1) \tag{4.160}$$

This interpretation is directly available from the default logic approach, if the inferences are properly interpreted. Recalling the discussion from Chapter 3, sentences derived from a default theory are true in some extension of that theory. Inferences that are contradictory are true in orthogonal extensions. For the purposes of the discussion here, the important question is what interpretation to give to the existence of multiple extensions. Throughout this thesis, derivability of a statement S from a default theory with a single extension has been interpreted in this linguistic setting to mean that the utterance allows the hearer to infer that the speakers knows S. In multiple extension default theories the derivability of S_1 and S_2 (and the nonderivability of $S_1 \wedge S_2$) means that some set of consistent beliefs (represented by the set of default rules that generate the extension) allow S_1 to be deduced and some set of consistent beliefs allow S_2 (and, of course, since S_1 and S_2 are inconsistent, no set of consistent beliefs can infer $S_1 \wedge S_2$). In addition, there are no means to choose between the two sets of beliefs. This situation in the default logic can be given the following interpretation for the linguistic situation: both S_1 and S_2 are possible for the speaker, and the speaker does not have the knowledge to know which is the case. Also, since all of the features needed for the preferred sense of a negated term are true in some extension, the notion of extension captures the notion P^*_S. Also provided by this interpretation is the following: since $MALE(t_1) \wedge FEMALE(t_1)$ cannot be derived in a default proof, one and only one of $MALE$ and $FEMALE$ can be true in any extension. Hence only one of '*not a bachelor*' and '*not a spinster*' is being used in its preferred sense, the other being used in one of its non–preferred senses (in this case denying the particular sex of the teacher). The theoretical foundation for the connection between the Gricean interpretation and the default logic interpretation still needs to be worked out.

4.6 Summary

The preceding sections have presented a detailed critical analysis of various methods that determine the presuppositions of natural language sentences. Although I have presented a number of empirical counterexamples to each method, the more important aspect of the criticism is on methodological grounds. In the case of Gunji (1982) I have demonstrated serious problems with his method's treatment of presuppositions and conventional implicatures with respect to sentences that contain disjunctive information. For Karttunen and Peters (1979) and

Soames (1982) I have provided an argument that undermines a key ingredient of their methods. Without the rule for extracting B from the intermediate $A \supset B$ their methods cannot generate the appropriate presuppositions for indicative conditionals.

Except for the problem with disjunctive presuppositions, the method presented by Gazdar (1979) remains reasonably intact. Although the default logic approach is built on completely different foundations, the influence of Gazdar's method is clear.

The default logic approach is a major improvement over the previous methods. Not only does it not succumb to the empirical counterexamples of the previous methods (with the exception of sentences of the form '*B, if A*') but it is methodologically more sound also.

Chapter 5

Generating Corrective Answers

It has been proposed by Belnap and Steel (1976) that, like declarative sentences, questions carry presuppositions, too. This idea has been applied in some natural language front–ends to databases to generate corrective answers that inform the questioner that the presuppositions of the question are false (Kaplan (1982) and Mays (1980a, 1980b)). The generation of corrective answers was the original motivation for the research presented in this thesis. Although all of the preceding discussion deals with the generation of presuppositions from asserted declarative sentences, the underlying assumptions made by the default logic method that is described there have some important ramifications for the problem of generating corrective answers.

The default logic method, as does any reasonable theory of presuppositions, makes two very important assumptions: all of the presuppositions of the sentence uttered by the speaker are known to be true by the speaker, and the speaker intends that the hearer infer these presuppositions. In the case of questions, these assumptions do not always hold. For example, the assertion of (5.1) presupposes (5.2).

The professors that teach CPSC101 do not teach CPSC114. (5.1)

There are professors that teach CPSC101. (5.2)

But it is debatable whether a hearer of question (5.3) can assume that the speaker knows (5.2), for (5.3) can be used to mean either the "presupposition–assuming" (5.4) or the "presupposition–unassuming" (5.5).

Do any professors that teach CPSC101 teach CPSC114? (5.3)

Does the non–empty set of CPSC101 professors intersect with the set of CPSC114 teachers? (5.4)

Are there any CPSC101 professors and if so do any of them teach CPSC114? (5.5)

Only in social contexts in which being ignorant of certain facts is preferred to believing falsehoods is the use of more precise questions prevalent. For example, (5.6) rules out interpretation (5.4).

Do any professors that teach CPSC101 teach CPSC114, or do professors not teach CPSC101? (5.6)

Although this vacillation between the two possibly intended meanings of the speaker's question is enough to undermine the requirements necessary for generating the presuppositions directly from the question, I will instead describe some other important differences between taking an answer–based view for generating corrective answers and the more standard question–based view. The answer–based view is motivated in a manner that is similar to the extension of Grice's maxim of quality proposed by Joshi (1982): the speaker (the answerer in this case) shall not utter a false statement nor a statement from which the hearer (the questioner in this case) can infer a falsehood. Joshi (1982) is neutral regarding how the answer should be formed to comply with the extended maxim of quality. In the remainder of this chapter I will present an argument demonstrating that the more versatile answer–based view increases the scope of questions and databases over which the generation procedure can operate.

5.1 Questions and Answers

The Question–Answer situation is a planning process in which the Questioner (Q) plans questions according to some desired outcome and the Answerer (A) plans replies according to the truth value of the available information. *Yes/no–*, *wh–*, and *how many*–questions are of concern here. (5.7)–(5.9) are examples of these types of questions. In each of the three examples **Q** is the question, **P** is the "presupposition of the question"[1], $\mathbf{A_1}$ represents a *positive direct answer* that entails **P**, $\mathbf{A_2}$ a *negative direct answer* that presupposes **P**, and $\mathbf{A_3}$ is a *corrective answer* which denies **P**. The answer can be shortened by deleting the restatement of the (modified)

[1]Scare quotes are used to indicate that I am not committed to the existence of such an entity.

question. The meaning of the shortened answer, shown in parentheses, is taken to be that of the full answer.

Q: Have you stopped beating the rug?

P: You have been beating the rug.

A_1: Yes, I have stopped beating the rug. (Yes.)

A_2: No, I have not stopped beating the rug. (No.) (5.7)

A_3: No, I have not stopped beating the rug, because I haven't started. (No, because I haven't started.)

Q: Which boys that went to the circus went to the movies?

P: Some boys went to the circus.

A_1: John and Bill, the boys that went to the circus, went to the movies. (John and Bill.) (5.8)

A_2: No boy that went to the circus went to the movies. (None of the boys.)

A_3: No boy that went to the circus went to the movies, because no boy went to the circus. (None, because no boy went to the circus.)

Q: How many boys that went to the circus went to the movies?

P: Some boys went to the circus.

A_1: Three boys that went to the circus went to the movies. (Three.)

A_2: None of the boys that went to the circus went to the movies. (None.) (5.9)

A_3: None of the boys that went to the circus went to the movies, because none of the boys went to the circus. (None, because none of the boys went to the circus.)

The standard approach[2] to the Question–Answer situation, which I call $\mathbf{P}_Q$, computes the "presupposition of the question" and generates answers to correct false presuppositions (Belnap and Steel (1976); Kaplan (1982)). This method provides A with two sources of information to form an answer: A's knowledge of the domain about which Q is requesting information

[2]Comments throughout are about the standard approach in general, but since Kaplan (1982) is contained in a computational framework and since it is representative of the standard approach, comparisons are made with it specifically.

and a supposed subset of Q's beliefs which A derives as the "presupposition of the question". The "presupposition" is inferred from lexical items and syntactic constructions in the question. The examples above demonstrate this for '*stop*' and relative clauses. A plans answers in the following way: If the presupposition is true then A can give a direct answer. If it is false then A is required to give a corrective answer which appears to correct the false belief rather than answer the main question.

The alternative approach, presented here, forms answers with presuppositions that can be proved true. This method, here called $\mathbf{P}_A$, produces answers from A's point of view regardless of Q's (supposed) beliefs. It is based on Gazdar's and Joshi's interpretation (Gazdar (1979) and Joshi (1982)) of the Maxim of Quality of the cooperative principle (Grice (1975)); that is, A cannot utter an answer that has non–true presuppositions. In addition, the theory discussed in Chapter 3 for computing presuppositions is used by A to plan the form of the answer. This theory states that Q will infer the presuppositions of the answer from lexical items and syntactic constructions contained in the answer unless the presupposition is inconsistent with the context. The context includes general real world knowledge, specific knowledge that Q has, and information contained in the sentence. A, applying this theory, plans the answer in the following way: If the presupposition is true then A can give a direct answer. If the presupposition is not provably true then since A knows that Q finds the presupposition assumable (that is, does not believe it to be false (Kaplan (1982))), A must supply enough extra information (possibly in the form of a *because*–clause) so that Q will not infer the (non–true) presupposition and will interpret the sentence properly. Details and examples are given in the next section.

For questions that ask about objects and relations in closed extensional data bases, $\mathbf{P}_Q$ is sound and complete. $\mathbf{P}_A$ should be viewed as generalizing the cooperative behaviour found in $\mathbf{P}_Q$ to data bases that are not closed, allow inferencing, and are incomplete with respect to the questions that can be asked.

5.2 Description of the Two Methods

Given the previous examples, it can be noticed that the structure of the answers for *yes/no*–, *wh*–, and *how many*–questions are just modifications of the question's syntax, together with appropriate additions such as '*yes*' or '*no*' for *yes/no*–questions, a list for *what*–, *which*–, or *who*–questions or a number for *how many*–questions, and *because*–clauses for corrective answers.

Since this is the case, $\mathbf{P}_Q$ and $\mathbf{P}_A$ can generate an answer from some simple set of rules and sentence schema. The following is a more detailed view of how the two methods compute answers.

Both methods transform the question into a query in some query language, and present it to a data base. Depending on the form of the question and the kind of answer that is generated from the query, the two approaches may coincide or differ. If the question is positive (the questions in (5.7)–(5.9) are positive) or negative[3] and the answer is positive, both methods produce an $\mathbf{A_1}$ answer. Yes–answers, non–empty/non–complete lists, and 'n', where $0 < n <$ *cardinality of the set in question* for *yes/no–*, *wh–*, and *how many*–questions, respectively, are positive answers. If the answer is negative, the two methods take different approaches. No–answers, empty/complete lists, and 'n', where $n = 0$ or $n =$ *cardinality of the set in question* for *yes/no–*, *wh–*, and *how many*–questions, respectively, are negative answers[4].

$\mathbf{P}_Q$ does the following for negative answers. The "presupposition of the question" is computed. It is then passed to the data base as a query. If the query is true then an $\mathbf{A_2}$ answer is formed. If the query is false an $\mathbf{A_3}$ answer is created. The content of the *because*–clause is computed according to an algorithm which finds the smallest failing subgraph in a Meta–Query Language (MQL) graph (Kaplan (1982)). The details are not important, but it essentially finds the most general correction.

$\mathbf{P}_A$ works in the following way for negative answers. A first forms an $\mathbf{A_2}$ answer. Because A is committed to the Maxim of Quality, A cannot utter the answer unless the presupposition of the answer is true. The presupposition is computed as in Chapter 3, translated into a query, and passed to the data base. The presupposition can be proved true, proved false, not provably true or false, or the proof may be terminated early because of resource limitations. Each of these outcomes is considered.

1. If the presupposition is true then the $\mathbf{A_2}$ answer can be uttered.

[3]The following are negative questions corresponding to the positive questions (5.7)–(5.9), respectively.

- Haven't you stopped beating the rug?
- Which boys that went to the circus didn't go to the movies?
- How many boys that went to the circus didn't go to the movies?

[4]Depending on the database algorithm, empty or complete lists for *wh*–questions and $n = 0$ or $n =$ *cardinality of the set in question* for *how many*–questions can be returned if one of the intersecting sets is empty.

2. If the presupposition is false then an $\mathbf{A_3}$ answer is formed with a *because*–clause that denies the presupposition. Noting that an $\mathbf{A_3}$ answer may have a presupposition, this answer is subjected to the same process again. If the new presupposition is true the $\mathbf{A_3}$ answer is uttered. If it is not true then the *because*–clause is replaced by another *because*–clause which denies the new presupposition. This cycle continues until the $\mathbf{A_3}$ answer has only true presuppositions, thereby ending up generating a sentence with the most general correction. This is analogous to $\mathbf{P}_Q$ which finds the smallest failing subgraph in MQL graphs.

3. If the presupposition cannot be proved true or false, or if the proof is terminated early, then a different kind of answer must be generated — an answer like '*I don't know (if...) because I don't know if* 'the presupposition' *is true.*'. And like the answers in item 2, this sentence may have new presuppositions that need to undergo the same cycle as in item 2. The result of any of these steps may be an $\mathbf{A_3}$ answer or an '*I don't know* ...' answer.

If the answer cannot be proved true or false the two methods are different. $\mathbf{P}_Q$ gives as a solution an '*I don't know* ...' answer. But this answer is potentially incorrect because it may have false presuppositions. $\mathbf{P}_A$ processes this class of answers in the same manner as negative answers. The following example illustrates the differences between the two approaches. The question given in (5.10) "presupposes" the sentence in (5.11).

Do any professors that teach CPSC101 teach CPSC114? (5.10)

There are professors that teach CPSC101. (5.11)

In some query language the query would be something similar to what is found in (5.12).

Does there exist an individual that teaches CPSC101 and teaches CPSC114? (5.12)

Different natural language answers are generated depending on the results of the query. The various answers are summarized below.

1. Suppose the data base can prove the query false, and can prove that the presupposition is true. Then the answer for both $\mathbf{P}_Q$ and $\mathbf{P}_A$ would be an $\mathbf{A_2}$ answer, that is, '*No.*'.

2. Suppose the data base can prove the query and the presupposition false. Then the answer for both methods would be an $\mathbf{A_3}$ answer, that is, '*No, because no professor teaches CPSC101.*'.

3. Suppose the data base can prove the query false, (say, by proving that no professor exists that teaches CPSC114) but cannot prove that the presupposition is true or false. Because the presupposition cannot be proved false, $\mathbf{P}_Q$ must give an $\mathbf{A_2}$ answer. This answer is wrong in this case because an $\mathbf{A_2}$ answer presupposes (ie A is communicating to Q that the data base can prove) that '*There are professors that teach CPSC101.*'. $\mathbf{P}_A$ can give an $\mathbf{A_3}$–like answer, that is, '*No, and in addition I don't even know if any professor teaches CPSC101.*' Note that $\mathbf{P}_A$ requires that any new presuppositions be treated like the original one. So the presupposition '*CPSC101 is taught.*' must now be proved. If the data base proves it true (say, by proving that sessional instructors teach CPSC101), the answer is not changed. If the data base proves it false, then the answer must be changed to '*No, and in addition CPSC101 is not taught.*'. If the data base cannot prove it either true or false, then the answer must be changed to '*No, and in addition I don't even know if CPSC101 is taught.*'.

4. Suppose the data base cannot prove the query true or false. In addition the presupposition cannot be proved true or false. $\mathbf{P}_Q$ would answer '*I don't know.*' which would be incorrect because this answer presupposes that there are professors that teach CPSC101. On the other hand, $\mathbf{P}_A$ would respond with '*I don't know, and I don't even know if any teach CPSC101.*'

5.3 Differences between $\mathbf{P}_A$ and $\mathbf{P}_Q$

$\mathbf{P}_Q$ works correctly with closed extensional data bases and for questions that can be answered by the data base; that is, questions that ask about objects and relations in the data base. Also it is complete for these types of data bases and questions. $\mathbf{P}_Q$ and $\mathbf{P}_A$ coincide in this restricted environment. $\mathbf{P}_A$ is intended to work additionally with data bases that are not closed, that allow inferencing, and that are incomplete with respect to the questions that can be asked.

The major difference (other than the obvious difference between computing presuppositions from questions or answers) between $\mathbf{P}_A$ and $\mathbf{P}_Q$ is that where $\mathbf{P}_Q$ must prove the presupposition false in order to give a corrective answer, $\mathbf{P}_A$ need only fail to prove it true in order to generate a corrective answer.

$\mathbf{P}_Q$ takes the "presupposition of the question" as a belief of Q. To correct Q, A must prove that this belief is false. From this point of view, this is a reasonable rule; A should not correct

a belief of Q unless A is certain that it is false. Simply changing $\mathbf{P}_Q$ to allow answers similar to those generated by $\mathbf{P}_A$ is not justified, because correcting Q would be allowed even though A is not sure that Q has false beliefs. A shift in point of view from computing the "presupposition of the question" to computing the presupposition of the answer must be made in order to justify the switch from having to prove false to failing to prove true.

Chapter 6

Conclusion

For nearly a century various debates about presuppositions have raged. Although the focus of attention has shifted, some themes remain constant: what are presuppositions, what relationship does a presupposition have with the sentence that presupposes it, and so on. Recently, the issue of how to derive the presuppositions of a natural language sentence has arisen and has become predominant.

The research reported in this thesis has concentrated mainly on the issue of deriving presuppositions of natural language sentences using default logic. However, the representation of presuppositions as default rules also comments on the other issues that have been at the heart of the presupposition debate. In the section 6.1 I will summarize the results discussed earlier and how they promote a distinctive view of the presupposition relation. In section 6.2 I will conclude this thesis with some avenues of further research that have been suggested by the research presented here.

6.1 Summary of Results

This thesis discusses yet another attempt to define a procedure to derive the presuppositions of a natural language sentence. Previous attempts have all assumed the projection method paradigm, with the noted exception of Gunji (1982). The procedure discussed here not only accomplishes a better empirical status but it also proposes a vastly different paradigm, one in which presuppositions are viewed as inferences of an appropriate logic, just as entailments are inferences of classical logics.

This paradigm shift — from compositionality to inferencing — brings with it some major

benefits. One of the major debates that emerged, beginning with Frege and Russell, was the representation of natural language sentences that contain presuppositional environments. Although there remained some adherents to Frege's notion of presupposition, the standard view that developed was Russell's:[1] presuppositional environments are ambiguous between two representations that differ in the scoping of the negation operator. As the notion of presupposition regained its popularity in the late 1960's a variety of representational views for presuppositional environments emerged, including a number in the ambiguity camp. One representational view which has emerged unscathed is that presuppositional environments are to be represented vaguely. The major contribution provided by the use of default logic is to provide a means of inferring the preferred interpretation from the vague representation, something which classical logics cannot do. The topics of representation and derivation of the preferred interpretation from the vague representation of negation form the major part of Chapters 2 and 3.

A second positive influence is the proper treatment of '*or*' in natural language. Compositionality (at least for presuppositions) treats '*or*' as a conjunction. This improper treatment of '*or*' surfaces in data which include lexical items with non–binary features. The inability of the compositional methods was discussed in section 4.2.1.3 and the successful derivation of the appropriate presuppositions using the default logic method was demonstrated in section 4.5.2.1.

In order for the compositional methods to succeed, they must conflate issues whose conflation has been argued against strenuously. For instance, Kempson (1975) and Wilson (1975) argue that a sentence cannot both entail and presuppose another sentence. All compositional methods must allow "positive presuppositional environments" to both entail and presuppose the "presupposition". The theory presented in Chapter 3 explicitly separates these two kinds of inference. Being forced into this bipartite view has motivated what I believe to be a much better analysis of the presuppositional qualities of '*too*' and '*again*' than what has been done before. A detailed account of this analysis is given in section 4.5.3.

A typical problem for any complex system incorporating a large number of rules is to justify the ordering of rule application. Both Gazdar (1979) and Soames (1982) have this problem. Since the default logic approach uses a proof procedure to derive the presuppositions, a fourth benefit is that the problem of rule ordering does not arise.

Fifthly, the search for a precise definition of the presupposition relation has been a strong motivation for this research. In a manner similar to Gazdar I have started with some simple

[1] Russell did not describe it in these terms, however.

underlying assumptions provided by Grice's Principle of Cooperative Conversation. However, the move to a quasi–logical paradigm has provided some basic tools that are unavailable to Gazdar. The goal of a precise definition has been only partially realized. A proof–theoretic definition has been generated but a model–theoretic one has been only sketched. The desired similarity to entailment has been partially achieved. A more precise definition of *preferred model* (the required analogy to model) is needed. On a more positive note the search for a more rigorous theory of natural language pragmatics, Gazdar's work being an exemplar, now has some badly needed formal tools: various non–monotonic logics.

In addition to providing a better overall understanding of presuppositions, the move from a compositional to a default logic approach has been very successful when compared to the previous methods at the level of deriving presuppositions. Empirically, it is better than the other methods. All of the problems that have been previously encountered (with one exception) are solved by the default logic approach. Most notably is the problem of non–binary features. The exception to this universal claim is the sentence of the form '*If B, too, then A.*'. However, if the criticism of Soames' method is correct, no previous method can deal with this problem, either. This counterexample to the default logic method remains, however. I believe that the solution lies in a better understanding of the sentential adverbs (which would surface in a better representation of the sentence), rather than a modification to the basic approach. Methodologically, the default logic approach is better than the previous methods. One serious aspect of all of the projection methods is that they are basically trying to repair an incorrect basic assumption, that presuppositions form a part of the compositional meaning of a natural language sentence. Additionally, all of the rules that have been added are *ad hoc*. In contrast, default logic has independent support for its existence — common sense reasoning, to be precise. And finally, negation was the central concept in the early definitions of natural language presupposition. In the default logic approach negation retains this pivotal position.

6.2 Future Work

The research reported in this thesis represents a continuation of the first attempt at using non–monotonic reasoning in a linguistic setting (Mercer and Reiter (1982)) (this paper appears here in an expanded form as section 3.2). Since this initial work, other uses have been reported: Mercer and Rosenberg (1984) discusses its use in generating corrective answers (this paper ap-

pears here in a slightly revised form as Chapter 5), Papalaskaris and Bundy (1984) discusses the use of circumscription in question–answering, Joshi, Webber and Weischedel (1984) entertains the idea of using default reasoning in a discourse, and Ascher (1984) looks at non–monotonic reasoning and a more encompassing view of linguistic understanding, Perrault (1987) applies default reasoning to speech acts.

A number of loose ends remain to be tidied up. In section 4.5 I mentioned the following issues:

1. a better understanding of the syntactic relationships between negation and sentential adverbs,

2. a solution to the problem concerning sentences of the form '*B, if A*',

3. expanding the sketchy discussion of the proposed solution for modified phrases,

4. issues concerning complex indicative conditionals, and

5. a more precise understanding of the connection between '*possibility*' and multiple extensions.

An important motivation for this research has been to describe natural language presuppositions in a logical setting. One of the reasons is that logic has a model theory. Although I give an indication in Chapter 3 that a model theory for presuppositions could be based on preferred models, a great deal of work still needs to be done in this area. A model theory is something which is not forthcoming in any of the projection methods that I discussed in Chapter 4.

An important element in the default logic approach has been the representation of the sentence uttered as well as the presuppositions of that sentence as knowledge of the speaker. Since the logic of knowing is too strong for any practical application, changing knowledge to belief is a necessary endeavour. Unfortunately, a precise understanding of belief systems has not yet been achieved. However, progress is being made (see Fagin and Halpern (1985)).

It is mentioned in section 2.2.2 that conversational implicatures may be representable as default rules. Further study of application of non–monotonic forms of reasoning to other areas of linguistics would be of interest. Some indication of this type of endeavour is given in the introductory paragraph to this section.

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