

# PROBABILISTIC AND DETERMINISTIC PRESUPPOSITIONS

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Abstract: On the assumption that assertoric discourse can be usefully explicated within a Decision-Theoretic Semantics [DTS] (Merin 1999), we discuss notions of relevance, distinguish probabilistic presuppositions as a generalization of familiar, deterministic presuppositions, and distinguish evidential time from causal time. On this basis, we distinguish positive presuppositions from negative presuppositions, identify some putative cases of implicature as probabilistic presuppositions and show that a longstanding taxonomic objection to Gerald Gazdar's well-known account of presupposition projection is otiose.

## 1. Expectation, Preferential and Evidential Relevance

'Decision theory' refers to a family of theories of suitably coherent beliefs, represented in judgmental probability, and of preferences. For the purposes of decision-maker's evaluation, it treats actions as random variables. These are functions from contingencies to sets of values, with a probability distribution or density defined over the inverse images of the values. When the values are numerical, as they routinely are assumed to be, a random variable  $X$  has an

expectation,  $E(X)$ , the sum of the possible values of  $X$ , weighted by the probabilities of the respective cells of contingencies that are each associated with a value. The principal principle of decision-theoretic praxeology is to choose that action which has maximal expectation.

In an assertoric context, the *relevance* of a proposition with respect to a context of belief and valuation might thus be defined as the change in the expectation of a suitable random variable expressing such valuations brought about by that proposition becoming accepted or having its probability changed (Jeffrey 1965). In other words, relevance will be a function of a difference or quotient of conditional and unconditional expectations.

When the random variable is of a general kind and such that its values may be interpreted as utilities or desirabilities, we might usefully speak of *preferential relevance* or *valuational relevance*. Example: A certain community Alpha, defined amongst other things by the right-minded personal and moral preferences and elastic supply schedules of its members, comes to believe that consuming Brand Beta enhances personal attractiveness or that liberating community Gamma decreases the amount of evil in the world. Assuming that people, as common sense so nicely puts it, tend to act on their beliefs, expected benefits of those with a stake in consumption of Beta or in the liberation of Gamma will increase.<sup>1</sup> Preferential relevance is to be distinguished from a special case of relevance familiarly known as *evidential relevance*. The latter is defined entirely in

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<sup>1</sup>Here preferential relevance is defined with respect to particular acts, i.e. purchasing plentiful amounts of Beta or supporting the liberation of Gamma by any means necessary. The framework generalizes easily to examples that involve the passing of exams and a night out at the movies. One might, of course, also define a notion of preferential relevance for questions. The obvious candidate for this appellation is familiar from the literature on the design of experiments. Stated in ordinal terms, a question may be more or less relevant relative to a decision problem depending on how far an answer to it that one can act upon will reduce the expected loss (increase the expected gain) attendant upon the decision. Establishing relevance in this sense is known as the problem of choice or design of an optimal 'question to nature', a suggestive synonym for 'experiment' found in many texts of elementary information theory and inferential statistics. For a brief outline of basic decision theory in such a context, see also Merin (1994), pp. 148-158.

terms of relations among probabilities (see Section 4, below).<sup>2</sup>

Probability is a special case of expectation, namely the expectation of 0-1-valued indicator random variables. These are also known as ‘Bernoulli’ variables. Shorn of their attached probability distribution, they are known as ‘indicator functions’, and, outside probability theory, as ‘characteristic functions’ of sets. When the sets are sets of possible worlds or of models standing in for aspects of worlds, indicator functions represent propositions as commonly construed.

## 2. Pragmatics and Semantics

In what follows we restrict our attention to the purely doxastic fragment of a DTS. This means that we consider in a formal way only constraints that can be stated exclusively in terms of probability spaces. This decision, which has for background the familiar dissociation of evidential and preferential aspects of decision-making in decision theory, has a tangible scientific payoff. When we restrict ourselves to the probabilistic fragment, we have much sharper constraints to work with. There are, as it were, fewer degrees of freedom to contend with than in the case where utilities are taken into consideration as well and where we are thus in danger of delivering, as explanations in the analysis of language phenomena, laboured paraphrases of what is already obvious to unaided common sense. As a taxonomic suggestion we might thus adapt the well-known saying of Gerald Gazdar’s to present concerns: Indexical kinematic semantics = Pragmatics minus Utilities. In what follows we proceed mainly in propositional terms, but I believe that the dark notion of ‘salience’ (of possible referents etc.), which plays a prominent role in the pragmatics of properly sub-sentential analyses, is amenable to a like analysis (see Merin 1999 on ‘also’).

## 3. Assertoric Updates of the Common Prior in a DTS

In a DTS, assertions are treated as intended Bayesian updates. In the simplest of terms, an assertion of a proposition  $E$  has the

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<sup>2</sup>For a routine definition of purely evidential relevance of answers to questions and of questions to other questions, see Merin (1999), p. 196n30.

intended effect of conditioning an ostensible Common Prior probability function [CPr], write it  $P^j$ , on  $E$  to yield a Common Posterior [CPo],  $P^{j+1}$ . The symbols  $P^j$  and  $P^{j+1}$  each stand for any representative of a set of probability functions solving a set of probability (in)equations. However, for simplicity's sake, we proceed in terms of representatives.

Conditioning on  $E$  implies, for one, that  $P^{j+1}(E) = 1$ . The assertion also conditions CPr on the proposition, write it  $p^s(E) = 1$ , that the assertor  $s$  be certain of  $E$ . One way to conceive of this process is to have the assertor's probability for  $E$  reflected in CPo. Thus, put at its most sparsely, the principle followed will be  $P^{j+1}(E|p^s(E) = 1) = 1$ .<sup>3</sup> This well-known principle of reflection, so dubbed by van Fraassen (1984) in the context of intra-personal decisionmaking involving stages of the same individual, offers a way to represent the commonsense idea that  $E$  becomes common belief because the assertor already believes it and is deemed to be authoritative on the matter. It is this presumed authority to command assent which, I take it, explicates the concept of knowledge independently of the concept of 'reliable justification'. Each of the two explications has its merits and problems, but the present one seems most apt for the theory of meaning. (Below we shall look at one of its logical reflexes.)

We write CP when referring indifferently to both of CPr and CPo. The CP is a probabilistic explication of a joint epistemic commitment state. Updating CPr to a CPo is subject to tacit or vocal ratification by the addressee. A denial will thus, amongst other things, represent a refusal to ratify the update (Merin 1994).

Common Ground [CG], as familiar from H.P. Grice and R.C. Stalnaker, is then identified with the set of propositions that receive unit probability in CP. I.e., we say proposition  $A$  is presupposed at  $j$  iff  $P^j(A) = 1$ . (See Merin 1997 for some traditional presuppositions treated in this framework, and Merin 1999 for others).

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<sup>3</sup>A more detailed account with more references to the philosophical literature can be found in Merin (2002).

#### 4. Evidential Time and Causal Time

We distinguish *evidential time*,  $t_e$  (e-time) and *causal time* time  $t_c$  (c-time) to establish a reasonably general framework for assertion, presupposition, and presupposition accommodation. E-time is subject alone to constraints of Bayesian updating. C-time is the time of physical events such as phonetic or brain processes. Discourse is thereby formally, and rather tritely in our case, an instance of a stochastic process with respect to e-time. This time reflects the order of admissible Bayesian updates.

Considered in terms of representatives, a discourse will be a sequence of probability spaces, i.e. of pairs  $(F^i, P^i)_{i \in I}$  ( $I$  some index segment of the integers). The left projection  $\{F^i\}$  of this sequence is an increasing sequence of Boolean algebras, i.e. a sequence such that for  $k \in I$ ,  $F^k \subseteq F^{k+1}$ . Intuitively, this means that the space of possibilities is partitioned by increasingly finer sets of propositions. Specificity of descriptive options does not in general decrease in discourse, as David Lewis (1979) has observed; and the notion of an increasing sequence of algebras explicates this idea.

Time, either way, is assumed isomorphic to a subinterval of the integers. A more exciting approach to e-time would assume dense time, that is, a set of moments of time isomorphic to the rationals. This would imply that between any pair of distinct times  $t$  and  $t''$  we can always insert a distinct third,  $t'$ . Dense ordering might offer an elegant, fully monotonic way of treating accommodation phenomena in the discourse record, but for present purposes we keep this possibility implicit.

We identify the time index  $t = t_e = t_e(j)$  with the discourse time of  $j$ . As a default, utterance time  $t_c$  will be set equal to  $t_e$ . However, in the case of accommodation, the two kinds of time diverge. I assume that an accommodated constraint introduced at c-time  $t_c$  is to be taken to have been operative at a e-time  $t_{e-k}$  where  $k > 0$ . The basic idea here is that monotonicity of ostensible updates is to be preserved as far as possible. (Non-monotonicity proper, which amounts to undoing deterministic presuppositions, takes us outside the Bayesian framework.) The possibility for e-time and c-time to diverge also affords an ostensibly monotone treatment of denial. Rather than assume that denial of a proposition  $E$  in some way

erases  $E$  from common ground, we hold that denial is a refusal to ratify  $E$  becoming CG. When the denial is flat, i.e. by utterance of ‘No’ or, in a logical language, of ‘ $\neg E$ ’, the refusal is coupled with an assertion of  $\neg E$ .

## 5. Issues and Evidential Relevance

Typically, assertions are made in support of one possible resolution of an issue. A binary, dichotomic issue  $H$  is a bi-partition of the carrier set of the domain of CP, to the cells of which distinct preferences attach at least ostensibly, i.e. for argument’s sake.

Unlike familiar modal-logical frameworks, the probabilistic framework affords non-deductive relevance relations. These play an essential role in explanation of certain language phenomena.

We say, standardly, that  $A$  is positively (negatively) relevant to a proposition  $B$  at  $j$  iff  $P(B|A) > P(B)$  ( $P(B|A) < P(B)$ ), and irrelevant to  $B$  iff  $P(B|A) = P(B)$  or  $P(A) = 0$ . Note that when  $P(A) = 1$ ,  $P(B|A) = P(B)$  for any  $B$ . Relevance relations determine the effects of  $A$  on the probability of  $B$  if  $A$  were to become a presupposition, say at  $j + 1$ , ceteris paribus. Relevance thus gives us a kinematics of belief. For the dynamics, to pursue the physicalist metaphor more literally than usual, we should also have to consider preferences. Here we ignore them to the extent of treating them as fixed parameters of the issue. We thus remain in the domain of context-dependent (indexical) semantics, as distinct from the more general realm of pragmatics proper.

In this framework, various forms of presupposition can be explicated, of which the traditional ones – fully deterministic with judgmental probability 1 and invariant under denial – are just a subclass. In particular, probabilistic presuppositions, i.e. more general probability constraints will be defined.

## 6. Probabilistic Presuppositions

A probabilistic presupposition (absolutely, without further qualification) at a context  $j$  is any equation or inequation satisfied by  $P^j$  which is not already a theorem of the probability calculus. Deterministic presuppositions are a special case of probabilistic presuppositions: those which assign unit probability to all their propositional

terms. Deterministic presuppositions can be intuited as presuppositions of propositions that are within the domain of the CP probability function,  $P^j$ . In thus intuiting them, we simply ignore—or better, in the phenomenologist’s terms: we treat as transparent—the doxastic qualification.

This, I take it, is one useful way to interpret the T-axiom,  $\Box(X) \rightarrow X$ , that distinguishes properly epistemic modal logic from doxastic modal logic (Hintikka 1962). When a doxastic agent is truly certain of a proposition  $E$ , he must ascribe knowledge of  $E$  to himself when challenged. (If he had doubts about the reliability of his justification, he could not be certain save in a Pickwickian sense.) When a doxastic agent asserts  $E$ , he claims that  $E$  should become a common certainty, which is as close to making a knowledge claim as human beings will ever come. What is to be believed by all who are open to reason—and ‘all’ includes the speaker—is knowledge to the best of the speaker’s knowledge.

By contrast to deterministic presuppositions, properly probabilistic presuppositions must be represented as elements of a richer algebra of propositions than deterministic presuppositions. They are always elements of a proposition algebra which includes CP-probability statements.

Some probabilistic presuppositions are exemplified in the semantics of the connective ‘but’. Thus, we have as a condition of most felicitous uses of clause-coordinating *A but B* the condition that, for a given issue proposition  $H$ ,  $P^j(H|A) > P(H) \wedge P^j(H|B) < P(H) \wedge P^j(H|AB) < P(H)$ .<sup>4</sup> The effect of the update proposed by utterance of *A but B* will indeed be to constrain the common posterior to satisfy  $P^{j+1}(AB) = 1$ . At this point all the relevance of A and B will have been spent and our specification of the probabilistic presupposition implies that, if only *A but B* is uttered,  $P^{j+1}(H) < P^j(H)$ .

Thus, DTS treats what is called the ‘conventional implicature’ attaching to ‘but’ as a probabilistic presupposition. This taxonomic

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<sup>4</sup>See Merin (1999), and Merin (1996), which is fuller but in German. I am not aware of any aspect of *but* which has been shown to resist treatment along the lines developed there, nor do I think that less developed theories could be of any but historical interest today.

decision is not idle, for at  $j + 1$ , the intended CPo, the two conjunct propositions  $A$  and  $B$  could no longer be relevant to any proposition, having already acquired unit probability. (Recall that, when  $P(A) = 1$ , the conditional probability  $P(B|A) =_{df} P(AB)/P(A)$  equals  $P(B)$ .)

Note also the ordered triple  $(H, P^j(H), P^{j+1}(H))$  of  $H$  and probabilities representing its doxastic status change amounts to an instance of what is often called ‘particularized conversational implicature’.<sup>5</sup> Using well-known if imprecise terminology, the finding of  $H$  will be an abductive inference, in a sense loosely related to what C.S. Peirce may have intended to convey by that term. Probability changes here are not in general changes to unit or zero probability; and this property takes care of the defeasible and relatively weak status of implicature which, in addition to the frequently implicit nature of  $H$ , distinguishes it from assertion.

So far we have spoken of probabilistic presuppositions in strict analogy to the usage of presupposition-at-a-context. But of course there are also speaker-presuppositions and, mediately, presuppositions of utterances and, more mediately yet, potential presuppositions of sentences.

The overriding criterion for presuppositional status generally is derived from coherence constraints on Bayesian updates and stochastic relevance relations. More narrowly, the criterion is augmented by preservation under denial, the traditional hallmark of presuppositions. This property turns out to hold also for certain probabilistic presuppositions.

Example: We assume that the constraint  $P^j(A), P^j(A) < 1$  attaches conventionally to utterances of  $A$  or  $B$  uttered at  $t(j)$ . Thus, it is a probabilistic presupposition at  $j$ . Assume that the intended effect of the assertion is to constrain  $j + 1$  to satisfy  $P^{j+1}(A \vee B) = 1$ . Denial of  $A$  or  $B$  thus amounts to a proposal that the Common Posterior be not  $j + 1$  but rather an alternative  $j + 1'$  (parse as:  $(j + 1)'$ ) such that  $P^{j+1'}(\neg(A \vee B)) = 1$ , i.e. such that  $P^{j+1'}(\neg A \wedge \neg B) = 1$ . In other words, at  $j + 1'$ ,  $\neg A \wedge \neg B$  is to be a deterministic presupposition. But note that  $P(\neg A \wedge \neg B) = 1$

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<sup>5</sup>It is an instance of this notion, for instance, under the intuitive interpretation in Kripke (1977).

entails  $P(\neg A) = 1 \wedge P(\neg B) = 1$  for any probability function  $P$ . This, in turn, entails  $P(A) < 1 \wedge P(B) < 1$ . Our probabilistic presupposition is therefore preserved under denial. In the traditional, sloppily expressed sense, it is thereby a presupposition of the sentence *A or B*. Less sloppily put, it is a speaker presupposition of the person who asserts *A or B*.<sup>6</sup> An accommodated additional deterministic constraint to the effect that *A* and *B* are disjoint, i.e.  $\neg(A \wedge B)$ , is again a presupposition in the technical sense just introduced. Such a constraint should be operative at  $j$ , even if it is inferred only after *A or B* has been uttered. The inference might be based on particularized world knowledge, or imposed by more general discourse considerations, one of which we shall meet below.

At any rate, a constraint  $P^j(\neg(A \wedge B)) = 1$  is deemed to obtain, and we can easily see that it is again preserved under denial of *A or B*. If the context  $j + 1'$  satisfies  $P^{j+1}(\neg A \wedge \neg B) = 1$ , it must also satisfy  $P^{j+1'}(\neg(A \wedge B)) = 1$ .

The disjointness constraint is, of course, what Gazdar (1979) defines to be the ‘scalar quantity implicature’ of binary ‘or’ and what has subsequently become known as ‘strong’ scalar implicature. Thus, we see that Gazdar’s implicatures—at any rate, those which do not follow from a proper subset of all his implicatures in conjunction with the basic ‘Quality’ assumption that assertion be confident—are all probabilistic presuppositions. Hence, from a Bayesian perspective, there is nothing untoward in their preceding, in Gazdar’s defeasibility hierarchy, presuppositions such as the existence presupposition attaching to definite descriptions.

Note that  $\neg(A \wedge B)$  is always negative to  $A \vee B$  when these

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<sup>6</sup>I am grateful to Laurence Horn of Yale University, himself an authoritative source on pragmatics, negation and denial, for finding these claims worth taking exception to when they were presented to a larger audience at the Formal Pragmatics Workshop, Berlin, March 2001. I did not, however, understand on what grounds other than a preference for invariant scope of terminology the objection rested. The claims are doctrinally related to the account of ‘pragmatic scales’ and of the action of negation on scalable predicate paradigms given in Merin (1999). This account does not, it appears, suffer from the defects which attend the widely familiar account proposed by Horn (see Horn 1989) and which have led its author to deny that everyday discourse with and about numbers is part of natural language.

two propositions can be relevant to any third proposition at all. This fact suggests that we can distinguish pragmatic presuppositions of a class of sentences which are entailments of its assertion from those which are accommodated entailments of its denial. Let  $K$  be the knowledge operator interpreted as certainty,  $P(\cdot) = 1$ ; for present purposes we can ignore the intersubjectivity claim attached in place of the ‘T’-axiom. Then  $K(A \text{ is true})$  is entailed by  $K(\text{someone knows } A)$  and is therefore a positive (and deterministic) presupposition, being a presupposition in as much as it is preserved under denial. By contrast,  $K(\neg A \vee \neg B)$ , which is entailed by  $K\neg(A \vee B)$  is a negative (and in our terms probabilistic) presupposition of  $K(A \vee B)$ .

Thus, I suggest that we partition the class of pragmatic presuppositions of expressions into *positive presuppositions* and *negative presuppositions*, defined by relevance. If  $A$  is a probabilistic or deterministic presupposition of  $B$ , and if  $A$  is positive (negative) to  $B$ , then it is a positive (negative) presupposition of  $B$ . If  $A$  entails  $B$ , then  $A$  and  $B$  are positively relevant to one another if each is relevant to any proposition at all. If  $\neg A$  entails  $B$ , then  $A$  and  $B$  are negatively relevant to one another, if each is relevant to any proposition at all. The existence presupposition of a definite description would be an instance of a positive presupposition. However, many of our best-loved lexical presuppositions are negative presuppositions. For example, if you have been beating your spouse habitually (the classic example in the modern literature on aspectual presupposition), enumerative induction will suggest that you will continue doing so. Suppose this is the assumption that we impute to competent language users. Then the proposition that you do not beat your spouse now, which is the ‘asserted’ part of ‘You have stopped beating your spouse’, will be negative to the presupposition that you have been beating said spouse.

In a dialogical, polyphonic context, negative presuppositions will be most readily explained by associating the presupposition with the claim of a virtual or actual opponent in debate (see Merin 1997, 1999).

More immediately, though, we have to contend with a fact about received current taxonomy, namely that  $\neg(A \wedge B)$  is often treated

as a conversational implicature of *A or B*. However, we must not be fazed by this surfeit of taxonomic options. Taxonomic categories of cultural objects should be explanatorily useful. This does not mean that they should pretend to determine natural kinds. In the Bayesian framework (of which the framework of doxastic modal logic KD is a proper coarsening) we assign presuppositional status on the most conservative and robust of criteria. What matters primarily here is the evidential status of the propositions concerned, not the putative causal history of their coming to mind. The latter, as is well known from the literature, is beset by deep uncertainties. The former, at the very least, has a robust and intelligible explication. It is for this reason, that we should treat them as presuppositions first. Their putative causal history for which the label ‘implicature’ may stand, can still be treated separately. There is a reflex of this in the notion of denial. Denial on the decision-theoretic view of discourse is essentially linked to joint decision-making. A denial, on this view, is not an erasure from common ground, but a proposal which is alternative to a contrary proposal that may have been prior to it in c-time, but which never became ratified as common ground and does not, therefore, precede it in e-time.

The general theoretical claim is explored for fruitfulness by application to a long-standing problem in the theory of meaning and of presupposition.

## **7. Application to a Problem in Presupposition Projection**

This problem is posed by Gerald Gazdar’s 1979 dynamic semantics for a propositional fragment of English. Gazdar’s incremental context-change theory of assertoric discourse proceeds by consistent incrementation of contextual constraints subject to a precedence hierarchy of speaker commitments. First come antecedent contextual commitments. Next come truthconditional contents of what is being asserted (modified Quality implicature). Then come potential Clausal quantity implicatures, notably that the assertor of *A or B* not know of either disjuncts whether it holds or not. Then come potential scalar implicatures (here: knowledge that not both obtain). Finally come potential presuppositions, e.g. of existence for defi-

nite descriptions. Potentiality, which is lexically coded, turns into actuality when incrementation is consistent with prior increments.

The problem now is that presuppositions, which intuitively should precede implicatures and perhaps even narrow truth-conditional assertoric content, are added last. But somehow it seems odd that presuppositions should be cancelled by inferences which, on the doctrine of implicature, are computed at a much later stage of discourse. The literature rarely fails to comment on this putative failing of Gazdar’s account (see e.g. Beaver 1997, Geurts 1999, Kadmon 2001). However, since more recent models of presupposition projection have little of principle to say about implicature, one cannot say that the problem is only of historical interest.

The solution rests on making full use of the interaction between assertoric truth-condition-based content (Quality, as redefined by Gazdar from H.P. Grice’s partly weaker requirement) and so-called Clausal implicatures. Assertion of content imposes the constraint  $K(A \vee B)$ , where  $K$  is an epistemic necessity operator as introduced in Section 6 above, indexed by Gazdar to the speaker, but in our model to the virtual collective agent to whom common epistemic commitments are imputed. I.e. we have  $P^{j+1}(A \vee B) = 1$ . Call this Global Confidence (in the proposition expressed by the complex sentence  $A \vee B$ ). Clausals, the most important kind of implicature in Gazdar’s scheme, split into two subkinds. There are constraints of Local Diffidence ( $\neg K(A), \neg K(B)$ , i.e.  $P^i(A), P^i(B) < 1$  ( $i = j, j + 1$ )) which, as I will argue, should be classed as probabilistic presuppositions. There are constraints of Local Sustenance ( $\neg K(\neg A), \neg K(\neg B)$ ; i.e.  $P(A), P(B) > 0$ ) which should be called implications in view of

THEOREM 1: Local Diffidence  $P(A), P(B) < 1$ , and  
Global Confidence  $P(A \vee B) = 1$  jointly imply Local  
Sustenance  $P(A), P(B) > 0$ .

The Diffidence clausals are presuppositions by the traditional criterion of persistence under denial:  $K(\neg(A \vee B))$ , i.e.  $P(A \vee B) = 0$  entails  $\neg K(A), \neg K(B)$ , i.e.  $P(A), P(B) < 1$ . Indeed, by way of accommodation, they can consistently be imposed as constraints on CP prior in discourse time to the constraint  $P(A \vee B) = 1$ . I

propose that it is they which attach to ‘or’, either as brute lexical defaults or else motivated in more or less familiar ways by reference to presumed speaker’s goals and expression alternatives. Whichever option we choose, we can now observe that presuppositions do precede assertoric content in e-time.

Presuppositional status also attaches to Scalar implicature proper, which is to account for disjointness intuitions variously attending ‘or’, presumed to have the truth conditions of inclusive disjunction. Intuitions on Scalar implicatures are well known to vary. There are feelings of a weak tendency for disjointness, and there, at the other extreme, those of Gazdar,  $K(\neg(AB))$ , i.e.  $P(AB) = 0$ . The first of these are, again, implications, since they need obtain only at the Common Posterior, i.e. the context obtained by updating on assertoric content. But they are implications which are orthogonal to all-or-none incrementation schemes such as Gazdar’s, in view of

THEOREM 2: Local Diffidence  $P(A), P(B) < 1$  and  
Global Confidence  $P(A \vee B) = 1$  imply negative inter-  
clausal relevance,  $P(B|A) < P(B)$ .

Here we make use of resources of probability which strictly exceed those of traditional doxastic modal logic.

The strong Scalar implicature, which is readily representable in modal logic, is again identified as a presupposition. When we deny *A or B*, and thus assert *Not-A and Not-B*, we are proposing that CP be updated by conditioning on a proposition which entails  $\neg(A \wedge B)$ , Gazdar’s strong Scalar implicature. Strong scalar implicature, when accommodated as above is therefore an accommodated probabilistic presupposition, and for two reasons. Intuitively, being accommodated, it obtains already at context  $j$ , not just at  $j + 1$ . Moreover, denial of  $A \vee B$ , transforms  $j$  into  $j + 1'$  such that  $P^{j+1'}(A \vee B) = 0$ , which implies  $P^{j+1'}(A \wedge B) = 0$ .

This can be stated in terms of modal logic. However, the motivation for accommodation once more appeals to resources beyond those of modal logic. Accommodation of the constraint  $P(A \wedge B) = 0$  will guarantee a desirable relevance property of disjunction with respect to an issue:

THEOREM 3: When  $P(AB) = 0$ , i.e. when  $\neg(A \wedge B)$  is presupposed, the relevance of  $A \vee B$  with respect to any issue proposition  $H$ , whose probability the assertion of  $A \vee B$  can be coherently intended to raise, is a convex combination of the relevances of the disjuncts  $A$ ,  $B$ .

Convexity will be desirable as a default under a view of assertoric discourse which, as a rule, assumes that talk is to some argumentative point. (This is not, however, the only motivation for strong Scalar implicature within a DTS; see Merin 1999 and Merin (to appear) for one based on the claim-concession structure of discourse.)

So the counterintuitive feature of Gazdar's scheme is removed: what appear to be implicatures in terms of a would-be Gricean causal motivation and thus in causal, physical time, are really presuppositions in evidential, discourse time structured by Bayesian update constraints. Quite in line with Gazdar's useful notions of potential presupposition and potential implicature, we have pleasant monotonicity of constraint incrementation throughout, for we treat changes of non-extreme probabilities as still covered by the monotonicity postulate defined for deductive consequence relations. It is only in cases of outright presupposition violation that we must abandon the relative calm of Bayesian waters for the uncharted seas of properly non-monotonic commitment revision.

Gazdar's kinematic approach to presupposition was stated entirely at the level of propositional relations. Whatever subsentential relations were engaged in the data to be addressed were quickly phrased in propositional terms by what amounted to a substitutional interpretation of quantificational aspects of their formal description. More recent approaches to presupposition within kinematic semantics proceed in terms of assignments, which are constructs familiar from the standard semantics of predicate logic (Kamp 1981, Heim 1982).

Such semantics are committed to an ontology of denotata for sub-clausal expressions, an ontology of individuals and relations on them. Prima facie this is a step forward, not least because the study of presupposition thereby becomes fully part of subsententially committed semantics. We do not thereby lose the ability to attend to purely propositional relations, since predicate calculus is

a conservative extension of propositional calculus, the latter being that fragment of the former whose predicates are all of zero arity. Still, there is a difference of emphasis in analysis, because the newly gained power suggests certain kinds of relations to be explanatorily pertinent which the weaker system had no means of addressing. The result may just happen to be that we do no longer search for explanations in inter-propositional relations which have not yet been fully explored.

In a decision-theoretic framework there are indeed reasons that militate for attending to such relations. Presuppositional relations as usually construed are relations of presumed common knowledge, conviction, or commitment. This makes them natural constructs of theories of interactive decision-making, which make up the field of inquiry known generically as game theory. A decision-theoretic approach to meaning will thus appeal as far as possible to propositions and to the epistemic or doxastic constructs that go with them.<sup>7</sup>

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