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CONDITIONALS, MEANING AND MOOD

by

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ABSTRACT OF THE DISSERTATION

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This work explores the hypothesis that natural language is a tool for changing a language user's state of mind and, more specifically, the hypothesis that a sentence's meaning is constituted by its characteristic role in fulfilling this purpose. This view contrasts with the dominant approach to semantics due to Frege, Tarski and others' work on artificial languages: language is first and foremost a tool for representing the world. Adapted to natural language by Davidson, Lewis, Montague, *et. al.* this dominant approach has crystalized as *truth-conditional semantics*: to know the meaning of a sentence is to know the conditions under which that sentence is true. Chapter 1 details the animating ideas of my alternative approach and shows that the representational function of language can be understood in terms of the more general function of changing representational mental states. Chapters 2-4 argue that the additional resources of this more general conception of meaning allow us to explain certain phenomena involving conditionals (e.g. *if Bob danced then Leland danced*) and grammatical mood (e.g. declarative, interrogative, imperative mood) that truth-conditional semantics does not. In the analysis of these specific phenomena and the articulation of the general approach on offer, it emerges that this approach combines insights and benefits from both use-theoretic and truth-theoretic work on meaning.

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Introduction

This work explores the hypothesis that natural language is a tool for changing a language user's state of mind and, more specifically, the hypothesis that a sentence's meaning is constituted by its characteristic role in fulfilling this purpose. This view contrasts with the dominant approach to semantics due to Frege, Tarski and others' work on artificial languages: language is first and foremost a tool for representing the world. Adapted to natural language by Davidson, Lewis, Montague, *et. al.* this dominant approach has crystalized as *truth-conditional semantics* (TCS): to know the meaning of a sentence is to know the conditions under which that sentence is true. Chapter 1 details the animating ideas of my alternative approach and shows that the representational function of language can be understood in terms of the more general function of changing representational mental states. Chapters 2-4 argue that the additional resources of this more general conception of meaning allow us to explain certain phenomena involving conditionals (e.g. *if Bob danced then Leland danced*) and grammatical mood (e.g. declarative, interrogative, imperative mood) that truth-conditional semantics does not. In the analysis of these specific phenomena and the articulation of the general approach on offer, it emerges that this approach combines insights and benefits from both use-theoretic and truth-theoretic work on meaning.

Chapter 1 "Language, Meaning and Cognition"

This chapter begins with a discussion of why TCS has achieved the orthodox status

it enjoys in the semantics of natural language. This involves saying a bit about what semantics is and why it is needed in linguistic theory. I argue that the systematic account of linguistic understanding and in particular entailment offered by TCS does count as an unparalleled and genuine explanatory accomplishment. In response, I will discuss three questions.

- Why do the meanings of a sentence compose in tandem with their syntactic structure? (As is essential to the systematic explanations of TCS)
- How can we reconcile a central idea of generative linguistics, that linguistic competence is not world-knowledge, with the component of TCS which insists that knowing the meaning of a name is knowing its referent?
- Can TCS offer a non-circular account of what it is to understand a sentence?

I will argue that TCS cannot answer the first question and offers no reconciliation of the second. I will also side with Dummett's (1975a; 1976b; 2006) arguments that TCS leads to a circular account of what it is to understand a sentence. The remainder of the chapter sketches a different form semantics could take and argues that it provides adequate responses to these questions. I also discuss how this alternative approach can match the important achievements of truth-conditional semantics.

A computational system's facility with a symbol S involves transitioning from one machine state to another upon encountering S . This kind of facility is the standard characterization of human syntactic competence (Chomsky 1957:27). This narrow functional explanation of syntactic competence suggests an a wide functional explanation of semantic competence. The meaning of a morpheme is the characteristic change it brings about in the mental states of a language user, where changes in those mental states are construed in terms of changes in their broad, truth-conditional content. While this conception of content provides a way of thinking about this relation, and so the changes a morpheme brings about, it is the characteristic change, or wide

functional role of the morpheme that constitutes its linguistic meaning. After providing a formal model which shows that any standard truth-conditional operator can be represented in this form, I note that even if the reverse were true (and it isn't) there are two kinds of arguments that could be made for this dynamic alternative. First, it could offer a picture of what meanings are that addresses the questions mentioned above. Second, it could facilitate compositional analyses and an account of logical consequence that are not stateable in a truth-conditional framework. Chapter 1 goes on to make the first argument. Chapters 2-4 instantiate the latter form.

Chapter 2 “Conditionals and Questions”

There is a long-standing debate in the philosophical literature about whether a conditional sentence expresses a conditional proposition or expresses the consequent proposition in a conditional way. By instantiating a broader conflict between use-oriented and truth-oriented approaches to semantics, this debate has commanded a great deal of attention. This chapter presents a phenomenon that neither approach can account for and goes on to develop a semantics that can. But there are two other important results offered here. First, this analysis combines the allegedly exclusive benefits of the propositional and non-propositional approaches. Second, it combines and argues for an account of the logic and truth-conditions of indicative conditionals that no current theory from either camp can offer. A semantics taking the general form articulated in Chapter 1 provides the key resources responsible for both accomplishments. It thereby unifies use and truth-theoretic perspectives into a more general one.

The confounding phenomenon mentioned above is the use of *if* in both interrogative and conditional contexts, e.g. *If Bob danced Leland danced* and *I wonder if Bob danced*. I explain why a uniform analysis of these uses of *if* is indeed necessary, and then I show how some familiar ideas about interrogatives and hypothetical reasoning, together with the ideas about semantics from Chapter 1, delivers such an analysis.

Chapter 3 “A Uniform Theory of Conditionals”

An attempt to extend the semantics offered in Chapter 2 to subjunctive conditionals, e.g. *If Bob had danced Leland would have danced*, confronts two puzzles. First, there is no available subjunctive reading of the *if*-clause in *I wonder if Bob had danced (by 2pm yesterday)*. Second, it is coherent to say *Bob never danced, but if he had Leland would have danced* but not *Bob never danced, but if he danced Leland danced*. Indeed, the semantics in Chapter 2 reduces the incoherence of this most recent discourse to the fact that *if*-clauses have the same meaning in interrogative and conditional environments. Building on work by others, I argue that the antecedents of subjunctives contain an operator absent in indicatives; call it an *expansion* operator. Once the this operator is taken into account, solutions to both puzzles emerge. But this fact proves to be of independent interest since it leads to a uniform semantics that has important advantages over the major alternative offered by Stalnaker.

My next task is to explore the results of combining a semantics for the expansion operator with the conditional semantics from Chapter 2. It is shown that the truth-conditions of existing analyses of subjunctive conditionals (e.g. Stalnaker 1968; Lewis 1973) can be mirrored in this setting by recasting them as a semantics of the expansion operator. This preserves the insights of these analyses but also, without any further stipulations, offers some important improvements. First, it can account for the fact that *If Bob had danced or Laura had sang, Leland would have danced* intuitively entails *If Bob had danced, Leland would have danced*. Second, when combined with plausible pragmatic assumptions it can explain why sequence (3.6) is consistent while (3.7) is not.

- (1)
 - a. If Laura had gone into the forest, she would have seen Bob dance
 - b. Of course, if she had gone into the forest and had her eyes closed, she wouldn't have seen Bob dance

- (2) b. If Laura had gone into the forest and had her eyes closed, she wouldn't have seen Bob dance
- a. # Of course, if she'd gone into the forest, she would have seen Bob dance

Chapter 4 “The Mark of Mood”

The slogan of truth-conditional semantics is that knowing the meaning of a sentence amounts to knowing the conditions under which that sentence is true. A difficulty as old as the slogan comes with the acknowledgment of meaningful non-declarative sentences, e.g. *Did Bob dance?*, *Dance!* One common response is to cleave the meaning of sentences into two parts and kinds, a propositional content and an illocutionary force or *mood* (e.g. Searle 1969). The illocutionary mood is analyzed as providing a rule of use that imposes certain conditions on its felicitous utterance, while the propositional content is articulated in truth-conditional terms. I provide a number of arguments against approaches that draw any theoretically substantive distinction between these two kinds of meaning and approaches which attempt to reduce all meaning to declarative meaning (e.g. Lewis 1970; Davidson 1979). I dub a superior approach that has caught on in formal semantics *content pluralism*. This approach claims that the three types of sentences have fundamentally different content structures. While this approach is an important improvement, I argue that it still fails to account for the full range of phenomena and fails to answer certain basic questions about how content and principles of rationality could determine use. The resources of Chapter 1 are then brought to bear on the semantic analysis of grammatical mood. Different moods are analyzed as providing different ways of changing and structuring mental states. Declaratives provide information. Interrogatives subdivide contextual information into competing alternatives. Imperatives introduce preferences over those alternatives. I show that this is not only a technically precise semantics, but is well-grounded in an attractive picture of intentionality, inquiry and rationality.

Chapter 1

Language, Meaning and Cognition

1.1 Introduction

Contemporary theoretical linguistics distinguishes six major subfields each having its own focus: **morphology** (the structure of words), **syntax** (the structure of phrases and sentences), **semantics** (the meaning of words, phrases and sentences), **pragmatics** (communicative interactions in general), **phonetics** (the sounds) and **phonology** (the abstract sound system) (e.g. Hayes *et al.* 2001: 7).¹ According to this approach, explaining linguistic behavior not only involves talking about the structure, sound and use of linguistic items, but also their **meaning**. For the uninitiated, talk of ‘meaning’ seems either harmlessly familiar or like an esoteric art. How did the initiated come to talk and theorize in this way? This chapter provides one brief glimpse of this history. This glimpse is just enough to articulate and motivate some general questions about semantics and how it fits into explanations of linguistic behavior. After suggesting that the dominant approach to semantics doesn’t provide adequate

¹As with the rest of the dissertation, all mistakes are my own. But that is particularly true of this chapter, which was prepared in haste and did not benefit from incorporating detailed criticism from my committee.

answers to these questions, I will describe a different way of thinking about semantics and a mathematical theory that embodies this way of thinking while providing the tools necessary to formulate rigorous explanations and hypotheses about particular linguistic phenomena. This will allow me to say what kind of phenomena would be needed for this approach to prevail over the orthodoxy. While Chapters 2-4 will argue that conditionals and mood exhibit these kind of phenomena, my discussion here will be purely theoretical. That is, I simply want to describe a way of thinking about linguistic meaning by putting it in a historical context, formulating it precisely and saying what language would have to be like for it, rather than the orthodoxy, to be true. Indeed I will go farther and argue that this way of thinking provides better answers to some basic theoretical questions than orthodox approaches. But before launching into this project I will attempt, by way of example, to lessen the feeling that talk of meaning and the pursuit of semantics is an esoteric art.

Imagine yourself interacting with a parrot on display in a cage at the zoo. You know the parrot can replicate sounds it hears. When the parrot produces the sentence *Please free me, they are torturing me here*, you might chuckle to yourself and even playfully say *I'm sorry I can't do that*. But you have no reason to free the parrot. Now imagine yourself instead interacting with a person on display in a cage at the circus. You know the person can replicate sounds it hears. When the person produces the sentence *Please free me, they are torturing me here*, you have every reason to free the person. Why is it that by producing the same sounds one utterance provides a reason for doing something and the other does not? An appealing answer: the person means what he said and the parrot does not. But what does that amount to? The person understands that his sentence describes a certain way the world could be and in uttering that sentence he is claiming that the world is that way. The parrot has no such understanding. This way of unpacking our talk of meaning ended up in the territory of *semantics* as Tarski described it in his paper "The Semantic Conception

of Truth: and the Foundations of Semantics”

Semantics is a discipline which, speaking loosely, *deals with certain relations between expressions of a language and the objects* (or ‘states of affairs’) ‘referred to’ by those expressions. (Tarski 1944: 345)

The idea that sentences of natural language have a semantics in this sense is also implicit in appealing ways of thinking about very basic linguistic behavior. Suppose I emit the sounds corresponding to *There is coffee in the kitchen* and you navigate your body towards a particular room in the house, grab a pitcher of hot brown liquid and pour it into a cup. It is tempting to say that you navigated to that room because of what I said and what you desired. More specifically, you wanted that brown liquid, and you took my utterance of *coffee* to refer to that kind of brown liquid. Additionally, you navigated to that room because it is the one you took my utterance of *the kitchen* to refer to. So it would seem that these semantic properties play an important role in explaining even the most common linguistic transactions. Further, there was something systematic about it: you took these references to be linked by my utterance in a way you wouldn’t have taken them to be in an utterance of the sentence *There isn’t coffee in the kitchen*. It seems plausible that this linking has something to do with the syntax and morphology of the sentence used and likewise for the systematic effect of adding a negative particle. Accordingly, it is quite easy to see how there might be a project within linguistics called *semantics* which precisely frames these kinds of explanations and relates the combinatorics of reference with the structure of language. More generally, one could conceive of semantics and the philosophy thereof as an attempt to understand what non-morphosyntactic and non-articulatory properties one must assume linguistic objects have to explain the rich behaviors in which those objects feature. This generalized conception reserves the possibility that the kind of referential relations Tarski builds into the definition of semantics may not be as appropriate for some words, e.g. *and*, as it is for *Alfred*.

1.2 A Historical Glimpse

1.2.1 From the Void

The initiated have not always embraced talk about meaning or semantics as a distinguished branch of linguistic inquiry. In one of the founding documents of theoretical linguistics, as Chomsky (1957: 93) hypothesized that natural languages may only have a ‘semantics’ in the sense of:

... the study of how this instrument, whose formal structure and potentialities of expression are the subject of syntactic investigation, is actually put to use in a speech community. (As rephrased in Chomsky 1995: 26)

On this view, linguistics is solely about linguistic structure. The study of how those structures are put to use by a speech community is a separate enterprise of no more interest to linguistics than the use of DNA to catch criminals is to the theoretical core of genetics. That same year, Grice (1957: 385) proposed that a speaker *A* means something by a sentence *S* just in case *A* intended the utterance of *S* to produce some effect in an audience by means of them recognizing this intention. Like Chomsky, Grice’s view left no room for a distinguishable branch of *linguistic* inquiry concerning meaning. Meaning in Grice’s sense need not be a property that depends on any of the particular features of the linguistic item *S* itself. As Grice pointed out, completely different artifacts can produce the kinds of effects necessary for meaning, e.g. a white flag can mean surrender. Indeed, Grice held that talk about sentences, rather than utterances, having a meaning (**sentence meaning**) is simply an abstract and general way of talking about the meanings speakers use them with on particular occasions (**speaker meaning**). To return to the parrot example, Grice would say that the parrot does not mean anything by the sounds it produced because it does not have the relevant and necessary intentions. So he claims the difference between the parrot and the human is not some *semantic understanding*, but rather a particular kind of

intention to produce certain effects.

The view that there is no autonomous theory of linguistic semantics, but rather a theory of syntax and a theory of use was not new with Chomsky and Grice. It seems to originate with Wittgenstein (1953). Several factors account for the waning allegiance to this approach in modern times. Grice's attempt to reduce sentence meaning to speaker meaning was highly problematic. Certain counterexamples to Grice's reduction seemed to evidence the need for autonomous rules of sentence interpretation (e.g. Searle 1965). Indeed, in his later work Grice drew an important distinction between certain effects an utterance could have and be intended to have, but were not part of the meaning of the sentence. Important applications of these ideas were used by Grice to defend the classical semantics for logical connectives developed by Frege and Tarski. This negative progress on the Gricean reduction happened to coincide with a resurgent attempt to apply the logical semantics developed by Frege, Tarski and others to natural language. Combined with a feeling that communication, thought and inference were surely more central to the nature of language than forensics to genetics, this resurgence delivered the modern age of linguistic semantics from the void imagined by Chomsky and Grice.

1.2.2 Into the Limelight

Frege's (1923:1) insight below also animated Davidson's (1966; 1967) adaptation of a Tarskian truth-theory to natural language semantics:

It is astonishing what language can do. With a few syllables it can express an incalculable number of thoughts, so that even a thought grasped by a human being for the very first time can be put into a form of words which will be understood by someone to whom the thought is entirely new. This would be impossible, were we not able to distinguish parts in the thought corresponding to the parts of a sentence, so that the structure of the sentence serves as an image of the structure of the thought.

Davidson (1967: 304) had his own way of stating the point:

It is conceded by most philosophers of language, and recently even by some linguists, that a satisfactory theory of meaning must give an account of how the meanings of sentences depend upon the meanings of words. Unless such an account could be supplied for a particular language, it is argued, there would be no explaining the fact that we can learn the language: no explaining the fact that, on mastering a finite vocabulary and a finitely stated set of rules, we are prepared to produce and to understand any of a potential infinitude of sentences.

For Davidson, the issue was one of *understanding*. How can one understand infinitely many sentences on the basis of (presumably) finite resources? Davidson (1967: 309) proposed an answer using the machinery provided by Tarski (1936a). At the center of this theory were theorems of the form (T). If L (the language being theorized about) was also the language being used to construct the theory, p simply was S . When two different languages are at play, Davidson (1974: 318) required that S and p have the same truth value.²

(T) ‘ S ’ is true in L if and only if p

When applied to a language L , Davidson’s theory was to yield for every sentence S of the language L a theorem of the form (T). Tarski had already shown that it was possible to do this for formal languages on the basis of a finite stock of axioms. Davidson contended that carrying this out for natural language would amount to showing how a speaker can understand a potential infinitude of sentences on the basis of finite knowledge.

To know the semantic concept of truth for a language is to know what it is for a sentence - any sentence - to be true, and this amounts, in one good sense we can give to the phrase, to understanding the language. (Davidson 1967: 310)

²More constraints are needed to make the theory work (Lepore & Ludwig 2007a).

This kind of systematic theory of language understanding was not possible within Grice's reductive theory. It was the first of two basic explanatory achievements that encouraged the pursuit of linguistic semantics.

Davidson did not actually construct a general semantic theory. Although he made important contributions to the understanding of some particular phenomena, he did not provide fully detailed theories for any significant fragment of any natural language. By contrast, Lewis (1970) and Montague (1970b,a, 1973) presented explicit, general theories and showed how to apply them to a range of phenomena. There were differences between Davidson's approach and the approaches developed by Lewis and Montague (hereafter 'Montague'), both in the architecture of the theories and in the kind of phenomena they emphasized. One point emphasized by the later is that our systematic understanding of language consists in part in the ability to recognize certain entailments as correct and certain sentences as incapable of truth or falsity. This came from the combination of Tarski's work on truth and logical consequence for artificial languages with Montague's (1970a) contention that:

There is in my opinion no important theoretical difference between natural languages and the artificial languages of logicians; indeed, I consider it possible to comprehend the syntax and semantics of both kinds of languages within a single natural and mathematically precise theory.

This marriage not only allowed Montague to say precisely what it was for one natural language sentence to 'follow' from others or to be incapable of falsity. It also explains why any speaker who accepts (1.1) and understands the word *women*, also accepts (1.2), and why any speaker who takes (1.3b) to follow from (1.3a) and understands the word *three* will also take (1.4b) to follow from (1.4a).

(1.1) All people are people

(1.2) All women are women

(1.3) a. Two men are mortal

- b. Someone is mortal
- (1.4) a. Three men are mortal
- b. Someone is mortal

Explaining this kind of systematic understanding is the other main achievement of contemporary linguistic semantics. Further, it appears to be irreducibly semantic, in Tarski's sense. Tarski (1936b:409-13) provides a simple argument in favor of a semantic rather than a purely formal account of logical consequence. For languages with the expressive power of natural languages, one can find sentences that intuitively follow from others but are not formally derivable from them. Tarski (1933) provided an example of a language containing a predicate F where formal rules can be defined to derive $F(0), F(1), \dots$ but no such rule to derive $\forall n F(n)$. Tarski notes that the arithmetic truth at the heart of Gödel's (1931) incompleteness theorem demonstrates the same point. It is well-known that in both cases a semantic definition matches intuition. Davidson's claim that semantic concepts are required for a systematic account of *general linguistic understanding* is less easily demonstrated. However, his subsequent work on the explanatory role of truth and its interconnection with belief and desire could be seen as an one attempt to do so (Davidson 1974, 1980, 2005).³

The approach to semantics outlined above comes with a title and a slogan.⁴

Truth-Conditional Semantics (TCS) To understand the meaning of a sentence is to know the necessary and sufficient conditions for that sentence's truth.

³There is actually a legitimate worry that Davidson's semantic framework cannot yield an adequate systematic theory of entailment. Tarski (1936b) makes essential use of the apparatus of model theory in his definition of logical consequence: $\phi_1, \dots \phi_n \models \psi$ iff for every model \mathcal{M} if ϕ_1, \dots, ϕ_n are true in \mathcal{M} , so is ψ . Davidson rejects this apparatus for philosophical reasons. The attempt to define logical consequence instead in terms of considering all possible replacements of the non-logical symbols does not work, as Tarski (1936b: 415-6) observed.

⁴As with Frege, Lewis and Montague embraced the slogan with a caveat: hyperintensionality requires some fine-graining of 'truth-conditions'. This detail needn't detain us here.

This is a sophistication of Wittgenstein’s (1922:4.024) claim that “To understand a proposition means to know what is the case if it is true.” While remaining the most popular contemporary approach to semantics, TCS has been actively opposed by philosophers who are allied under a different moniker and motto.⁵

Use-Theoretic Semantics (UTS) To understand the meaning of a sentence is to know how to use that sentence.

Advocates of UTS have presented a number of valuable theoretical and empirical challenges for TCS. What would be nice is to have a theory that was responsive to these points and maintain the kinds of systematic explanations gestured at above. The empirical challenges use-theorists have presented involve indicative conditionals (Adams 1975; Edgington 1995) and non-declarative sentences, e.g. *Bob danced?*, *Dance!* (Austin 1962; Dummett 1976a; Searle 1969). These phenomena are the topics of Chapters 2-4. In the remainder of this paper I will discuss the most clear theoretical objection, raise some theoretical objections of my own and sketch an alternative approach that will be at the heart of the chapters to come.

1.2.3 Dummett’s Circularity Objection

Dummett’s circularity objection is developed in Dummett (1975b) and Dummett (1976b), but is most clearly stated in Dummett (2006:Ch.4). This objection is not immediately directed at the equation of meaning with truth-conditions, but rather with the equation of understanding a sentence with knowing its truth-conditions. Dummett (2006: 51) claims that “truth-conditional theories of meaning and of content are irredeemably circular.” Here is what he has in mind. Suppose first that we pursue a ‘linguistic strategy’ and explain what it is to grasp contents of sentences in terms of what it is to understand sentences. The TCS equation turns this explanation

⁵E.g. Wittgenstein (1953); Sellars (1953); Dummett (1975b); Brandom (1994); Horwich (1998).

into a loop, since understanding a sentence itself requires grasping the content of a sentence, namely that the sentence has such-and-such truth-conditions. Suppose instead that we take a detour through thought and say that to understand sentences is to grasp associated thoughts. If we now say that grasping thoughts amounts to knowing the conditions under which those thoughts are true, we again end up in a circle. Knowing this involves judging (and so grasping) a thought, namely the thought that those thoughts are true. The problem is surprising elementary. If we try to write out what it is to understand a sentence according to TCS we will either end up writing it in terms of understanding another sentence or in terms of grasping a thought, which in turn comes to grasping yet another thought. Dummett takes this to indicate a general constraint on explaining what it is to understand a sentence in terms of theoretical (even if implicit and partially practical) knowledge. Unless there are additional theses in place saying what practical abilities that knowledge (at least in part) consists in, the theory not only shirks the task of connecting meaning and use, it results in circularity. Dummett (2006: 56) responds with the following.

What forces a truth-conditional theory of meaning or of content to be circular? And what would a non-circular theory be like? A non-circular theory of meaning would represent a knowledge of the meaning of a sentence or word as knowing how to use that sentence or word; a non-circular theory of content would represent a grasp of a proposition or of one of its constituent concepts as knowing how to frame that proposition or some range of propositions involving that concept and to act on it or them. This knowledge would not consist merely in a practical ability, however complex. It would comprise an extensive knowledge of facts; at least this would be so when linguistic knowledge was in question. But the knowledge would be of the intermediate type: the facts known would not be statable in words, or at least not so statable by the subject. For this reason, there would be no circularity in the account.

It is far from clear to me that following Dummett in regarding linguistic understanding as a kind of ineffable mix of theoretical and practical knowledge is necessary. But he does seem to have raised a *prima facie* challenge to truth-conditional semantics, one which clearly pushes towards a positive theory based on use rather than truth.

1.2.4 From Syntax to Semantics

The very possibility of applying a Davidsonian or Montagovian semantics to natural language depends upon natural language having a precise syntax. Not only that, but the way the theories are stated enforces a correspondence between that syntactic structure and the calculation of the sentence's truth-condition. For example, saying that '*p and q*' is true iff '*p*' is true and '*q*' is true requires that the quoted linguistic item on the left is decomposable into two constituents and a conjunctive particle *and*. Furthermore, one applies such a clause at this point even if, say, *or* occurs within *p*, because *and* is the main connective. Indeed, Montague explicitly demanded that the meaning of a complex sentence like *George loves the largest oil baron in the Middle East* be derived from composing the meaning of each of its parts in the order dictated by syntactic structure. In Davidson's theory, this same constraint must be effected under a different guise. There it must be required that the derivation of the T-sentence be canonical, in the sense that axioms and rules of inference are applied 'in the right order' (Lepore & Ludwig 2007a: 72,109-12).

It is uncontroversial that this correspondence between syntax and semantics is an essential innovation in the construction of systematic theories of meaning. But why should it be a feature of such a theory? Why is there this tight connection between semantic composition and syntactic structure? One possibility is to maintain the Tractarian view that the structure of the sentence mirrors the structure of the fact it corresponds to (Wittgenstein 1922). Even the author of the *Tractatus* tempered this idea with the assumption that it is actually the logical form that is mirrored in reality, which is held to diverge radically from the structure of the natural language sentence. Davidson (1990: 302-4) is on record rejecting the view, and it is indeed difficult to imagine the varied syntactic structures of the world's languages corresponding perfectly to some metaphysically deep structure in the world. So it would seem that we have no insight into this deep fact about the connection between syntax

and semantics.

An entirely different concern can be raised about the marriage of truth-conditional semantics with an assumption common among linguists, particularly syntacticians, that our linguistic competence is largely autonomous from our all-purpose world knowledge. TCS seems to say that semantic competence involves knowing what objects in the world certain words refer to. But surely ancient astronomers were fluent speakers before they knew that *Hesperus* and *Phosphorus* are the same planet. Surely it was an empirical discovery that *water* and H_2O refer to the same substance. Indeed, it seems like the world must participate in order for a bit of language to refer at all. In other words, it seems like reference is something that is genuinely achieved by already competent speakers, not attained by them definitionally.

Introductory linguistics textbooks often address this worry by noting that entailment is the primary semantic data to be explained and knowing that an entailment is valid does not require knowing whether or not the sentences that make it up are true or false (e.g. Hayes *et al.* 2001:372). This is true, but it only goes so far. If we are just concerned with entailments, we can regard the reference axioms of a truth theory or the interpretation function of model theory as encoding matters not within the sphere of linguistic competence (indeed model theory encourages this idea), and establish entailments without consulting them. But the fact remains that the architecture of these theories includes specifications of these facts in their specification of a meaningful language. It would be more satisfying if we were able to somehow build these facts into the contextual information brought to bear on interpretation rather than the basic laws of linguistic meaning. This would not only reflect the fact that only open-class lexemes like names and predicates seem to refer while closed-class items have no intuitive connection to the act of reference. It would encourage the seemingly inevitable idea that the ‘lexical semantics’ of those open-class items, while constrained by whatever texture the language faculty builds into them, is permeated

by world-knowledge and constituted in part by our relationship with our physical environment.

For this very reason, I think it is no accident that many philosophers of mind who have advocated some kind of informational or causal theory of content have carried it out only for names and/or predicates. When it comes to logical vocabulary (and presumably all closed-class vocabulary), they are happy to say that the meaning of these expressions are their functional role (e.g. Fodor 1990: 110). But then we really have two separate projects which our semantic architecture should respect, and a serious question of how they should interact.

1.3 A Different Model of Semantics

In this section I will begin by discussing two ways truth-conditions have been understood in the literature on TCS, and settle for one of them: information. This is then used to sketch an alternative characterization of linguistic meaning which accepts this notion of content, but rejects it as a notion of linguistic meaning. After providing some technical details to make the contrasts precise, I will show that the alternative solves the theoretical puzzles raised in §§1.2.3 and 1.2.4.

1.3.1 Two Conceptions of Truth-Conditions

While Davidson and Montague agreed on the centrality of truth to a semantic theory of natural language, their specifications of truth-conditions took quite different forms and embodied quite different conceptions of what pairing a sentence with its truth-conditions amounts to. Davidson thought of (1.5) as a way for an English speaker to interpret the German sentence it mentions.

(1.5) “Schnee ist weiss” is true in German if and only if snow is white

The English sentence on the right side of the biconditional articulates necessary and sufficient conditions for the German sentence, and in this sense gives it truth-conditions. But this articulation is parasitic on an understanding of English, and therefore does not specify the meaning of the German sentence once and for all in non-linguistic terms. On this view, meaning is made by decoding one language into another. Following Frege's lead, Tarski, Carnap, Montague and Lewis sought to break out of the linguistic circle. Lewis (1970: 22) describes the strategy candidly:

In order to say what a meaning is, we may first ask what a meaning does, and then find something that does that. A meaning for a sentence is something that determines the conditions under which the sentence is true or false. It determines the truth-value of the sentence in various possible states of affairs, at various times, at various places, for various speakers, and so on. Similarly, a meaning for a name is something that determines what thing, if any, the name names in various possible states of affairs, at various times, and so on. . . Similarly, a meaning for a common noun is something that determines which (possible or actual) things, if any, that common noun applies to in various possible states of affairs, at various times, and so on.

I will simplify: assume truth-values, etc. depend only on the possible state of affairs (worlds) where it is evaluated. Then the meaning of a name should determine a referent for each world and the meaning of a common noun (predicate) should determine a set of things for each world. Both can be modeled as a function that maps worlds to the appropriate referent/set of things. Such a function is paired with each symbol by the interpretation function $\llbracket \cdot \rrbracket$.⁶ For a first-order logic name and predicate:

$$(1.6) \quad \begin{aligned} \text{a. } \llbracket \mathbf{a} \rrbracket &= \{ \langle w, a \rangle \mid w \in \{w_0, w_1, \dots\} \} \\ \text{b. } \llbracket \mathbf{P} \rrbracket &= \{ \langle w, P \rangle \mid P = \{a\} \text{ if } w = w_0, P = \{a, b\} \text{ if } w = w_1, \dots \} \end{aligned}$$

The meaning of an atomic sentence can then be identified with a function which maps w to the True (1) if the referent of \mathbf{n} in w is in the extension of \mathbf{P} at w , and otherwise

⁶ $\llbracket \cdot \rrbracket$ is half of a model \mathcal{M} which also consists of the domain of entities $D_{\mathcal{M}} = \{a, b, c, \dots\}$ and truth-values $T_{\mathcal{M}} = \{0, 1\}$ $\llbracket \cdot \rrbracket$ is defined over. I omit the \mathcal{M} from $\llbracket \cdot \rrbracket_{\mathcal{M}}$ throughout.

maps w to the False (0).

$$(1.7) \llbracket P(a) \rrbracket = \{ \langle w, t \rangle \mid t = 1 \text{ if } \llbracket a \rrbracket(w) \in \llbracket P \rrbracket(w) \text{ \& } t = 0 \text{ if } \llbracket a \rrbracket(w) \notin \llbracket P \rrbracket(w) \}$$

The view becomes more picturesque if we follow Stalnaker (1976) and identify the meaning of a sentence with the set of worlds it maps to 1. This can be thought of as the information carried by $P(n)$. Like information, it distinguishes some ways the world could be (worlds in the set) from ways it can't be (worlds excluded from the set). On this approach, meaning isn't made by compiling one language into another. It is made by specifying a relation between $P(n)$ and whatever feature the worlds in $\llbracket P(n) \rrbracket$ have in common. **Indication** is a candidate for this relation (Dretske 1981:65). However instantiated, this relational view is what Lewis and Montague have in mind when they talk about the truth-conditions of a sentence.

While Davidson advances an esoteric perspectival account of meaning, the model-theoretic view advances a boldly realist and fully general account. What is to decide between them? The realist strategy, unlike Davidson's, holds promise for a reductive theory of content/meaning, assuming possible worlds can be defined in non-linguistic and non-intentional terms (Stalnaker 1984: 1-42). Davidson (1976: 176) disavows that desideratum, but his reason for doing so is that he doesn't think it is possible. An additional, purely methodological advantage lies with the model-theoretic view. Being the more explicit, committing and expressive theory, it should be the hypothesis until retreat becomes necessary.⁷ But, perhaps most importantly, it seems that this level of expressive power is necessary for explaining why we have the judgements of entailment that we do. As alluded to in note 3, there are reasons to think that the resources of model theory are necessary for capturing our ordinary notions of logical consequence (Tarski 1936b:415-6). Accordingly, this will be the notion of

⁷I gather from Davidson (1967, 2005:76-163) that he thought the semantic paradoxes and the problem of predication necessitated his approach. I disagree, but cannot explore the matter here.

truth-conditional content or information that I will henceforth operate with.

1.3.2 Where Two Models Come Apart

Everybody agrees that language use happens against an ever-changing background of information, and that explaining how it works will require understanding the kinematics involved. Towards this end, Stalnaker (1978) formulated a model of what this information consists in and how semantics and pragmatics conspire to change it. The information that accumulates can be thought of as that which the agents are taking for granted in some way for the purposes of their activities. Call this information c , short for *contextual information*, or given our model of information *contextual possibilities*. According to Stalnaker's model semantics pairs a sentence ϕ with a proposition $\llbracket \phi \rrbracket$ (modulo context-sensitivity) and pragmatics provides a rule for changing c : $c \cap \llbracket \phi \rrbracket$. This is the **classical picture**. But there is also what might be called the **dynamic picture** most clearly articulated by Heim (1982) and Veltman (1996). On this model, semantics assigns a function to ϕ which maps the initial contextual information c to the contextual information that results from accepting ϕ . I will follow Veltman in writing $c[\phi] = c'$ to say that c' is the result of accepting ϕ when the contextual information is c . Specifying the meaning of ϕ , amounts to specifying the difference between c and c' . The role of pragmatics becomes negotiating the acceptance of an utterance of ϕ and either recognizing or formulating the larger plan that its utterance is part of. To summarize:

Classical Picture Linguistic meaning is information

Dynamic Picture Linguistic meaning is information change potential

To make the dynamic picture more concrete consider how one would specify the meaning of an atomic sentence of first-order logic. Using the notation from §1.3.1:

$$(1.8) \quad c[\mathbf{P}(\mathbf{a})] = \{w \mid \llbracket \mathbf{a} \rrbracket(w) \in \llbracket \mathbf{P} \rrbracket(w)\}$$

This raises two questions: does the dynamic picture not also ‘dynamify’ the meanings of subsentential expressions and isn’t it the case that $c \cap \llbracket P(a) \rrbracket = c[P(a)]$? The dynamic picture can be extended down to subsentential expressions, but for the moment just consider this initial stage of the project. The answer to the second question is *yes*, giving way to the question: what does the dynamic picture do for us? I want to discuss one kind of answer that has been provided in the literature, say something about it and then discuss a different kind of answer.

Several authors have noted that while $c \cap \llbracket P(a) \rrbracket = c[P(a)]$ it is not true for all interesting ϕ that $c[\phi] = c \cap \llbracket \phi \rrbracket$. For example, Veltman (1996) discusses an epistemic possibility modal \Diamond for which $c[\Diamond\phi] \neq c \cap \llbracket \Diamond\phi \rrbracket$ and Groenendijk *et al.* (1996) present a dynamic semantics for \exists where $c[\exists x \phi] \neq c \cap \llbracket \exists x \phi \rrbracket$ (though c undergoes an enrichment here). In both cases, phenomena in natural language are discussed which seem to involve the transitions encoded by the dynamic meanings. The argument is then that since these operators capture information changes in natural language use that the classical combination of semantics and pragmatics cannot, it follows that the dynamic picture is to be preferred. Indeed, van Benthem (1986) proves that $c \cap \llbracket \phi \rrbracket = c[\phi]$ if and only if $c[\phi] \subseteq c$ and $c[\phi] = \bigcup_{w \in c} \{w\}[\phi]$. While \exists violates the former, \Diamond violates the later. But, there is a loophole in at least half of this argument, and that consists in how sophisticated one can be in assigning propositions to ϕ . If one allows for the proposition to depend on c , operators like Veltman’s become classically definable.

For Veltman, $c[\Diamond P(a)] = \{w \in c \mid c[P(a)] \neq \emptyset\}$ and $\llbracket \Diamond P(a) \rrbracket = W[\Diamond P(a)]$ (W is the set of all worlds). To see that $c[\Diamond P(a)] \neq c \cap \llbracket \Diamond P(a) \rrbracket$ consider the case where $\{w_0, w_1\}[P(a)] = \emptyset$ while $W[P(a)] = \{w_2\}$. Then $\{w_0, w_1\}[\Diamond P(a)] = \emptyset$. Since $W[P(a)] = \{w_2\}$, $W[\Diamond P(a)] = W$, which is also by definition $\llbracket \Diamond P(a) \rrbracket$. So $\{w_0, w_1\} \cap \llbracket \Diamond P(a) \rrbracket = \{w_0, w_1\} \cap W = \{w_0, w_1\} \neq \emptyset$. But now suppose that we have on offer the following context-sensitive propositional semantics for \Diamond : $\llbracket \Diamond P(a) \rrbracket_c = \{w \mid c \cap \llbracket P(a) \rrbracket \neq \emptyset\}$. Since $\{w_0, w_1\} \cap \llbracket P(a) \rrbracket = \emptyset$, $\llbracket \Diamond P(a) \rrbracket_{\{w_0, w_1\}} = \emptyset$. So $\{w_0, w_1\} \cap$

$\llbracket \Diamond P(a) \rrbracket_{\{w_0, w_1\}} = \emptyset = c[\Diamond P(a)]$. This is in fact the trick at the heart of Yalcin's (2007) non-dynamic semantics which, like Veltman's, captures the inconsistency of $\phi \wedge \Diamond \neg \phi$ and $\neg \phi \wedge \Diamond \phi$.

From this consideration of Veltman's theory it follows that an argument for his semantics must be made in less simple terms. It must be that the dynamic representation of the meaning is somehow better, even if it can be mimicked classically. There are no such arguments in the literature on dynamic semantics for any operator, let alone Veltman's (though I am not sure one doesn't exist on his behalf). Chapters 2-4 provide a plethora of arguments of this form, but they do not discuss \Diamond . The style of the argument in Chapters 2 and 3 is simple: only the dynamic form of the meaning yields a compositional semantics and adequate conception of logical consequence. In Chapter 4 it will be that only a dynamic form of the meaning can uniformly represent the contributions of sentential connectives in non-declarative sentences and supports an adequate notion of entailment. In the remainder of this chapter I want to provide an entirely theoretical argument: even if the dynamic and classical theories were empirically equivalent, stating and thinking of the classical theory in the dynamic format allows us to address the questions raised in §§1.2.3 and 1.2.4, while preserving the explanatory insights of truth-conditional semantics articulated in §1.2.2.

1.3.3 Filling in Some Details

On the dynamic picture a meaning is an information change potential (ICP). This is just a way of modifying a set of possibilities and thereby changing the information it embodies. The content of c is defined by whatever acceptance attitude is appropriate to modeling communication and inquiry. So, to say that a sentence ϕ of a speaker S 's language has a given ICP is just to say that ϕ plays a characteristic role in changing some of S 's mental states, a role specified in terms of how the contents of those states change. These characteristic changes may come in the wake of speech acts, where

ϕ changes the content of the attitude defining c , and thoughts where ϕ may change the content of less public attitudes.⁸ How does this **dynamic** approach relate to truth-conditional ones? A specific example of such a semantics will allow me state this precisely.

Consider a first-order language with the familiar syntax and assume that a model continues to assign referents to names and predicates as above. The meanings of sentences are specified in the format discussed above.

Definition 1 (Update Semantics)

- $$\begin{array}{ll} (1) & c[\mathbf{P}(\mathbf{a})] = \{w \in c \mid \llbracket \mathbf{a} \rrbracket(w) \in \llbracket \mathbf{P} \rrbracket(w)\} \\ (2) & c[\neg\phi] = c - c[\phi] \\ (3) & c[\phi \wedge \psi] = (c[\phi])[\psi] \\ (4) & c[\Diamond\phi] = \{w \in c \mid c[\phi] \neq \emptyset\} \end{array}$$

(1)-(4) assign each kind of formula a special role in modifying c . Atomic sentences eliminate possibilities incompatible with the referent of the name being in the extension of the predicate. Conjunctions update with each of their conjuncts in sequence. Negation eliminates the possibilities compatible with its scope. (4) approximates epistemic *might* (Veltman 1996). It **tests** whether it is consistent to accept ϕ in c . Inconsistency (\emptyset) results if it is not. Otherwise, c remains as it was.

The classical concept of truth is still definable in this framework, though it is a special case of the more general concept of **support**.

Definition 2 (Support, Truth in w)

- $$(1) \text{ Support } c \models \phi \Leftrightarrow c[\phi] = c \quad (2) \text{ Truth in } w \ w \models \phi \Leftrightarrow \{w\}[\phi] = \{w\}$$

Some information c supports a sentence just in case the semantic effect of that sentence on c is *informationally redundant*. Truth in a world is a special case of support. A sentence is true in w just in case it is redundant with respect to *perfect information*

⁸I will not be able to address the interesting question of whether the communicative role (Grice 1957), the cogitative role (Harman 1975; Chomsky 1964:58-9) or neither role is *constitutive* of a sentence's linguistic meaning.

about w : $\{w\}$.⁹ Think of c as the content of an agent's doxastic state. Support tracks when that agent is already committed to accepting ϕ . In the extreme case where the agent has a complete picture of w , support says something unique about w . If this picture is really a complete picture of w and ϕ is already part of it, ϕ must be true in w . This definition of truth differs from that endorsed by Veltman, and a brief justification of this difference is in order.

According to Veltman ϕ is true in w iff $W[\phi] = c$ and $w \in c$, i.e. when totally ignorant, ϕ does not exclude w from consideration. But, the relationship between this definition and the classical one is obscure. It also leads in a less interesting direction than the one pursued in the main text. Veltman's definition is really a contextualist one: ϕ is true in w relative to W iff w is not eliminated from W by ϕ . But it does not generalize to cases where $w \notin c$. If $w \notin c$ then automatically ϕ is false in w relative to c since w won't be in $c[\phi]$. This is a drastic shortcoming which would prevent the theorist from predicting any context-sensitive utterances to be actually true when the agent's have even one false belief. One could stipulate that the actual world never be tossed out, but this vitiates the whole point of the set-up, namely to model uncertainty. One could stipulate that the information be true, but the problem would recur when we attempt to evaluate various utterances for truth at counterfactual worlds. Lastly, Veltman's definition of truth yields a less insightful comparison of the classical and dynamic concepts of logical consequence. Given my definition of truth, truth-preservation is really just a special case of the dynamic consequence relation such as that given in Definition 8 below. This is not true for Veltman's definition.¹⁰

⁹This definition is mentioned by van Benthem *et al.* (1997: 594) by my application and defense of it is novel.

¹⁰A truth-focused version of update-to-test consequence would go: for all w , if $w \in W[\phi_1] \cdots [\phi_n]$ then $w \in W[\phi_1] \cdots [\phi_n][\psi]$. This will not coincide with classical consequence since the order of the premises may matter for whether $w \in W[\phi_1] \cdots [\phi_n]$; e.g. you can have $w \in W[\Diamond\phi][\neg\phi]$ while

The propositional content of a sentence is the set of worlds where it is true and hence determined by and distinct from its linguistic meaning (its ICP).

Definition 3 (Propositional Content) $\llbracket \phi \rrbracket = \{w \mid w \models \phi\}$

This method for deriving truth-conditions from ICPs will be central in §2.3.2 below.

A sentence's truth-conditions deliver a limited picture of its meaning: how it affects perfect information. Its ICP delivers a broader picture: how it interacts with even uncertain information about the world. For the Boolean connectives alone there is no difference of importance here, but epistemic \Diamond changes things. Indeed, one can prove what is usually the semantics in a truth-conditional framework:

$$(1.9) \quad \llbracket \phi \wedge \psi \rrbracket = \llbracket \phi \rrbracket \cap \llbracket \psi \rrbracket$$

$$(1.10) \quad \llbracket \phi \vee \psi \rrbracket = \llbracket \phi \rrbracket \cup \llbracket \psi \rrbracket$$

$$(1.11) \quad \llbracket \neg \phi \rrbracket = W - \llbracket \phi \rrbracket$$

$\Diamond \phi$ is distinguishable from ϕ only when their effects on *imperfect information* are compared. Definitions 5.1 and 5.4 entail that $\{w\}[\Diamond p] = \{w\}$ just in case $\{w\}[p] = \{w\}$. Now suppose p is true in w and false in w' , but that it is uncertain which one is realized. Then $\{w, w'\}[\Diamond p] = \{w, w'\}$ while $\{w, w'\}[p] = \{w\}$. By contrast, the orthodox approach to distinguishing $\Diamond \phi$ and ϕ does so truth-conditionally. On the orthodox analysis $\Diamond \phi$ expresses a context-sensitive proposition reporting the fact that ϕ is consistent with some salient information in the utterance context (e.g. DeRose 1991:593-4). But there are problems with this report-model (Yalcin 2008), ones solved by the semantics above (Yalcin 2008:§2.6).¹¹ On that semantics, an asser-

$w \notin W[\neg \phi][\Diamond \phi]$.

¹¹Yalcin (2008) goes on to give a different analysis. He notes that Veltman's semantics cannot distinguish *For all Frank believes, it's raining in Topeka* and *Frank believes it might be raining in Topeka*. Yet Veltman's analysis can be augmented with the partition structure at the heart of Yalcin's analysis to capture the contrast between these sentences. This point is elaborated below in Remark 3, Appendix 2.A.

tion of $\Diamond\phi$ does not convey something about the relevant information by asserting a ‘second-order’ proposition about that information. Rather, in interpreting an utterance of $\Diamond\phi$ the hearer’s competence with $\Diamond\phi$ together with the assumption that the speaker is not being inconsistent allows the hearer to draw an inference: that the information the speaker intended to be interpreted against leaves open a ϕ -possibility. Epistemic modals are very flexible in the information they allow this to be: the participants’ shared information, the speaker’s private information, the hearer’s private information, some expert’s information, etc. (von Fintel & Gillies 2007, 2008: §9).

This ‘test’ semantics entails that truth-conditions give an incomplete picture of meaning. A complete picture must say how sentence interacts with imperfect information too. Here is one attractive way of making entailment sensitive to this dimension of meaning.

Definition 4 (Entailment v1) $\phi_1, \dots, \phi_n \models \psi \Leftrightarrow \forall c : c[\phi_1] \dots [\phi_n] \models \psi$

It says that ψ is entailed by a sequence of premises just in case adding those premises incrementally to any body of information makes ψ redundant.¹² This specifies which linguistic inference moves may be made while preserving even uncertain information. Predictably, classical entailment emerges by focusing on perfect information: $\phi_1, \dots, \phi_n \models_{CL} \psi \Leftrightarrow \forall \{w\} : \{w\}[\phi_1] \dots [\phi_n] \models \psi$.¹³ With this definition, I have completed the formal work for demonstrating that like truth-conditional semantics, dynamic semantics offers a systematic account of entailment. Indeed, (1.9)-(1.11) emphasize that the dynamic and truth-conditional approaches are equivalent when we limit ourselves to certain operators definable in the dynamic framework. I now want to argue that even if we did limit ourselves to the classically definable operators, embracing the dynamic way of thinking allows one to address the theoretical

¹²More on this definition: van Benthem (1996: Ch.7) and Veltman (1996: §1.2).

¹³Perfect information eliminates order-sensitivity, i.e. (i) $\{w\}[\phi_1] \dots [\phi_n] \models \psi$ is equivalent to (ii) if $\{w\}[\phi_1] = \{w\}, \dots, \{w\}[\phi_n] = \{w\}$ then $\{w\}[\psi] = \{w\}$.

questions raised in the preceding sections.

1.3.4 From Syntax to Semantics and Back Again

Why do sentences of natural language have structure and why do they have the kinds of structures they do? The standard answer, first articulated by Chomsky (1957) and developed extensively subsequently, is this. To say that a sentence has a given structure is to say that there is always a unique way of decomposing it and this is guaranteed by the fact that it was derived in a particular way. For example, we can say that *John's mother is happy* has the structure $[John's\ mother][is\ happy]$ and not $[John's[mother\ is]][happy]$ because *John's* and *mother* were concatenated and then the product was concatenated with *is happy*. The unique decomposition is guaranteed by this derivation, since the decomposition is just the derivation in reverse. Automata theory tells us that only certain kinds of mechanisms can generate certain syntactic structures. It follows that natural languages have the kinds of structures they do because our mind's faculty for producing language is a certain kind of mechanism. To put it another way, our syntactic competence consists in our language faculty instantiating a certain kind of mechanism, abstractly described. To fill out this picture of syntactic competence, one must say more about the nature of these mechanisms.

An automata can be described precisely in abstract terms. Ignoring some (for us) irrelevant details, an automata consists of some states S , some symbols Σ and a transition function δ which pairs each state $s \in S$ and symbol $\sigma \in \Sigma$ with a (possibly identical) state $s' \in S$. δ is called the transition function because it says that the machine transitions from s to s' when it encounters σ . On this model, syntactic competence is the ability to transition from one state into another upon encountering some symbol. As with the automata used to write these words, this ability is never perfectly realized. The mechanism can malfunction due to physical limitations. But it is only by combining an account of the abstract mathematical properties of the

machine and an account of the physics of its instantiation that this messy behavior can be explained. So the messiness doesn't undercut the need to specify how the ideally competent mechanism would behave.

This articulation of syntactic competence is a functional one. It says what it is to be competent by saying how a competent speaker's language faculty functions. There are two importantly different kinds of functional explanations. **Narrow** functional explanations make reference only to the internal states of the mechanism and how they change. This was the variety of functional explanation given for syntactic structure above. **Wide** functional explanations make reference to the agent's external environment (including relations between the agent and its environment) and how it changes (Harman 1988). The proposal I would like to make is that linguistic semantics should offer wide functional explanations that correspond to the narrow functional explanations of syntax. This is because the two branches of inquiry aim to specify different features of the same event, namely the act of processing a symbol. This proposal explains the isomorphism between syntactic form and semantic composition, and it explains why natural languages are systematic in this way: if their sentences were not uniquely decomposable there would be many ways for the meanings of the sentences to be put together, so the meaning of the whole would not be determined by the meaning of the parts. The fact that an automaton must be described and studied at a variety of levels is not an invention of philosophical caprice. It is deeply ingrained in the way computer science is practiced (Newell 1981:4-5). Indeed, Newell's position is that there is a certain wide level of explanation called the **knowledge level** which is essential to what it is for an agent to be intelligent.

Only the dynamic representation of classical meanings makes clear how those meanings could be thought of in terms of their wide functional roles. For the meaning of a sentence to consist in its wide functional role, specifying that meaning must amount to specifying some way in which the agent's environment changes. The

truth-conditional model of *information* that emerged from §1.3.1 does play a crucial part in doing this. We can think of the environmental element that changes as the informational content c of the agent’s mental state. This is an element of the environment insofar as it specifies a relation between the agent and their environment. But the truth-conditional model of linguistic meaning says nothing about how this content changes when an agent accepts a sentence. For example, the equation $\llbracket \phi \wedge \psi \rrbracket = \llbracket \phi \rrbracket \cap \llbracket \psi \rrbracket$ says nothing about how an agent’s state of mind should change in response to accepting a conjunction. By contrast, $c[\phi \wedge \psi] = c[\phi][\psi]$ specifies the wide functional role of \wedge by specifying how an agent’s informational relationship with their environment c changes when they accept a conjunction. Thus, only the dynamic representation, even if it can be mimicked in a truth-conditional semantics, captures the true nature of linguistic meaning. Furthermore, only the dynamic representation gives the meaning of language in the format that legions of philosophers have craved but never been able to articulate precisely: functional role (e.g. Sellars 1974; Harman 1982; Block 1986). Since functional-role semantics has been advocated as one of the canonical use-theories of meaning, it would seem that the dynamic theory under discussion here is such a theory. But since that theory is a generalization of the truth-conditional semantics, the traditional opposition between these approaches emerges as a confusion. The benefits of both can be embraced at once.

A more radical form of the dynamic semantics offered above can also make explicit the distinction between the empirically permeated relation of reference and that of linguistic meaning. The semantics above contained an element which brought reference into the description of linguistic competence: $\llbracket \mathbf{a} \rrbracket$ and $\llbracket \mathbf{P} \rrbracket$ (Definition 1.1). This appearance can be eliminated with two swift modifications: take names and predicates to be variables that receive their referents from an assignment function (Cumming 2008) and enrich c to model not only the agent’s information about the non-linguistic world but how their names and predicates map onto the entities and

properties that make up the world, i.e. the reference relation (Groenendijk *et al.* 1996). Formally, an assignment function s maps individual variables x_a, x_b, \dots, x_n to referents $s(x_a), s(x_b), \dots, s(x_n)$, and predicate variables X_P, X_Q, \dots, X_N onto properties, i.e. functions from worlds to sets of individuals, $s(X_P), s(X_Q), \dots, s(X_N)$. Now the information at stake in language use is a set of world and assignment function pairs, e.g. $c = \{\langle w_0, s_0 \rangle, \langle w_1, s_0 \rangle, \langle w_0, s_1 \rangle, \langle w_1, s_1 \rangle\}$. The new semantics comes out as:

$$(1.12) \ c[X_P(x_a)] = \{\langle w, s \rangle \in c \mid s(x_a) \in s(X_P)(w)\}$$

Instead of employing knowledge attributed to the speaker by the linguistic theory like $\llbracket a \rrbracket$ and $\llbracket P \rrbracket$, this equation describes the speaker's competence as the ability to combine two pieces of world-knowledge ($s(x_a), s(X_P)(w)$) in a particular way (predication). Thus, a competent speaker is not assumed to know what x_a and X_P refer to. The only two posits of the theory are motivated on independent grounds. Cumming (2008) presents strong argument for the variable treatment over descriptive and Millian accounts, and shows that this refined sense of information can account for the hyperintensionality of attitude verbs; a problem our embrace of possible-worlds semantics demanded solving anyway.

1.3.5 Straightening Out Dummett's Circularity

Dummett himself thought that a use-theory of meaning could break out of the circularity he saw in truth-conditional accounts of linguistic understanding. Since it has been shown above that the dynamic semantics developed there takes a form many have called a use-theory, it will be no surprise that it offers a way out of Dummett's circularity. The circularity for TCS arose in two different forms. If they attempt to say that understanding the content of a sentence just consists in understanding the sentence, then a loop ensues. After all, they say that to understand a sentence is to grasp the content of a sentence, namely that the sentence has such-and-such

truth conditions. If they attempt to say that understanding a sentence is to grasp the associated thought, another loop arises if they also say that grasping thoughts amounts to knowing the conditions under which those thoughts are true. After all, knowing this involves judging, and so grasping, a thought: the thought that though thoughts are true. On the dynamic picture, to understand a sentence is just for that sentence to have a particular wide and narrow functional role. So understanding the content of a sentence can be analyzed in terms of understanding the sentence without circularity, since it is not assumed that this amounts to grasping the content of any expression. It amounts to (a functioning agent) being able to transition from one state of mind to another, both widely and narrowly construed.

1.4 Conclusion

This chapter recalled some prominent reasons for thinking that linguistic semantics is part of a mature theory of linguistic behavior. The systematic phenomena that provided these reasons was seen to be nicely accommodated by a particular version of truth-conditional semantics. However, this approach left open pressing questions about the relationship of syntax to semantics and linguistic competence. I sketched an alternative ‘dynamic’ approach and stated two new forms of argument for that approach. The first was to argue that representing meaning in that format was necessary to explain the compositional, systematic structure of language and the entailment patterns it gives rise to. Those arguments are the topics of Chapters 2-4. In this chapter I argued that even if one embraces a form of dynamic semantics that can be classically expressed, there are reasons for preferring the dynamic model. Unlike the truth-conditional model, it explains why semantic composition and syntactic structure work in tandem, how to keep reference out of our linguistic competence and how to specify in a non-circular way what it is to understand a sentence.

Chapter 2

Conditionals and Questions

2.1 Introduction

Conditional sentences, such as (3.1) and (3.2), are a heavily worked resource in the activities of planning, communication and inquiry.

(2.1) If Bob danced, Leland danced (‘Indicative’)

(2.2) If Bob had danced, Leland would have danced (‘Subjunctive’)

Their study has unearthed phenomena which have dramatically influenced semantic theory and views on its role in the explanation of these activities. Frege (1893), Jeffrey (1963), Grice (1989a) and others, used the tools of **truth-functional semantics**. They model the meaning of *if* as a binary truth-function that computes the truth-value of the conditional from the truth-values of the antecedent and consequent. C.I. Lewis (1914), Stalnaker (1968), D.K. Lewis (1973) and others explore a **possible-worlds semantics**. They render *if* as a binary propositional function, taking two sets of possible worlds (propositions) to a third one, the conditional propo-

sition.¹ These truth-conditional **connective theories** are canonically distinguished from **suppositional theories** (e.g. Quine 1950: 21; von Wright 1957: 131; Mackie 1973: Ch.4; Adams 1975: 1-42; Edgington 1995: §§7-9) which maintain that the acceptance or assertion of a conditional does not involve the acceptance or assertion of a conditional proposition. Instead, the *if*-clause contributes a supposition under which the consequent alone is accepted or asserted. There is ambivalence about the theory's semantic foundations. But all variants endorse a departure from the truth-conditional model and most adopt a **probabilistic semantics**.²

Much recent debate has focused on which of these two approaches should be adopted (e.g. Lycan 2006; Edgington 2008) and is a rare case where truth-theoretic and use-theoretic perspectives compete and engage. The exclusive advertised benefits of suppositional theories are their treatment of conditionals' probabilities (Adams 1975; Bennett 2003; Edgington 2008) and indicative conditionals' sensitivity to the private epistemic states of language-users (Gibbard 1981; Edgington 1995; Bennett 2003). Truth-conditional theories emphasize their ease in explaining truth-value judgements, adhering to compositionality, treating indicative and subjunctive conditionals uniformly and integrating with truth-conditional frameworks used for other regions of discourse.

There is, however, one phenomenon that neither approach can accommodate, namely non-conditional, interrogative occurrences of *if* (Harman 1979: 48).³

¹To simplify matters, I will suppress discussion of Kratzer's (1986; 1991) **restrictor theory** which differs in compositional detail from connective theories. This theory also constructs conditional propositions using possible-worlds semantics, but maintains that conditionals are held together by a (frequently covert) binary modal operator and relegates *if* to a supporting role: semantic vacuity or serving only to restrict the modal. This approach is equally frustrated by (2.3)-(2.5). Here, *if* neither restricts a modal nor wilts into semantic vacuity.

²E.g. Adams (1975); Appiah (1985); McGee (1989); Edgington (1995); Bennett (2003). Belnap (1973) hybrids connective and suppositional accounts by, essentially, using a three-valued logic. There are numerous, more tenebrous, versions.

³See also Haiman (1978).

(2.3) Albert wondered if Mabel loved John

(2.4) Mabel asked if John was going to the party

To these specimens I add (2.5).

(2.5) The future is coming. The question is if we will be ready for it.

Here we find an isolated *if*-clause introducing a question as the *argument* of an interrogative attitude verb or the identity relation. There is simply no supposition and no binary operation on propositions or truth-values.

The convergence of interrogatives and conditional antecedents is very common even across *unrelated* languages,⁴ a pattern which makes lexical ambiguity approaches both implausible and unexplanatory. This **conditional-interrogative link** should not be construed as an identification of *all* conditional antecedents in all languages with interrogatives, and need not be for it to be of theoretical importance.⁵ Their widespread overlap requires explaining how it is that a language could use the same morpheme to form a conditional antecedent and an embedded interrogative. Whatever the abstract semantic structure of conditionals is, it must be flexible enough to frame an answer to this question and hence must not be what existing theories take it to be.

This paper argues that accommodating the conditional-interrogative link does not merely capture a phenomena that eludes the two dominant approaches. It leads to a new perspective on the debate between them and directly impacts the issues

⁴As documented in Kayne (1991: §2.2), French *si* and Italian *se* occur both in conditionals and under interrogative verbs; the same pattern holds in Spanish. Similarly for Bulgarian and many of the Slavic languages (Bhatt & Pancheva 2006: 653). The pattern is also prominent in non-Indo-European languages, occurring in Hebrew (Roger Schwarzschild p.c.), Hua, Mayan Tzotzil and Tagalog (Haiman 1978: 570), just to name a few. In American Sign-Language (ASL) and Italian Sign-Language (LIS) the same non-manual articulation marks the antecedents of conditionals and interrogatives: a raised brow (Pyers & Emmorey 2008, Adriana Belletti p.c.).

⁵Even in English there are sentences with conditional meanings but no plausibly interrogative antecedent, e.g. *q provided that p, q given that p*.

that make that debate important. Like those approaches, the semantics proposed in §2.2.5 has important implications for the shape of semantic theory, but it also shows that one need not choose between the perspectives and benefits of those two approaches. The meaning of a sentence is identified with the characteristic role it plays in changing mental states of language users. Truth-conditions are determined by this role, but I explore a view of entailment and language use from the more general perspective (§2.2.3). This allows for a model of communication whereby agents can convey features of their epistemic situation without directly reporting it (§2.2.5). It also allows me to combine a successful logic of natural language indicative conditionals (§2.3.1) with a desirable account of their truth-conditions (§2.3.2) in a way no other semantics has. The semantics offered in §2.2.5 can be extended to subjunctive conditionals to deliver a uniform account of the two varieties, but that will have to wait for another occasion (Chapter 3).

2.2 A New Semantics for Conditionals

As Austin (1956:211-2) reminds us:

The dictionary tells us that the words from which our *if* is descended expressed, or even meant, ‘doubt’ or ‘hesitation’ or ‘condition’ or ‘stipulation’. Of these, ‘condition’ has been given a prodigious innings by grammarians, lexicographers, and philosophers alike: it is time for ‘doubt’ and ‘hesitation’ to be remembered...

Considering several paraphrases of *I can if I choose* he observes:

...[W]hat is common to them all is simply that the *assertion*, positive and complete, that ‘I can’, is linked to the *raising of a question* whether I choose to, which may be relevant in a variety of ways. (Austin 1956:212; original emphasis)

This passage is intended as a remark on one sense of *if*. However, I shall contend that it provides a general insight about conditionals: q *if* p links the assertion of q to the raising of a question $p?$ This insight provides the key to understanding the conditional-interrogative link.

2.2.1 First Steps

Begin with the interrogative side of the link, considering occurrences of *if* like (2.3) and (2.4) above. The leading hypothesis about their semantics relies on the leading hypothesis about the semantics of interrogatives due to Hamblin (1958).⁶ Hamblin's central idea was that the meaning of an interrogative is not given by its truth-conditions, but rather by its answerhood-conditions. A **polar** (yes/no) interrogative like (2.6a) has two complete and direct answers: (2.6b) and (2.6c).⁷ It thus presents two exclusive and exhaustive alternative propositions. An answer to it consists in selecting exactly one of them. Accordingly, (2.6a)'s answerhood-conditions can be identified with the set containing these two propositions, i.e. Q_b in (2.7). On analogy with the terminology of *propositions*, this set is often called a *question* (Higginbotham 1996: 362).

- (2.6) a. Did Bob dance?
 b. Yes, Bob danced
 c. No, Bob didn't dance

- (2.7) $Q_b = \{b, \bar{b}\}$
 b = the proposition that Bob danced
 \bar{b} = the proposition that Bob didn't dance

⁶Force-based approaches (e.g. Searle 1969) are inferior in numerous ways. See Higginbotham (1993: §6), Groenendijk & Stokhof (1997: §§3.3-3.6) and Belnap (1990: §§1-2).

⁷The proposal extends to interrogatives like *Who danced?*, but these will not be relevant here.

Believes in (2.8a) expresses a relation between Cooper and the proposition denoted by *that Bob danced*. Similarly, *wonder* in (2.8b) expresses a relation between Cooper and the question denoted by *if Bob danced*.

- (2.8) a. Cooper believes that Bob danced
 b. Cooper wonders if Bob danced

The conditional-interrogative link compels us to wonder how this question could combine with the meaning of *Leland danced* to yield a plausible meaning for *if Bob danced, Leland danced*. Austin hints that they could be, but how?

The following discourses provide counsel, their genre inspiring the label **advertising conditional**.

(2.9) Do you need an efficient car? (Then) Honda has the vehicle for you

(2.10) Single? You haven't visited Match.com

(2.11) Art thou bound unto a wife? Seek not to be loosed. Art thou loosed from a wife? Seek not a wife.

(*Corinthians 7:27*, cited by Jespersen 1940: 374)

Jespersen (1940: 374) proposes that the conditional interpretations in (2.11) arise from each command being issued against a background where an affirmative answer (*yes*) to its preceding question is *supposed*. Each sequence thereby comes to have a conditional meaning, just as *supposing p, q!* does. With modifications, this idea provides an account of the 'link' between the consequent and interrogative antecedent of a conditional *sentence*.⁸ This account begins with a certain characterization of the

⁸This extension to the sentential domain is foreshadowed by German, among other languages, in its parallel use of word-order to identify the antecedent of a conditional and an interrogative.

(2.12) Hast du was, dann bist du was
 Have you something, then are you something

relationship between conditional sentences and suppositional reasoning.

F.P. Ramsey’s enduring remark draws together conditionals and supposition:

If two people are arguing ‘If p , will q ?’ and are both in doubt as to p , they are adding p hypothetically to their stock of knowledge, and arguing on that basis about q ... (Ramsey 1931a: 247)

On this view, evaluating a conditional involves a *hypothetical* addition to the information being taken for granted, which is precisely what supposition involves. Ramsey notes a connection between this process and doubting if p (see also Grice 1989a: 75–8), but makes little of it. Inquiry and communication not only take place against a background of information but also a background of issues. These issues are questions left open by the background information. But, more importantly, they are questions that have been distinguished as ones that the agents are out to settle. On Hamblin’s picture, these questions are a cluster of epistemically open, exhaustive and incompatible propositions the agents are aspiring to decide between. This richer picture of inquiry and communication brings one closer to making sense of the interrogative antecedents of conditionals. To see this, enrich Ramsey’s remark in the following way: if two people are arguing ‘if p , will q ?’ they are hypothetically adding $p?$ to their stock of issues, then further hypothesizing a *yes*-resolution of that issue (à la Jespersen) and arguing on that basis about q (thereby linking the assertion of q to the raising of a question $p?$ à la Austin). If the sole contribution of *if* p to this process is the addition of $p?$, then the proposal is on track to accommodate the conditional-interrogative link. The process can be so-rendered, but I shall return to this task after elaborating the proposal in more detail.

‘If you have something, then you are something’
(Bhatt & Pancheva 2006: 644; see also Embick & Iatridou 1994)

According to the proposal above, evaluating a conditional *q if p* consists in (i) hypothetically taking an interest in deciding between *p* and *not-p*, i.e. the question *p?*, (ii) further hypothesizing a *p* outcome and (iii) concluding that *q* follows from this outcome.⁹ Exploiting the parallel between supposition and ‘hypothetical additions’, this proposal can be clarified by providing a *rough* paraphrase of a conditional sentence like (3.1) in terms of a suppositional discourse like (3.1’).

(3.1) If Bob danced, Leland danced

- (3.1’) a. Suppose that we are wondering if Bob danced. . .
 b. . .and it turns out he did.
 c. Then it will follow that Leland danced.

This method of interpreting conditionals captures their core semantic property, namely **modus ponens**: *if p then q* and *p* entails *q*.¹⁰ Interpreting a conditional is positioning oneself to apply modus ponens. This involves taking the consequent to follow from the antecedent. But it also involves entertaining the question *p?* This in turn requires clearly distinguishing live *p* and *not-p* possibilities, and taking an interest in finding out which class the actual world belongs to. The richer picture construes conditionals as a more complete microcosm of inquiry: they involve entertaining an issue and exploring the consequences of a certain hypothesis about its resolution.

I have described the meaning of a conditional in terms of a *process* but I am looking for a *semantics*. Have I found it? It is universally accepted that models of how language-users track an unfolding process play a key role in explaining how they use language to get things done. My claim is that explicitly encoding this

⁹It might seem arbitrary to require that a *positive* answer to *if p* is hypothetically adopted. At the end of §2.2.5 I will motivate this assumption.

¹⁰The theory in §2.2.5 provides a compelling diagnosis of McGee’s (1985) attempts to counterexample modus ponens. This diagnosis is proposed by Gillies (2004: §3).

process in the semantics of sentences gives a more general, more streamlined and more perspicuous account of how *if* fits into the grammar of English. Above, that process was specified as a transition from one ‘body of information and issues’ to another, one that involved ‘hypothetical additions’. This proposal will be developed in three phases. I will begin by adopting a model of the bodies of information and issues in question (§2.2.2) and then introduce the basic ideas of a semantics based on transitions between them (§2.2.3). I will then offer a model of hypothetical additions to these bodies of information and issues (§2.2.4). The resources of these three sections are combined in §2.2.5 to provide a semantics for conditionals according to which the role of *if* in conditionals and embedded interrogatives is the same. Though I will be concerned here exclusively with indicative conditionals, the approach is extended to subjunctives in Chapter 3.

2.2.2 From Information to Issues

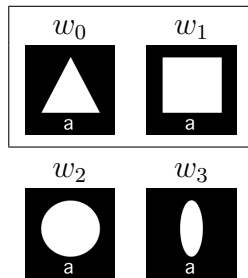
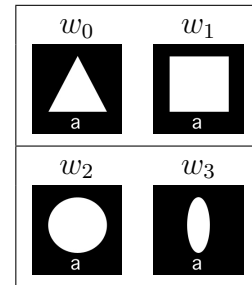
What is information? I won’t hazard an answer to that difficult question here. I will merely adopt a standard and convenient model of information to lend precision to my discussion of the questions I am out to answer. The model:

Informational content can be understood in terms of possibilities. The information admits some possibilities and excludes others. Its content is given by the division of possibilities into the admitted ones and the excluded ones. The information is that some one of *these* possibilities is realized, not any of *those*.

(Lewis 1983: 4)

Formally, an informational content (*proposition*) can be identified with a set of possible worlds (Stalnaker 1976). This set distinguishes ways the world might be (worlds in the set) from ways it isn’t (worlds excluded from the set).

This model also lends precision to Hamblin’s picture of interrogative content. His picture was that the content of a polar interrogative is identified with the set $\{p, \bar{p}\}$. On the present model, this set amounts to a division of the space of possibilities into two mutually exclusive and exhaustive sets called **partitions**. Figures 2.1 and 2.4 illustrate these ideas about content for an impoverished space of worlds containing just one two-dimensional object a , which can have four different shapes. Let p be the proposition that ‘ a is a polygon’. To understand communication and inquiry,

Figure 2.1: The proposition p Figure 2.2: The question $\{p, \bar{p}\}$

it is necessary to consider the body of information that accumulates as the process unfolds. Think of this information as what the agents are taking for granted in some way. Call the set of worlds encoding this information c , short for **contextual possibilities**. Grice, Lewis, Stalnaker and others view this background information as what’s *mutually* taken for granted.¹¹ I make no specific assumptions about the attitude that defines c , though §2.3.3 will return to that topic.

To understand communication and inquiry, it necessary to consider more than just the information that gets taken for granted. Recent work in epistemology, semantics and pragmatics makes clear that representing the issues at stake in that activity is also crucial.¹² This can be achieved by dividing c into partitions. These partitions

¹¹E.g. Lewis (1969, 1979), Grice (1989b) and Stalnaker (1999, 2002). For more on the representation of this attitude see Fagin *et al.* (1995); Clark (1996: Ch.4).

¹²E.g. Jeffrey (1990: Ch.11), Schaffer (2004), Groenendijk (1999), Roberts (2004) and Yalcin (2008).

represent open, incompatible propositions the agents are concerned with deciding between; their **issues**.¹³ Formally, this division of c may be identified with a set of sets of worlds which I will refer to as C . So if there are no issues and $c = p$ from Fig. 2.1, the acceptance of the question of whether a is a square involves a transition from $\{\{w_0, w_1\}\}$ to $\{\{w_0\}, \{w_1\}\}$. Given their relationship, c can always be constructed from C by merging the members of C , i.e. $\bigcup C = c$. This allows one to state all changes in terms of changes to C . New information eliminates worlds from the members of C . New issues further divide the members of C . See Appendix 2.A.2 for details.

2.2.3 Semantics, Linguistic Meaning and Logic

On the standard approach to semantics sentences are paired with contents.¹⁴ A declarative sentence p is paired with an informational content $\llbracket p \rrbracket$ and an interrogative sentence $?p$ is paired with a question $\llbracket ?p \rrbracket$. The process by which these contents are incorporated into C is held to be a matter of pragmatics. That is, the process is supposed to be regulated by general principles of rational coordination, not linguistic competence.

The kind of semantics sketched in §2.2.1 was different. There, the linguistic meaning of an expression was a transition from one ‘body of information and issues’ to another, i.e. a transition from one content to another. It thereby redraws the relationship between content and linguistic meaning, and the role linguistic competence plays in changing C . The goal of this section is to give a basic sketch of a semantics with this format and make these points more explicit. Towards this end, I will begin by specifying simpler transitions in terms of sets of contextual possibilities rather

¹³*Open* since they are composed from worlds in c . *Incompatible* since they are disjoint. Objects of concern, since they are the alternatives in c .

¹⁴Or, when context-sensitivity lurks, functions from contexts to contents.

than C .

A semantics stated in terms of transitions from one informational content to another can be modeled by letting the semantic value of ϕ be a function $[\phi]$ that maps one set of possibilities to another, writing $c[\phi] = c'$ to mean that c' is the result of applying $[\phi]$ to c .¹⁵ Read $c[\phi] = c'$ as: c' is the result of updating c with ϕ .¹⁶ This equation identifies a sentence's meaning with its **information change potential** (ICP).¹⁷ An ICP is just a way of modifying a set of possibilities, changing the information it embodies. The content of c is defined by whatever acceptance attitude is appropriate to modeling communication and inquiry. So, to say that a sentence ϕ of a speaker S 's language has a given ICP is just to say that ϕ plays a characteristic role in changing some of S 's mental states, a role specified in terms of how the contents of those states change. These characteristic changes may come in the wake of speech acts, where ϕ changes the content of the attitude defining c , and thoughts where ϕ may change the content of less public attitudes.¹⁸ How does this **dynamic** approach relate to truth-conditional ones? This will become clear below where I consider a specific example of such a semantics.

Consider a propositional language with the familiar syntax, starting with a set of atomic sentences $\mathcal{At} = \{p_0, p_1, \dots\}$. A possible world will be treated as an assignment of one truth-value, either 1 (True) or 0 (False), to every atomic sentence. The meanings of sentences are specified in the format discussed above.

¹⁵In more familiar notation: $[\phi](c) = c'$.

¹⁶The terminology of 'update' and the general format of this semantics originates with Veltman (1996) (circulated in 1990) and it is closely related to Heim's (1982) system. Pratt (1976) is the earliest precursor I am aware of.

¹⁷To pay homage to Heim's (1982) terminology of *context change potentials*.

¹⁸I will not be able to address the interesting question of whether the communicative role (Grice 1957), the cogitative role (Harman 1975; Chomsky 1964: 58-9) or neither role is *constitutive* of a sentence's linguistic meaning.

Definition 5 (Update Semantics)

- $$\begin{aligned}
(1) \quad c[\mathbf{p}] &= \{w \in c \mid w(\mathbf{p}) = 1\} & (2) \quad c[\neg\phi] &= c - c[\phi] \\
(3) \quad c[\phi \wedge \psi] &= (c[\phi])[\psi] & (4) \quad c[\Diamond\phi] &= \{w \in c \mid c[\phi] \neq \emptyset\}
\end{aligned}$$

(1)-(4) assign each kind of formula a special role in modifying c . Atomic sentences eliminate possibilities incompatible with their truth. Conjunctions update with each of their conjuncts in sequence. Negation eliminates the possibilities compatible with its scope. (4) approximates epistemic *might* (Veltman 1996). It **tests** whether it is consistent to accept ϕ in c . Inconsistency (\emptyset) results if it is not. Otherwise, c remains as it was.

The classical concept of truth is still definable in this framework, though it is a special case of the more general concept of **support**.

Definition 6 (Support, Truth in w)

- $$(1) \text{ Support } c \models \phi \Leftrightarrow c[\phi] = c \quad (2) \text{ Truth in } w \ w \models \phi \Leftrightarrow \{w\}[\phi] = \{w\}$$

Some information c supports a sentence just in case the semantic effect of that sentence on c is *informationally redundant*. Truth in a world is a special case of support. A sentence is true in w just in case it is redundant with respect to *perfect information* about w : $\{w\}$.¹⁹ Think of c as the content of an agent's doxastic state. Support tracks when that agent is already committed to accepting ϕ . In the extreme case where the agent has a complete picture of w , support says something unique about w . If this picture is really a complete picture of w and ϕ is already part of it, ϕ must be true in w .

The propositional content of a sentence is the set of worlds where it is true and hence determined by and distinct from its linguistic meaning (its ICP).

Definition 7 (Propositional Content) $\llbracket \phi \rrbracket = \{w \mid w \models \phi\}$

¹⁹This definition is mentioned by van Benthem *et al.* (1997: 594). Chapter 1 discusses my preference for this one over Veltman's (1996: 231).

This method for deriving truth-conditions from ICPs will be central in §2.3.2.

A sentence’s truth-conditions deliver a limited picture of its meaning: how it affects perfect information about the world. Its ICP delivers a broader picture: how it interacts with even uncertain information about the world. For the Boolean connectives alone there is no difference of importance here, but epistemic \Diamond changes things. $\Diamond\phi$ is distinguishable from ϕ only when their effects on *imperfect information* are compared. Definitions 5.1 and 5.4 entail that $\{w\}[\Diamond p] = \{w\}$ just in case $\{w\}[p] = \{w\}$. Now suppose p is true in w and false in w' , but that it is uncertain which one is realized. Then $\{w, w'\}[\Diamond p] = \{w, w'\}$ while $\{w, w'\}[p] = \{w\}$. By contrast, the orthodox approach to distinguishing $\Diamond\phi$ and ϕ does so truth-conditionally. On the orthodox analysis $\Diamond\phi$ expresses a context-sensitive proposition reporting the fact that ϕ is consistent with some salient information in the utterance context (e.g. DeRose 1991: 593-4). But there are problems with this report-model (Yalcin 2008), ones solved by the semantics above (Yalcin 2008: §2.6).²⁰ On that semantics, an assertion of $\Diamond\phi$ does not convey something about the relevant information by asserting a ‘second-order’ proposition about that information. Rather, in interpreting an utterance of $\Diamond\phi$ the hearer’s competence with $\Diamond\phi$ together with the assumption that the speaker is not being inconsistent allows the hearer to draw an inference: that the information the speaker intended to be interpreted against leaves open a ϕ -possibility. Epistemic modals are very flexible in the information they allow this to be: the participants’ shared information, the speaker’s private information, the hearer’s private information, some expert’s information and other options (von Fintel & Gillies 2007, 2008: §9). This is relevant to the semantics for indicative conditionals offered in §2.2.5.

²⁰Yalcin (2008) goes on to give a different analysis. He notes that Veltman’s semantics cannot distinguish *For all Frank believes, it’s raining in Topeka* and *Frank believes it might be raining in Topeka*. Yet Veltman’s analysis can be augmented with the partition structure at the heart of Yalcin’s analysis to capture the contrast between these sentences. This point is elaborated below in Remark 3, Appendix 2.A.

In §2.2.5 indicative conditionals are analyzed with the same kind of ‘test’ semantics as \Diamond . They are therefore claimed to be the same kind of vehicle for indirectly conveying information as \Diamond . This is worth noting for two reasons. It is precisely the sensitivity to and capacity for conveying private information that has provided the strongest case for suppositional theories (e.g. Stalnaker 2005: §3). I will return to this topic in §2.3.3. This ‘test’ semantics entails that, like \Diamond , truth-conditions give an incomplete picture of their meaning. A complete picture must say how they interact with imperfect information too. §2.3.1 contends that making entailment sensitive to this dimension of meaning yields a better logic than truth-conditional and probabilistic approaches.

Definition 8 (Entailment v1) $\phi_1, \dots, \phi_n \models \psi \Leftrightarrow \forall c : c[\phi_1] \cdots [\phi_n] \models \psi$

It says that ψ is entailed by a sequence of premises just in case adding those premises incrementally to any body of information makes ψ redundant.²¹ This specifies which linguistic inference moves may be made while preserving even uncertain information. Predictably, classical entailment emerges by focusing on perfect information: $\phi_1, \dots, \phi_n \models_{CL} \psi \Leftrightarrow \forall \{w\} : \{w\}[\phi_1] \cdots [\phi_n] \models \psi$.²²

Ultimately, transitions between bodies of information won’t cut it. To specify the meaning of declarative and interrogative sentences in one theory, the transitions will need to be between bodies of information *and issues*, i.e. $C[\phi] = C'$. The semantics in Definition 5 can be easily restated in this format (see Appendix 2.A, Definition 33). The meaning of a polar interrogative $?\phi$ can then be specified as partitioning the worlds that would survive an update with ϕ from the worlds that wouldn’t. For example, let $\mathbf{p} := ‘a \text{ is a polygon}’$, $\mathbf{t} := ‘a \text{ is a triangle}’$ and $\mathbf{c} := ‘a \text{ is a circle}’$. Updating $C = \{\{w_0, w_1, w_2, w_3\}\}$ with $?\mathbf{p}$ will return $\{\{w_0, w_1\}, \{w_2, w_3\}\}$, pictured in

²¹More on this definition: van Benthem (1996: Ch.7) and Veltman (1996: §1.2).

²²Perfect information eliminates order-sensitivity, i.e. (i) $\{w\}[\phi_1] \cdots [\phi_n] \models \psi$ is equivalent to (ii) if $\{w\}[\phi_1] = \{w\}, \dots, \{w\}[\phi_n] = \{w\}$ then $\{w\}[\psi] = \{w\}$.

Fig.2.3. Updating that body of information and issues with $?(t \vee c)$ will yield the one depicted in Fig.2.4. My proposal to treat *if* as a polar interrogative operator amounts

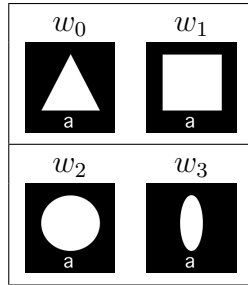


Figure 2.3: $C[?p]$

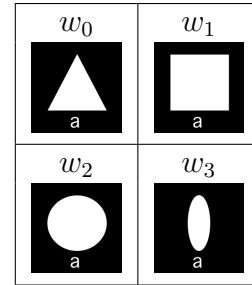


Figure 2.4: $(C[?p])[?(t \vee c)]$

to saying that it does what $?$ does, namely partition the contextual possibilities.

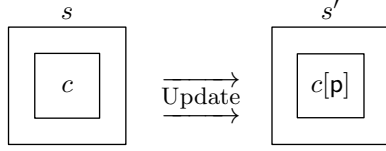
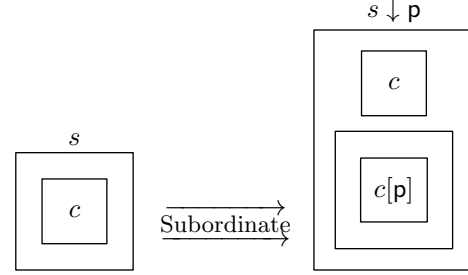
This section has described at length what it means to specify a semantics in terms of transitions between bodies of information and issues. But it has done little to advocate for that view, and has left out an essential ingredient of the informal analysis of conditionals I proposed in §2.2.1. According to that story, the interpretation of a conditional involves (i) *hypothetically* adding the question $p?$ to issues under consideration, (ii) further *hypothesizing* a p outcome and (iii) concluding that q follows from this outcome. I have said nothing about what it means to *hypothetically* adopt a question or proposition. The next section fills this gap. I will describe (some of) the transitions found in suppositional discourse and a theoretical model for understanding them. In §2.2.5 I will show that these transitions can be used to specify the semantic composition of conditionals, i.e. the steps informally outlined in (i)-(iii). It is only by composing meanings with this dynamic structure that the proposed semantics is able to account for the conditional-interrogative link. This, along with the discussion of entailment and truth-conditions in §2.3, constitutes my evidence for the kind of semantic theory outlined above.

2.2.4 Supposition and ‘Hypothetical Additions’

Supposition exhibits a virtuosic twist on assertion and acceptance. It involves an experimental addition to the information being taken for granted. This addition is not the reflex of accepting new information, but merely entertaining it to see the landscape from a more informed perspective. The result is a kind of inquiry within an inquiry. The true virtuosity comes in how the results of this experiment in logical tourism are exported back home. To model this phenomena, I will amend the idea that the state of an inquiry or conversation is fully specified by its current background of information and issues. This amended specification should allow one inquiry to be ‘nested’ inside another while keeping separate the information taken for granted from the information that is merely entertained.²³ Below, I sketch just such a specification and describe how it models three transitions in suppositional discourse that will be part of the semantics for conditionals offered in §2.2.5.

Begin in a **state** of conversation or inquiry s where there is a lone body of contextual possibilities c , ignoring issues for simplicity. I will represent this as the unit sequence containing c : $s = \langle c \rangle$. An ordinary update with \mathbf{p} will affect c : $s[\mathbf{p}] = \langle c[\mathbf{p}] \rangle$. Accordingly, this kind of update changes what’s accepted. The **supposition** of \mathbf{p} is a different kind of update which doesn’t change c , but involves **entertaining** an update with \mathbf{p} . This can be modeled as replicating s and updating it with \mathbf{p} while leaving c untouched: $s' = \langle c, \langle c[\mathbf{p}] \rangle \rangle$. The left position is reserved for the contextual possibilities, while entertained enrichments of it are stored to the right. I call the transition of creating a hypothetical state and updating it **Subordination**, notating it $s \downarrow \mathbf{p}$. In suppositional discourse Subordination can be exploited by two other transitions. **Elaboration**, written $s' \Downarrow \mathbf{q}$, continues enriching the newly supposed

²³See Appendix 2.A.2. Related proposal: Kaufmann (2000).

Figure 2.5: Update $s[p]$ Figure 2.6: Subordination $s \downarrow p$

information, e.g. $s' \Downarrow q = \langle c, \langle c[p][q] \rangle \rangle = s''$.²⁴ **Conclusion** is the virtuosic transition that brings the results of the hypothetical inquiry to bear on what's actually being taken for granted. To see how this works, and to illustrate these other transitions in the wild, it is helpful to look at an example.

X and Y invited Paula, Quine and Roger to a potluck without telling them what to bring. Y is worried that if Paula brings a side-dish, the ratio of side-dishes to main-dishes will be wrong. X is attempting to assuage this worry.

- (2.13) a. X : Suppose Paula brings a side-dish to the potluck.
- b. Y : And let's suppose Quine brings a complementing side-dish too.
- c. X : Okay. Well, then Roger will bring a main-dish, since Quine always tells Roger what to bring and Quine likes a balanced meal.
- d. Y : I see. If Paula and Quine bring side-dishes, Roger will bring a main-dish.

The effect of X 's accepted supposition is an instance of subordination. X and Y are entertaining the consequences of updating c with the sentence $p :=$ 'Paula brings a side-dish': $s \downarrow p = \langle c, \langle c[p] \rangle \rangle$. Y then goes on to elaborate this supposition with $q :=$ 'Quine brings a complementing side-dish too', yielding: $(s \downarrow p) \Downarrow q = \langle c, \langle c[p][q] \rangle \rangle$. (2.13c) is the crucial step. There are two observations that must be accounted for.

²⁴Subordinating q would create yet another sub-context: $\langle c, \langle c[p], \langle c[q] \rangle \rangle \rangle$.

First, whatever (2.13c) does together with (2.13a-b), licenses the indicative conditional in (2.13d). Second, when X commits to there being some $\mathbf{p} \wedge \mathbf{q}$ -worlds in c that are not \mathbf{r} -worlds (2.13c)'s analog (2.14d) sounds contradictory:

- (2.14) a. Y : Paula, Quine and Roger might all bring side-dishes!
 b. X : That's true, but suppose Paula brings a side-dish.
 c. Y : And let's suppose Quine brings a complimenting side-dish too.
 d. X : # Okay. Well, then Roger will bring a main-dish, since Quine always tells Roger what to bring and Quine likes a balanced meal.

This example also shows that (2.13c)'s effects are not isolated to the suppositional context: the inconsistency of (2.14d) is *real* not just *entertained* as in a proof by contradiction. These two facts can be accounted for by saying that the effect of (2.13c) is to perform a kind of **entailment test** with $\mathbf{r} :=$ 'Roger brings a main-dish': proceed with what you are accepting if what's supposed — $c[\mathbf{p}][\mathbf{q}]$ — entails \mathbf{r} , otherwise fail (inconsistency). This can be captured in an equation. Where s' is the conversational state *after* (2.13c):

$$(2.15) \quad s' = \langle \{w \in c \mid c[\mathbf{p}][\mathbf{q}] \models \mathbf{r}\}, \langle c[\mathbf{p}][\mathbf{q}] \rangle \rangle$$

It may take a second glance, but this amounts to (2.16).

$$(2.16) \quad s' = \begin{cases} \langle c, \langle c[\mathbf{p}][\mathbf{q}] \rangle \rangle & \text{if } c[\mathbf{p}][\mathbf{q}] \models \mathbf{r} \\ \langle \emptyset, \langle c[\mathbf{p}][\mathbf{q}] \rangle \rangle & \text{otherwise} \end{cases}$$

I call the entailment test by which s'' arose *Conclusion*, wherein what's entertained is related to what's accepted. It is symbolized with the up arrow: $((s \downarrow \mathbf{p}) \downarrow \mathbf{q}) \uparrow \mathbf{r} = s'$. When this test is passed in (2.13) it guarantees that all of the $\mathbf{p} \wedge \mathbf{q}$ -worlds in c are \mathbf{r} -worlds. This is just the condition imposed by a (epistemically) strict-conditional $\Box((\mathbf{p} \wedge \mathbf{q}) \supset \mathbf{r})$ ranging over c . On the plausible assumption that this strict-conditional

will entail the corresponding indicative conditional (interpreted in c), it is clear why (2.13a-c) entails (2.13d).

2.2.5 The Theory

The previous section introduced three transitions between states and identified them in discourse. In this section I will propose that the same three transitions are present in the compositional semantics of conditionals.²⁵ Indeed, I will show that they can be used to characterize the three steps provided in the informal analysis of conditionals proposed in §2.2.1. That analysis claimed that a conditional is interpreted by: (i) hypothetically taking an interest in deciding between p and *not*- p , i.e. the question $p?$, (ii) further hypothesizing a p outcome and (iii) concluding that q follows from this outcome. This proposal was elucidated with a rough paraphrase of (3.1).

(3.1) If Bob danced, Leland danced

- (3.1') a. Suppose we are wondering if Bob danced. . .
 b. . . and it turns out that he did.
 c. Then it will follow that Leland danced.

The interpretation of (3.1) starts in an initial state s and proceeds through steps resembling (3.1'). This process is depicted, left-to-right, in Fig. 2.7. First, if ϕ adds to a *hypothetical* stock of issues, as in (3.1'a). Formally, this involves partitioning c into the ϕ -worlds and the $\neg\phi$ -worlds, but in a hypothetical context. It is achieved by Subordinating the interrogative meaning of the *if*-clause. Second, a *yes* resolution of this issue is hypothesized, as in (3.1'b). This is achieved by Elaborating the affirmative answer. Third, ψ is drawn as a conclusion of this resolution, as in (3.1'c). The

²⁵This requires taking meanings to be transitions between states. The definitions from §2.2.3 can be carried over to this new format: Appendix 2.A.3.

$$s[(\text{if } \phi) \psi] = ((s \downarrow \text{if } \phi) \downarrow \phi) \uparrow \psi \text{ (preliminary version)}$$

$$\begin{aligned} c' &= \{w \in c \mid c[\phi] \models \psi\} \\ &= c \text{ or } \emptyset \end{aligned}$$

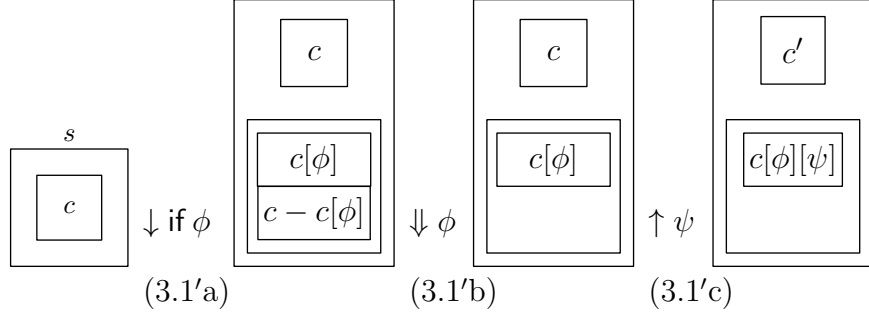


Figure 2.7: Step-by-Step Effects of Conditional Update

step tests that the hypothetical information, now $c[\phi]$, makes an update with ψ informationally redundant, i.e. entails ψ . This is achieved using the Conclusion operation. Chaining these operations together:

$$(2.17) \quad ((s \downarrow \text{if } \phi) \downarrow \phi) \uparrow \psi = \langle \{w \in c \mid c[\phi] \models \psi\}, s[\text{if } \phi][\phi][\psi] \rangle$$

If ψ is informationally redundant in $c[\phi]$ then c stays as it is, having guaranteed that all of the ϕ -possibilities in c are ψ -ones. Otherwise, a contradictory constraint has been placed on the contextual information and negotiation should ensue. With one provision to follow about the presuppositions of indicative conditionals, (2.17) gives the meaning of $(\text{if } \phi) \psi$. Before discussing the issues surrounding that provision, I want to be more explicit about how this semantics accommodates the conditional-interrogative link.

In the conditional semantics above, *if* contributes a unary polar interrogative operator $(\text{if } \cdot)$. There is an additional contribution made by the *syntax* of conditionals, which is the complex function built out of the arrow functions. On this view, the syntax of conditionals grammatically enforces the kind of discourse relations witnessed in advertising conditionals (§2.2.1) and certain suppositional discourses, e.g. (2.13) of §2.2.4. Here, I assume that the *if*-clause is an interrogative complementizer phrase

adjoined to the consequent clause. So the composition rule governing its semantics is a general mechanism for combining interrogative adjuncts with a matrix clause.²⁶ Sentences like *Cooper wonders if Bob danced* do not have this syntactic structure, since the *if*-clause occurs as the argument of the verb *wonder*. Accordingly, the transitions involving hypothetical additions are entirely absent in them.

One might still wonder how to formulate Hamblin’s semantics for embedded interrogatives in the format above. The term *if* ϕ partitions a set of possibilities into the ϕ ones and $\neg\phi$ ones, on analogy with Hamblin’s picture. Yet recall that on Hamblin’s picture the semantics of a sentence like *A wonders if* ϕ involves a relation between an agent *A* and a question $\llbracket \text{if } \phi \rrbracket = \{\llbracket \phi \rrbracket, \llbracket \neg\phi \rrbracket\}$. The compositional semantics offered above does not deal in semantic values like $\llbracket \text{if } \phi \rrbracket$, but rather in processes which divide a space of possibilities in the corresponding way. So Hamblin’s semantics for embedded interrogatives cannot be directly adopted here to unify both occurrences of *if*. However, the basic idea of that semantics can be recaptured in the present framework.

Begin by assigning each agent *A* in each world *w* a body of information and issues C_A^w representing their private agenda in inquiry, i.e. a space of epistemic possibilities partitioned into the issues *A* is out to settle in *w*. Following Hintikka (1962) and many others, attitude verbs can be represented with a relative modality for each agent, e.g. $B_A(\cdot)$ for *A believes*. For *wonder* I introduce $W_A(\cdot)$. Updating a state *s* with $W_A(\text{if } \phi)$ will eliminate any world *w* where either C_A^w entails ϕ or updating C_A^w with *if* ϕ introduces some issues not already represented in C_A^w , i.e. $\langle C_A^w \rangle[\text{if } \phi] \neq \langle C_A^w, \dots \rangle$. Further, *if* ϕ will presuppose that for each world *w* among the contextual possibilities,

²⁶This is rendered more plausible by noting that it offers a new direction for analyzing certain constructions that have been classified as free-relatives (Caponigro 2004), i.e. *Whether or not Bob danced, Leland danced*; *When Bob danced, Leland danced*; *Where Bob danced, Leland danced*; *How Bob danced, Leland danced*.

ϕ is compatible with C_A^w , i.e. $\langle C_A^w \rangle[\phi] \neq \langle \emptyset, \dots \rangle$.²⁷ This endows $W_A(\text{if } \phi)$ with the following truth conditions: it is true in w if A 's epistemic possibilities in w leave open ϕ and are already partitioned in the way accepting $? \phi$ would partition them. This is only a sketch of an analysis, but it should make clear that Hamblin's basic approach to embedded interrogatives can be maintained in the present framework. That sketch incorporated an unremarked assumption: if ϕ presupposes that it is being interpreted in a context that is compatible with ϕ . This is the provision I delayed discussing three paragraphs back.

Indicative conditionals presuppose that their antecedents are possible with respect to the contextual possibilities, i.e. compatible with those possibilities. (2.18) exemplifies this generalization.²⁸

(2.18) # Bob never danced. If Bob danced, Leland danced.

Many have incorporated this presupposition into their theory by stipulating that it is part of the meaning of *indicative conditionals* (Stalnaker 1975: §3; von Stechow 1999; Gillies 2009: 346). Accounting for the conditional-interrogative link leads to a more satisfying approach. This presupposition can be derived from the presupposition of the *if*-clause together with well-known facts about presupposition projection. Further, the presupposition of the *if*-clause emerges as a natural component of an interrogative semantics for *if*.

It is well-known that the presuppositions of *if*-clauses project out of conditionals (e.g. Karttunen 1973: 172), so conditionals should presuppose whatever their *if*-clauses do. Hence, $q \text{ if } p$ should presuppose the possibility of p if the *if*-clause does. An interrogative semantics of the sort proposed here helps make sense of why *if* p

²⁷For more details see Appendix 2.A.3.

²⁸To most informants, (2.18) was highly infelicitous. Since failed presuppositions are routinely accommodated in discourse interpretation, one would expect some noise.

should presuppose the possibility of p . First, *if* is a polar interrogative operator, so it divides the contextual possibilities into two incompatible alternatives, the p -worlds and the *not* p -worlds. If there are no p -worlds in c , this division idles. This story seems promising, but so far it fails to explain why *if*-clauses don't also presuppose that *not* p is compatible with the contextual possibilities.²⁹ Fortunately, there is something to say about this. *If* isn't just a polar interrogative operator, it is a biased one. More specifically, it is an interrogative operator that encodes a certain bias towards the positive answer p (Bolinger 1978; Eckardt 2007). It is a small leap to suggest that this bias also impacts the presuppositional content of *if*-clauses. But what does it mean to say *if* is positively biased and what evidence is there for thinking it is so-biased?

When I say that *if* p is *biased towards the positive answer*, I mean that the positive answer is understood to be particularly relevant to some concern, decision, plan, opinion, etc.³⁰ Indeed, this seems to be one of the important differences between *if* and *whether*. The empirical argument for this comes from cases like (2.20), due to Bolinger (1978: 96-7), and can be illustrated in more detail with examples like (2.21), due to Eckardt (2007: §4).

(2.20) a. I asked Joan if she would marry me but she refused

b. *I asked Joan whether she would marry me but she refused

(2.21) a. We need to find out who the first speaker is and if she needs a projector.

²⁹One might argue that *if*-clauses *do* presuppose that some *not* p -worlds are live.

(2.19) ? Bob always danced. If Bob danced, Leland danced.

This is odd, but the intuition is less robust than (2.18). There might be interference by logical training where one routinely says things like (2.19) in the process of performing modus ponens. A thorough study of 'untutored' speaker's intuitions is needed.

³⁰And *not* that the positive answer is itself desired or expected or preferred.

- b. We need to find out who the first speaker is and if she doesn't need a projector.
- c. We need to find out who the first speaker is and whether she needs a projector.

Among conference planners, (2.21a) seems appropriate in a context where everyone other than the first speaker is known not to need a projector, and hence the planners would have to do something if the first speaker needs one, namely provide one. (2.21a) seems appropriate in a context where the presenters have been told that there will be projectors but due to a last-minute projector shortage and a concurrent schedule the planners are attempting to relocate a projector from one location to location to another. In this case, the planners are able to do something to solve their problem if the speaker *doesn't* need a projector, namely move it to another location. (2.21c), on the other hand, seems more versatile, presenting the issue in a perfectly neutral way. Indeed, this contrast in the bias of *if* and *whether* sheds light on two other facts relevant to the theory proposed here. First, in conditionals it is the *positive answer* that is hypothetically adopted. Second, a sentence like *q whether or not p* seems to be equivalent to a pair of conditionals *q if p* and *q if not-p*. As I suggested above, conditionals are glued together by a composition rule that parallels the pragmatic interpretation of advertising conditionals. Informally, the rule can be read as saying: when interpreting an interrogative clause adjoined to a matrix clause, check whether hypothetically adopting each of the 'most preferred' answer(s) to the interrogative clause entails adopting the matrix clause. This rule can also be applied to a sentence like *q whether or not p*, and since *whether* ranks its answers equally, it will require that hypothetically adopting *p* entails adopting *q* and hypothetically adopting *not-p* entails adopting *q*.

This paper will not attempt a formal analysis that does justice to the above details of presupposition projection and interrogative bias. However, it will be important to

include their upshot in the semantics, namely that indicative conditionals presuppose that their antecedent is compatible with c . The following adaptation of (2.17) suffices for this purpose.

Definition 9 (Inquisitive Conditional Semantics)

$$s[(\text{if } \phi) \psi] = \begin{cases} ((s \downarrow \text{if } \phi) \downarrow \phi) \uparrow \psi & \text{if } s[\phi] \neq \langle \emptyset, \dots \rangle \\ \text{Undefined} & \text{otherwise} \end{cases}$$

This definition treats presupposition failure as undefined update. Other authors have developed this idea at length (e.g. Heim 1983; Beaver 2001). In §2.3 it will become clear why it is important to represent this nuance in the semantics offered here.

2.3 A New Look at Old Issues

The semantics in §2.2.5 does more than accommodate the conditional-interrogative link. It provides a new take on familiar issues in the study of conditionals.

2.3.1 The Logic of Indicative Conditionals

Consider the two worst entailments of the material conditional:

$$(2.22) \text{ Material Antecedent (MA) } \neg\phi \models \phi \supset \psi$$

Bob didn't dance. So, if Bob danced, he was a turnip.

$$(2.23) \text{ Material Negation (MN) } \neg(\phi \supset \psi) \models \phi$$

It's not true that if God exists, he's a turnip. So, God exists.

Stalnaker (1968, 1975) and Adams (1975) propose indicative conditionals that invalidate MA and MN, but do so at the cost of invalidating:³¹

(2.24) **Import-Export** $\phi_1 \rightarrow (\phi_2 \rightarrow \psi) \models (\phi_1 \wedge \phi_2) \rightarrow \psi$

Antecedent Strengthening $\phi_1 \rightarrow \psi \models (\phi_1 \wedge \phi_2) \rightarrow \psi$

Disjunctive Antecedents $(\phi_1 \vee \phi_2) \rightarrow \psi \models (\phi_1 \rightarrow \psi) \wedge (\phi_2 \rightarrow \psi)$

Transitivity $\phi_1 \rightarrow \phi_2, \phi_2 \rightarrow \psi \models \phi_1 \rightarrow \psi$

Contraposition $\phi \rightarrow \psi \models \neg\psi \rightarrow \neg\phi$

Instances of these principles in natural language generally sound good, but Adams and Stalnaker have artfully constructed a few that do not. The semantics offered in §2.2.5 can validate all of the patterns in (2.24), expose the craft of these alleged counterexamples and handle (2.22) and (2.23).³² I will defend this claim in detail below. The pattern of explanation and logic that emerges is reminiscent of sophisticated strict-conditional theories (Warmbrod 1983: §5; Gillies 2009: 338, 347). The explanation has two key features. The first is that entailment is thought of in terms of general information preservation rather than truth preservation, as in §2.2.3. The second is that the presuppositional behavior of indicatives (§2.2.5) is taken into account — much as Strawson (1952: 173-9) suggested for *all*. Both features were motivated by the account of the conditional-interrogative link above. So what emerges appears

³¹McGee (1989) extends Adams' approach to handle some embeddings and validate import-export. But it still does not yield a plausible semantics of natural language conditionals (Edgington 2008: §4.3). Stalnaker (1975) introduces the notion of a *reasonable inference* which offers some consolation. Contraposition and transitivity come out as reasonable inferences — the former requiring the additional assumption that the conclusion is appropriate in the context augmented with the premises (Stalnaker 1975: §IV). But this does not provide any help with import-export, antecedent strengthening or disjunctive antecedents.

³²One caveat is in order. Only restricted versions of the final four patterns in (2.24) are valid when conditionals involving embedded conditionals and modal expressions are allowed. However, I detail in Appendix 2.A.5.2 intuitive counterexamples to the unrestricted versions. In many cases, these are novel counterexamples not discussed elsewhere in the literature.

to be a more general and streamlined account of *if* and the logic of indicative conditionals that it engenders.

Entailment is about information. So to study the logic of inquisitive conditionals, it is only necessary to attend to the way they affect the contextual possibilities. The following fact describes this effect completely.

Fact 1 (The Inquisitive Conditional is Strict over c)

Let s be a state and c_s the contextual possibilities in that state. Then the effect of $(\text{if } \phi) \psi$ on c_s is identical to the following update just defined on c_s :

$$c_s[(\text{if } \phi) \psi] = \begin{cases} \{w \in c_s \mid c_s[\phi] \models \psi\} & \text{if } c_s[\phi] \neq \emptyset \\ \text{Undefined} & \text{otherwise} \end{cases}$$

PROOF See Appendix 2.A.5.2.

If ϕ is compatible with c_s , an update with $(\text{if } \phi) \psi$ will test whether all of the ϕ -worlds in c_s are ψ -worlds. This test returns the whole set if passed and returns none of it if failed. If ϕ is incompatible with c_s , the update is simply undefined. This semantics has the flavor of a strict-conditional semantics, and something quite like it is advanced by Warmbrod (1983: §5) and Gillies (2009: 338, 347). As they note, it can provide a very successful logic for indicative conditionals. Modus ponens and modus tollens are valid and $(\text{if } \phi) \phi$ is a logical necessity, but what about the forms in (2.24)?

Neither MA nor MN are valid for the inquisitive conditional (on Definition 8). Consider MA. Given Definition 8 for entailment, MA claims that following an update with $\neg\phi$ and update with $(\text{if } \phi) \psi$ is redundant, i.e. $c[\neg\phi] = c[\neg\phi][(\text{if } \phi) \psi]$. $c[\neg\phi]$ eliminates all ϕ -worlds. But, any update with $(\text{if } \phi) \psi$ presupposes that there is at least one ϕ -world, so $c[\neg\phi][(\text{if } \phi) \psi]$ is *never defined* let alone always identical to $c[\neg\phi]$. MN requires $c[\neg((\text{if } \phi) \psi)] = c[\neg((\text{if } \phi) \psi)][\phi]$. Consider the left term. By the semantics of negation $c[\neg((\text{if } \phi) \psi)] = c - c[(\text{if } \phi) \psi]$. Let c be any set flunking the test invoked by $(\text{if } \phi) \psi$, but containing some $\neg\phi$ world w . Then $c[\neg((\text{if } \phi) \psi)] = c - \emptyset = c$.

Thus MN's requirement comes to $c = c[\phi]$. This cannot be true: $w \in c$ and $w \notin c[\phi]$. Hence $\neg((\text{if } \phi) \psi) \not\models \phi$. The validity of the patterns in (2.24) is demonstrated in Appendix 2.A.5.

Consider Bennett's (2003: 145) allegation that transitivity is invalid. A farmer is reflecting on the state of his farm. He is nearly certain that the cows are not in the field, but accepts that

(2.25) a. If the cows are in the field, the gate is open

Since he's nearly certain that they aren't in the field he also accepts:

(2.25) b. If the gate is open, the cows haven't noticed it

By transitivity, it would seem to follow that

(2.25) c. If the cows are in the field, they haven't noticed that the gate is open

but this sounds wrong. What gives? On the theory advanced here (2.25a) tests that all the live in-the-field worlds are gate-is-open worlds and presupposes that this test is not vacuously passed, i.e. there is at least one live in-the-field world w . So, in w the cows are in the field and the gate is open, presumably they got there by noticing this. Now turn to (2.25b). This requires that all the gate-open worlds are haven't-noticed worlds. But this requirement will not be passed on account of w . The impression that the farmer can consistently accept (2.25a) and (2.25b) can only come from forgetting (2.25a)'s presupposition and letting (2.25a) be vacuously satisfied. The inference sounds strange, just like any unexpected inferential leap from inconsistent premises. Hence (2.25) only shows that transitivity may lead us astray when we forget the presuppositions of accepting a conditional. This is a reminder, not a counterexample.

Now consider contraposition. From *if it rains, there won't be a terrific cloudburst* it doesn't seem to follow that *if there is a terrific cloudburst, it won't rain* (Adams

1975: 15).³³ The premise tests that all of the live rain worlds are not-cloudburst worlds. The contrapositive *if there is a terrific cloudburst, it won't rain* presupposes that there is a live cloudburst world. Cloudbursts require rain, so this must be a rain world. But the premise required that all of the live rain worlds be *not*-cloudburst worlds. Hence, the conclusion's presupposition cannot be met in any c where the premise can be accepted. As the theory has been stated, this *is* a counterexample to contraposition. The equality $c[(\text{if } r) \neg c] = c[(\text{if } r) \neg c][(\text{if } c) \neg r]$ fails since the left term may be defined while the right is not. But one may respond by following Strawson (1952: 173-9) who maintains that only cases where presuppositions are met count against validity. This amounts to modifying the definition of entailment: if the presuppositions of the premises and conclusion are incrementally satisfied then the premises make the conclusion informationally redundant.

Definition 10 (Entailment v2)

$$\phi_1, \dots, \phi_n \models \psi \Leftrightarrow \forall c : \text{if } c[\phi_1] \dots [\phi_n][\psi] \text{ is defined, } c[\phi_1] \dots [\phi_n] \models \psi$$

It is neither implausible nor ad-hoc to say that language users do not count cases involving presupposition failure against an otherwise valid argument. Indeed, on further inspection this modification is already required to secure other validities. Consider an instance of modus ponens: $p, (\text{if } p) ((\text{if } q) r) \models (\text{if } q) r$ and a c containing a $p \wedge q \wedge \neg r$ -world. $c[p][(\text{if } p) ((\text{if } q) r)] = \emptyset$ yet $\emptyset[(\text{if } q) r]$ is undefined. So it's not true that for every $c : c[p][(\text{if } p) ((\text{if } q) r)] = c[p][(\text{if } p) ((\text{if } q) r)][(\text{if } q) r]$. It's only true for contexts where the presuppositions are satisfied. Similarly, $\models (\text{if } \phi) \phi$ would fail since you could always find a c incompatible with ϕ . Alleged counterexamples to antecedent strengthening and disjunctive antecedents employ the same trick Adams did above: a move from a satisfied premise to an unsatisfied conclusion. Hence, by adopting the more sophisticated definition of entailment above one is able to provide

³³Gillies (2009: 346-8) also discusses these examples involving contraposition.

a tidy explanation of why the forms in (2.24) generally seem valid and say exactly what is going on in the cases that have been offered as counterexamples.

The move to Definition 10 requires reconsidering the diagnosis of MA above. Since MA is a case where the presuppositions are *never* met, it vacuously satisfies Definition 10. One could amend Definition 10 to also require that there is a c where the presuppositions of the premises and conclusion can be incrementally satisfied. This would have the consequence of invalidating any instances of any arguments containing conditionals with logically inconsistent antecedents, e.g. $(\text{if } p \wedge \neg p) \psi, p \wedge \neg p \models \psi$ and $\models (\text{if } p \wedge \neg p) (p \wedge \neg p)$. Since speakers have no positive intuitions about the validity of these forms, this is not a serious empirical problem. But, it yields a byzantine formal system where validities are limited to conditionals with consistent antecedents and certain desirable metatheorems fail, e.g. $\models (\text{if } \phi) \psi \Leftrightarrow \phi \models \psi$. There is a more tidy alternative. Even if one grants the technical validity of MA, the semantics above does not predict that any instance of MA should sound acceptable in any context to competent speakers. After all, acceptability requires presuppositions to be met and MA cannot meet them in any context. Accordingly, one can grant vacuous validities to simplify the logic without predicting that they govern the intuitions of any speaker in any context. I propose viewing MA in this light.

I have seen no attempts to invalidate import-export, and its validity is quite uncomfortable to deny. Given this and the above, the semantics offered here deserves to be regarded as delivering the most successful logic of natural language indicative conditionals available.³⁴ A key part of this account was the assumption that indicative conditionals presuppose the possibility of their antecedent. As discussed in §2.2.5, inquisitive conditional semantics provides a more principled story about

³⁴There are several points of contact between the semantics defended here and Lycan (2001). The present proposal parts way with Lycan in upholding modus ponens, transitivity and antecedent strengthening.

this assumption than previous accounts, hence strict-conditional ones in particular. Truth-conditions provide another point of difference between the two theories. The framework from §2.2.3 determines the truth-conditions of sentences from their dynamic effects on the contextual information. This method yields context-insensitive, partial truth-conditions for indicative conditionals. §2.3.2 will illustrate one beneficial consequence of this difference.

2.3.2 Truth-Conditions, Bets and Indicative Conditionals

Consider the following case. We think that the local zoo might get a new animal this spring, but have different hunches about what it would be. I suspect an armadillo and you a roadrunner. We like to bet so I wager \$5 that

(2.26) If the zoo gets an animal this spring it will be an armadillo

You wager against me. Spring comes. It brings wildflowers, birds, bees, but no new animal to the zoo. Who has to pay? The intuition that neither of us gets paid is overwhelming. This remains even if we find out that the zoo board had decided to get an armadillo but the funding was cut at the last minute. I made the better bet, but my attempts to collect \$5 may be rebuffed. You can point out that our bet only covered the case where the zoo got an animal, so the bet is off. You can even acknowledge that if the funding hadn't been cut, the zoo would have gotten an armadillo, but hold fast that technically you got lucky and are off the hook. This phenomena is problematic for traditional similarity and strict-conditional theories.

These traditional theories are wedded to the following story. When (2.26) is uttered in the betting-context it expresses a proposition. After all, we agree that the local zoo might get a new animal, so (2.26)'s presupposition that the antecedent is compatible with the available information is met in that context. This information will also determine exactly which proposition is expressed. When we evaluate the

bet, we are evaluating the truth of this proposition in a world where the zoo didn't get an animal but if it had it would have been an armadillo. The problem is that these theories predict this proposition to be true, but our intuitions require it to be neither true nor false. On the similarity theory, we bet on the proposition that the zoo-gets-animal worlds most similar to those compatible with our information are zoo-gets-armadillo worlds. On the strict theory, we bet on the proposition that all the worlds accessible from those compatible with our information are either zoo-doesn't-get-animal worlds or zoo-gets-armadillo worlds. The actual world $w_{@}$ was among the worlds compatible with our information. Given the board's choice, the zoo-gets-animal worlds most similar to $w_{@}$ are zoo-gets-armadillo worlds. Similarly, all the worlds accessible from $w_{@}$ should be either zoo-doesn't-get-animal worlds or zoo-gets-armadillo worlds. So both propositions are true. But if the proposition is true then why do you get off the hook? Isn't settling our bet settling the truth-value of the proposition on which we bet?

A traditional theorist might attempt to respond by pointing out that (2.26)'s presupposition is no longer met in the context where the bet is being settled. This response would liken our bet on (2.26) to a case where we bet on

(2.27) Carlotta stopped smoking

only to find out that she never smoked to begin with. Here too it seems that the bet would be called off. There is still a puzzle if one's semantics predicts (2.27) to be true in such a scenario, but bracketing this issue there is an important difference between the cases. In betting on (2.27) we presupposed that Carlotta smoked at some point and then find out that this presupposition was *false*. This is not the case in (2.26). We presupposed that the zoo getting a new animal was compatible with our information in the betting context. We do not then find out that this presupposition was *false*, i.e. the zoo getting a new animal was *not* compatible with our information in the betting context. We just get better informed and according to the traditional

semantics learn that the proposition expressed by (2.26) was false. Our intuitions about (2.26) remain unexplained.

There is a long history of developing three-valued logics to account for intuitions of this sort (e.g. de Finetti 1936: 35; Jeffrey 1963; Belnap 1973; McDermott 1996: 6; Milne 1997). Immediately below, I argue that none of these attempts are satisfactory. But first, I will focus on the positive account delivered by the ideas developed in §§2.2.3 and 2.2.5. This account will mimic the three-valued one, but with more plausible results.³⁵ Recall §2.2.3's method for deriving truth-conditions from information change potentials: ϕ is true in w iff $\{w\}[\phi] = \{w\}$. Adapting this to states, ϕ is true in w iff $\langle\{w\}\rangle[\phi] = \langle\{w\}, \dots\rangle$. This definition yields the following consequences for the inquisitive conditional.

Fact 2 (Truth-Conditions for Inquisitive Indicative Conditionals)

1. $(\text{if } \phi) \psi$ is true in w , if both ϕ and ψ are true in w .
2. $(\text{if } \phi) \psi$ is false in w , if ϕ is true in w and ψ is false in w
3. Otherwise, $(\text{if } \phi) \psi$'s truth-value is undetermined in w

4. Therefore, $\llbracket(\text{if } \phi) \psi\rrbracket = \{w \mid w \models \phi\}$ is not a well-defined proposition □

Suppose ϕ is false in w . What is $(\text{if } \phi) \psi$'s truth-value in w ? This amounts to asking what the result of $\langle\{w\}\rangle[(\text{if } \phi) \psi]$ is. This conditional update must meet the presupposition that $\langle\{w\}\rangle[\phi] \neq \langle\emptyset, \dots\rangle$. But since ϕ is false in w , this presupposition is not met, i.e. $\langle\{w\}\rangle[\phi] = \langle\emptyset, \dots\rangle$. Thus, $(\text{if } \phi) \psi$'s truth-value is undefined at any world where ϕ is false. Similar reasoning confirms the other truth-conditions stated above in Fact 2. In the bet scenario, we ended up in a world where the conditional

³⁵There is one important point of contrast not elaborated below. Since the partiality of my theory is aligned with presupposition failure, it may appeal to presupposition accommodation to account for cases where one is tempted to say that an indicative conditional has a truth-value at a world where its antecedent is false.

is undefined, hence neither true nor false. Note that if the presupposition is relaxed, $\llbracket(\text{if } \phi) \psi\rrbracket = \llbracket\neg\phi \vee \psi\rrbracket$. But, this proposition would play no role in the logic or communicative use of conditionals.

Similar accounts using three-valued logics face daunting difficulties. These approaches assign $\phi \rightarrow \psi$ to the truth-value assigned to ψ , if ϕ is assigned 1 (true). Otherwise, the conditional is assigned i (indeterminate). To block Material Negation $\neg(\phi \rightarrow \psi) \models \phi \wedge \neg\psi$ and the even more garish $\phi \rightarrow \psi \models \phi \wedge \psi$, they must require that a valid argument does not merely preserve truth. It must also guarantee that if the conclusion is false at least one of the premises is false (McDermott 1996:31). It is far from clear how such a definition should be motivated, but setting this aside, more concrete difficulties emerge. Modus ponens becomes invalid, since $(\phi \rightarrow \phi) \rightarrow \phi, \phi \rightarrow \phi \models \phi$ comes out invalid. When the conclusion is false none of the premises have truth-values. These theories require profligate meanings for the other sentential connectives (e.g. McDermott 1996:5). While suppressing Material Negation, they fail to validate an entailment that captures the intuitive point of a negated indicative conditional: $\neg(\phi \rightarrow \psi) \models \Diamond(\phi \wedge \neg\psi)$; when it is known that $\neg\phi$, the conclusion is false but the premise is undetermined. Three-valued accounts also invalidate contraposition. When $\neg\phi \rightarrow \neg\psi$ is false $\phi \rightarrow \psi$ will be undefined.³⁶ As discussed

³⁶Huitink (2008: §5.3) attempts to address this problem. She begins with ‘Strawson Validity’: $\phi_1 \models_S \psi$ iff $\phi_1, \phi_2 \models \psi$, where \models is classical validity and ϕ_2 ’s truth guarantees that ϕ_1 and ψ have classical truth-values. Since $\phi \rightarrow \psi, \neg\psi \models \neg\phi$, contraposition is Strawson Valid even on a trivalent semantics. Unfortunately, Material Negation is Strawson Valid too, since $\neg(\phi \rightarrow \psi), \phi \models \phi$. Even more gruesome is the result that $\phi \rightarrow \psi \models_S \phi \wedge \psi$, since $\phi \rightarrow \psi, \phi \models \phi \wedge \psi$. Even if a technical bandage can be found for these wounds, the proposal suffers from a more basic flaw. It is built on the idea that some inferences like contraposition have an implicit premise which is that all of the sentences involved have truth-values (Huitink 2008: 174). This is fine, but there is no plausibility to the claim that intuitions about the validity of contraposition rely on the implicit premise that $\neg\psi$. Consider the following line of reasoning. Bob might have danced and if he did, Leland danced. So Leland might have danced, but if he didn’t, Bob didn’t either. Here, contraposition sounds correct despite the fact that the antecedent of the conclusion is explicitly *not* accepted. The alternative detour through reasonable inference creates the same problems (Huitink 2008: §5.3.2). Jeffrey (1963: 39) validates contraposition by a different route but also at the cost of validating Material Negation. Much more work is needed to make the case that a trivalent account can maintain contraposition

in §2.3.1, the semantics from §2.2.5 delivers a far superior logic of indicative conditionals. A further difficulty for trivalent accounts arises from the fact that they offer no clear account of the relationship between indicative and subjunctive conditionals. Chapter 3 shows that the present theory does not suffer from this difficulty.

2.3.3 Open Ends

Sensitivity to Private Information

Gibbard (1981: §7) presents a case with the following form (see also Bennett 2003: §34). Gibbard receives two unsigned notes from his trusted confederates, Zach and Jack, about a poker match. One note contains the conditional *if p then q* and is intuitively true as the case is described. The other note contains a conditional *if p then not-q* that also seems true. Propositional theories predict these two conditionals to express incompatible propositions at any context meeting their presupposition. So these theories must say what is different about the two note-issuing contexts. As Gibbard sets up the case, the common knowledge in the two contexts is the same. So any contextualist reply will appeal to a difference in context known only to one (or none) of the conversationalists. In Gibbard's case, it appears to be the private knowledge had by Zach and Jack, respectively. But this saddles both of them with defective communicative intentions. They each intend to communicate a proposition with a speech act that requires their hearer to have some collateral information to get that proposition out of that speech act. But they intend to do so while knowing that their hearer does not have that information.

The semantics from §2.2.5 offers a different picture. When a speaker issues *if p then q*, they intend to be interpreted against some information/possibilities *c*. The semantics says that this conditional will reduce *c* to \emptyset if there is a *p-and-not-q* world

in a plausible way.

in c , and leave c as it is otherwise. Knowing this, and assuming the speaker is being consistent, the hearer may infer something about c : it contains no *p-and-not-q* worlds. When c is private information, this process will get across something about the speaker's private information without assuming the hearer has access to it and without directly reporting it. Further, it works just as well for getting across information about other bodies of information, e.g. what is known by experts, what is common knowledge, etc. So the picture is not ruined by familiar cases where the speaker will rescind their assertion in light of better information (von Fintel & Gillies 2008). It is not my goal here to promote this picture over propositional approaches to Gibbard's case (e.g. Stalnaker 2005: §2). I merely observe that it looks like (an improvement on) the non-propositional alternative.

Adverbs of Quantification

Lewis (1975a) argued that no plausible connective-based analysis of conditionals could yield the correct truth-conditions when embedded under adverbs with varying quantificational force, e.g. *always*, *sometimes* and *usually*. Lewis (1975a: n14) acknowledged that a semantics, like Belnap's (1973), that delivers trivalent truth-conditions could produce the correct truth-conditions in these cases, but contends that such an account makes too many compromises. Lewis concludes that *if...then...* does not have its usual meaning in these constructions and instead merely serves to mark the restrictor and nuclear scope of the quantificational adverbs. Kratzer (1986, 1991) extended this argument to modal adverbs and developed the more plausible (and radical) view that all conditionals work in this way, analyzing bare conditionals as containing covert universal modal quantifiers.

Recently, Huitink (2008: Ch.5) has raised some problems for Kratzer's (1986) analysis, shown that a sophisticated version of Belnap's semantics solves these difficulties and used that semantics to account for the interaction of conditionals with quantificational adverbs. As I argued in §2.3.2, trivalent approaches like the Huitink/Belnap

analysis make unacceptable logical compromises. However, the trivalent approach developed here avoids these drawbacks. Yet, in virtue of its trivalent truth-conditions, it can also cover the data involving quantificational adverbs. A more thorough demonstration of this is in order, but a partial demonstration follows from the semantics given in Appendix §2.A. On that semantics $\Box(\text{if } \phi) \psi$, $(\text{if } \phi) \Box\psi$ and $(\text{if } \phi) \psi$ are equivalent, as are $(\text{if } \phi) \Diamond\psi$ and $\Diamond(\phi \wedge \psi)$.

Conditionals and Probability

Under certain assumptions, the (conditional) probability of q given p cannot be identified with the probability of any proposition, let alone the one that if p then q .³⁷ Yet, many have been attracted to these assumptions and **the Equation** $P(\text{if } p \text{ then } q) = P(q \mid p)$ (Adams 1975; McGee 1989; Bennett 2003; Edgington 2008) and hence adopting a non-propositional semantics. The style of semantics proposed in §2.2.5 displaced propositions in favor of transitions between states of inquiry. Probability calculi with this flavor have been studied (van Benthem *et al.* 2009). This offers one open prospect for maintaining the Equation. There is, however, a simple and familiar option provided by the semantics above. If the probability of a conditional is just a measure of the worlds where it is true, the three-valued truth-conditions generated by my semantics entails the equation. That such a three-valued semantics has this property has been known since de Finetti (1936). The present account offers a new and more attractive way of endorsing such a semantics.

And More

The consequences explored here in §2.3 have made no use of the structure provided by states of inquiry (§2.2.4). However, this structure is used in the work on subjunctives described in Chapter 3 to understand Sobel sequences. It also finds an application

³⁷Lewis (1976, 1986); Hájek & Hall (1994).

in the analysis of conditional non-declaratives, e.g. *if Bob danced did Leland dance?*, an analysis reserved for Chapter 4.

2.4 Conclusion

The conditional-interrogative link shed doubt on truth-conditional connective and suppositional approaches. Making sense of this data instigated a shift in the format of semantic theory. Instead of propositions, transitions between bodies of information and issues took center stage. The accompanying perspective on entailment and truth-conditions turned out to offer a more successful account of indicative conditionals than the best versions of either approach (§§2.3.2, 2.3.1). The basic idea of the semantics offered here has much in common with the idea behind suppositional approaches. It is unsurprising then that it offers the prospect of enjoying the two most desired benefits of that approach: sensitivity to private information and their ability to preserve the Equation (§2.3.3). Yet, this semantics also has the benefits of a truth-conditional connective approach. It offers clear predictions about truth-value judgements, adheres to compositionality, treats indicative and subjunctive conditionals uniformly and integrates with truth-conditional frameworks used for other regions of discourse. The semantic framework presented here is a generalization of truth-conditional semantics (§2.2.3), so whatever is available on the latter approach is also available on the former.³⁸ Hence, the benefits of these two approaches may not be exclusive after all. Having earned a place in concrete applications, the perspective on meaning offered here merits further investigation.

³⁸(Muskens 1996) shows how to combine Montague’s compositional framework with the kind of semantics developed here.

2.A The Logic of Inquisitive Conditionals (LIC)

2.A.1 Syntax

Remark 1 For simplicity, assume $\text{if } \phi := ?\phi$. Although strictly speaking a conditional is written $((?\phi)(\psi))$, I will prefer the more readable $(\text{if } \phi) \psi$.

Definition 11 (LIC Syntax)

- | | | |
|-------|--|---|
| (1) | $p \in \mathcal{Wff}_A$ | if $p \in \mathcal{At} = \{\mathbf{a}_0, \mathbf{a}_1, \dots\}$ |
| (2) | $\neg\phi \in \mathcal{Wff}_A$ | if $\phi \in \mathcal{Wff}_A$ |
| (3) | $\Diamond\phi \in \mathcal{Wff}_A$ | if $\phi \in \mathcal{Wff}_A$ |
| (4) | $\Box\phi \in \mathcal{Wff}_A$ | if $\phi \in \mathcal{Wff}_A$ |
| (5) | $(\phi \wedge \psi) \in \mathcal{Wff}_A$ | if $\phi, \psi \in \mathcal{Wff}_A$ |
| (6) | $(\phi \vee \psi) \in \mathcal{Wff}_A$ | if $\phi, \psi \in \mathcal{Wff}_A$ |
| <hr/> | | |
| (7) | $(?\phi) \in \mathcal{Wff}_Q$ | if $\phi \in \mathcal{Wff}_A$ |
| (8) | $(\phi \wedge \psi) \in \mathcal{Wff}_Q$ | if $\phi, \psi \in \mathcal{Wff}_Q$ |
| (9) | $(\phi \vee \psi) \in \mathcal{Wff}_Q$ | if $\phi, \psi \in \mathcal{Wff}_Q$ |
| <hr/> | | |
| (10) | $\phi \in \mathcal{Wff}_{AQ}$ | if $\phi \in \mathcal{Wff}_A \cup \mathcal{Wff}_Q$ |
| <hr/> | | |
| (11) | $\phi \in \mathcal{Wff}_{Q+}$ | if $\phi \in \mathcal{Wff}_{AQ}$ |
| <hr/> | | |
| (12) | $((?\phi)(\psi)) \in \mathcal{Wff}_{Q+}$ | if $\phi \in \mathcal{Wff}_A, \psi \in \mathcal{Wff}_Q$ |
| <hr/> | | |
| (13) | $((?\phi)(\psi)) \in \mathcal{Wff}_C$ | if $\phi \in \mathcal{Wff}_A, \psi \in \mathcal{Wff}_A$ |
| (14) | $((?\phi)(\psi)) \in \mathcal{Wff}_C$ | if $\phi \in \mathcal{Wff}_C, \psi \in \mathcal{Wff}_C$ |
| (15) | $\neg\phi \in \mathcal{Wff}_C$ | if $\phi \in \mathcal{Wff}_C$ |
| (16) | $\Diamond\phi \in \mathcal{Wff}_C$ | if $\phi \in \mathcal{Wff}_C$ |
| (17) | $\Box\phi \in \mathcal{Wff}_C$ | if $\phi \in \mathcal{Wff}_C$ |
| (18) | $(\phi \wedge \psi) \in \mathcal{Wff}_C$ | if $\phi, \psi \in \mathcal{Wff}_C$ |
| (19) | $(\phi \vee \psi) \in \mathcal{Wff}_C$ | if $\phi, \psi \in \mathcal{Wff}_C$ |
| <hr/> | | |
| (20) | $\phi \in \mathcal{Wff}$ | if $\phi \in \mathcal{Wff}_{Q+} \cup \mathcal{Wff}_C$ |

2.A.2 States and Operations on Them

Definition 12 (Worlds) $W : \mathcal{At} \mapsto \{1, 0\}$ where $\mathcal{At} = \{p_0, p_1, \dots\}$

Definition 13 (Contextual Possibilities/Information) $c \subseteq W$

Definition 14 (Contextual Information and Issues)

- C is a non-empty set of subsets of W
 - $\emptyset \neq C \subseteq \mathcal{P}(W)$
- \mathcal{C} is the set of all such C
- $\bigcup C$ is the information embodied by C ; the sets in C are called *alternatives*; overlapping and non-maximal alternatives are allowed.

Definition 15 (States) S is the set of all states

1. If $C \in \mathcal{C}$, $\langle C \rangle \in S$.
2. If $C \in \mathcal{C}$, $s \in S$, $\langle C, s \rangle \in S$.
3. Nothing else is a member of S .

Definition 16 (Subordination, Elaboration, Conclusion)

Where $s = \langle C, \langle C_0, \dots \langle C_n \rangle \dots \rangle \rangle$:

1. $s \downarrow \phi = \langle C, \langle C_0, \dots \langle C_n, \langle C \rangle[\phi] \rangle \dots \rangle \rangle$
2. $s \Downarrow \phi = \langle C, \langle C_0, \dots \langle C_n \rangle[\phi] \dots \rangle \rangle$
3. $s \uparrow \psi = \langle \{c \in C \mid \langle C_n \rangle \models \psi\}, \langle C_0, \dots \langle C_n, \langle C_n \rangle[\psi] \rangle \dots \rangle \rangle$

2.A.3 Systems of Update Semantics

Definition 17 (Informational Semantics) $[\cdot] : (\mathcal{Wff}_A \times C) \mapsto C$

- $$\begin{aligned}
 (1) \quad c[\mathbf{p}] &= \{w \in c \mid w(\mathbf{p}) = 1\} & (2) \quad c[\neg\phi] &= c - c[\phi] \\
 (3) \quad c[\phi \wedge \psi] &= (c[\phi])[\psi] & (4) \quad c[\phi \vee \psi] &= c[\phi] \cup c[\psi] \\
 (5) \quad c[\Diamond\phi] &= \{w \in c \mid c[\phi] \neq \emptyset\} & (6) \quad c[\Box\phi] &= \{w \in c \mid c[\phi] = c\}
 \end{aligned}$$

Definition 18 (Inquisitive Semantics) $[\cdot] : (\mathcal{Wff}_{AQ} \times \mathcal{C}) \mapsto \mathcal{C}$

Where $C = \{c_0, \dots, c_n\}$ and $\overline{C}_\phi := \{c_0 - \bigcup(\{c_0\}[\phi]), \dots, c_n - \bigcup(\{c_n\}[\phi])\}$:

- $$\begin{aligned}
 (1) \quad C[\mathbf{p}] &= \{\{w \in c_0 \mid w(\mathbf{p}) = 1\}, \dots, \{w \in c_n \mid w(\mathbf{p}) = 1\}\} \\
 (2) \quad C[\neg\phi] &= \overline{C}_\phi \\
 (3) \quad C[\phi \wedge \psi] &= (C[\phi])[\psi] \\
 (4) \quad C[\phi \vee \psi] &= C[\phi] \cup C[\psi] \\
 (5) \quad C[?\phi] &= C[\phi] \cup \overline{C}_\phi \\
 (6) \quad C[\Diamond\phi] &= \{c' \in C \mid C[\phi] \neq \{\emptyset\}\} \\
 (7) \quad C[\Box\phi] &= \{c' \in C \mid \bigcup(C[\phi]) = \bigcup C\}
 \end{aligned}$$

Remark 2 Above, \overline{C}_ϕ may be pronounced *the ϕ complement of C* . Forming this set amounts to eliminating the ϕ -worlds from each alternative in C .

Remark 3 Other than adding the minimal provisions to handle interrogatives, Definition 33 mimics the behavior of Definition 17 exactly. This does not make full use of the resources provided by defining updates on sets of alternatives rather than mere sets of worlds. An enhanced clause (6) illustrates this: $C[\Diamond\phi] = \{c' \in C \cup \{\bigcup C[\phi]\} \mid C[\phi] \neq \{\emptyset\}\}$. According to this semantics, $\Diamond\phi$ not only tests that there is at least one ϕ -world in $\bigcup C$, but also brings the ϕ -worlds ‘into view’ by adding the set containing them as an alternative in the output body of information and issues. This is similar to Yalcin’s (2008) idea of modal resolution and accommodates the data he uses to motivate that idea. But it parallels exactly Ciardelli *et al.*’s (in press) model

of *might*'s attentive content and Murray's (in press) related proposal about the structure of speech acts. These sophistications are not essential to the data discussed here. I will not populate the formalism with them. But I ultimately view them as natural components of the overall view of inquiry and language use advocated here.

Definition 19 (Inquisitive State Semantics) $[\cdot] : (\mathcal{Wff} \times S) \mapsto S$

Where $s = \langle C, \langle C_0, \dots \langle C_n \rangle \dots \rangle \rangle$, $C = \{c_0, \dots, c_n\}$, $\overline{C}_\phi := \{c_0 - \bar{c}_0, \dots, c_n - \bar{c}_n\}$ and for $0 \leq i \leq n$, $\bar{c}_i := \bigcup X : \langle \{c_i\} \rangle [\phi] = \langle X, \dots \rangle$:

- (1) $s[p] = \langle \{ \{w \in c_0 \mid w(p) = 1\}, \dots, \{w \in c_n \mid w(p) = 1\} \}, \langle C_0, \dots \langle C_n \rangle \dots \rangle$
- (2) $s[\neg\phi] = \langle \overline{C}_\phi, \langle C_0, \dots \langle C_n \rangle \dots \rangle \rangle$
- (3) $s[\phi \wedge \psi] = s[\phi][\psi]$
- (4) $s[\phi \vee \psi] = \langle C' \cup C'', \langle C_0, \dots \langle C_n \rangle \dots \rangle \rangle$
where $s[\phi] = \langle C', \dots \rangle$ and $s[\psi] = \langle C'', \dots \rangle$
- (5) $s[?\phi] = \langle C' \cup \overline{C}_\phi, \langle C_0, \dots \langle C_n \rangle \dots \rangle \rangle$ where $s[\phi] = \langle C', \dots \rangle$
- (6) $s[\Diamond\phi] = \langle \{c' \in C' \mid C' \neq \{\emptyset\}\}, \langle C_0, \dots \langle C_n \rangle \dots \rangle \rangle$ where $s[\phi] = \langle C', \dots \rangle$
- (7) $s[\Box\phi] = \langle \{c' \in C' \mid C' = C\}, \langle C_0, \dots \langle C_n \rangle \dots \rangle \rangle$ where $s[\phi] = \langle C', \dots \rangle$

Definition 20 (Inquisitive Conditional Semantics)

$$s[(\text{if } \phi) \psi] = \begin{cases} ((s \downarrow \text{if } \phi) \downarrow \phi) \uparrow \psi & \text{if } s[\phi] \neq \langle \{\emptyset\}, \dots \rangle \\ \text{Undefined} & \text{otherwise} \end{cases}$$

Remark 4 Definition 21 below assumes that each agent A 's doxastic state in each world w may be modeled as a body of information and issues C_A^w which is a set of sets of worlds. Roughly put, the formula $W_A(\text{if } \phi)$ is true in w just in case A 's information in w does not entail ϕ and A has distinguished ϕ and $\neg\phi$ as alternatives to decide between. The latter is guaranteed by requiring that updating the state $\langle C_A^w \rangle$ gives you back a state with the very same body of information and issues. Note, however, that $W_A(\text{if } \phi)$ presupposes that there is at least one ϕ -world in C_A^w . As I suggested in

the main text, this presupposition originates with the *if*-clause and also surfaces in conditionals. The update format makes Definition 21 look much more complicated than what I just stated. In the Definition one must look at each alternative $c_i \in C$, eliminate any world w where A 's information entails ϕ or A hasn't distinguished ϕ and $\neg\phi$ as alternatives to be decided between. Aloni & van Rooy's (2002: §3.6) semantics has much in common with this.

Definition 21 (Inquisitive Attitude Semantics)

Where $s = \langle C, \langle C_0, \dots \langle C_n \rangle \dots \rangle \rangle$ and $C = \{c_0, \dots, c_n\}$:

$$s[\mathbf{W}_A(\text{if } \phi)] = \begin{cases} \langle \{ \{ w \in c_0 \mid \langle C_A^w \rangle[\text{if } \phi] = \langle C_A^w, \dots \rangle \ \& \ \langle C_A^w \rangle \not\models \phi \}, \\ \dots, \{ w \in c_n \mid \langle C_A^w \rangle[\text{if } \phi] = \langle C_A^w, \dots \rangle \ \& \ \langle C_A^w \rangle \not\models \phi \} \rangle, \\ \langle C_0, \dots \langle C_n \rangle \dots \rangle \rangle & \text{if } \forall w \in \bigcup C : \\ & \langle C_A^w \rangle[\phi] \neq \langle \{\emptyset\}, \dots \rangle \\ \text{Undefined} & \text{otherwise} \end{cases}$$

2.A.4 Semantic Concepts

Definition 22 (Informational Semantic Concepts)

- (1) Support $c \models \phi \Leftrightarrow c[\phi] = c$
- (2) Truth in w $w \models \phi \Leftrightarrow \{w\}[\phi] = \{w\}$
- (3) Inconsistency $c[\phi] = \emptyset$
- (4) Semantic Content $\llbracket \phi \rrbracket = \{w \mid w \models \phi\}$
- (5) Contextual Content $\llbracket \phi \rrbracket_c = c[\phi]$
- (6) Logical Necessity $\models \phi \Leftrightarrow \forall c : c[\phi] = c$
- (7) Entailment $\phi_1, \dots, \phi_n \models \psi \Leftrightarrow \forall c : c[\phi_1] \dots [\phi_n] \models \psi$

Definition 23 (Inquisitive Semantic Concepts)

- (1) Support $C \models \phi \Leftrightarrow \bigcup C = \bigcup(C[\phi])$
- (2) Truth in w $w \models \phi \Leftrightarrow \bigcup(\{\{w\}\}[\phi]) = \{w\}$
- (3) Inconsistency $C[\phi] = \{\emptyset\}$
- (4) Informational Content $\llbracket \phi \rrbracket = \{w \mid w \models \phi\}$
- (5) Logical Necessity $\models \phi \Leftrightarrow \forall C : \bigcup C = \bigcup(C[\phi])$
- (6) Entailment $\phi_1, \dots, \phi_n \models \psi \Leftrightarrow \forall C : C[\phi_1] \dots [\phi_n] \models \psi$

Definition 24 (Semantic Concepts)

- (1) Support $s \models \phi \Leftrightarrow s[\phi] = s' \ \& \ \bigcup C_s = \bigcup C_{s'}$
- (2) Truth in w $w \models \phi \Leftrightarrow \langle \{\{w\}\}[\phi] \rangle = \langle C', \dots \rangle$ and $\bigcup C' = \{w\}$
- (3) Inconsistency $s[\phi] = \langle \{\emptyset\}, \dots \rangle$
- (4) Informational Content $\llbracket \phi \rrbracket = \{w \mid w \models \phi\}$
- (5) Logical Necessity $\models \phi \Leftrightarrow \forall C : \bigcup C = \bigcup C'$, where $\langle C \rangle[\phi] = \langle C', \dots \rangle$
- (6) Entailment $\phi_1, \dots, \phi_n \models \psi \Leftrightarrow \forall s : s[\phi_1] \dots [\phi_n] \models \psi$

Definition 25 (Entailment v2)

$$\phi_1, \dots, \phi_n \models \psi \Leftrightarrow \forall s : \text{if } s[\phi_1] \dots [\phi_n][\psi] \text{ is defined, } s[\phi_1] \dots [\phi_n] \models \psi$$

Definition 26 (Logical Necessity v2)

$$\models \phi \Leftrightarrow \forall C : \text{if } \langle C \rangle[\phi] \text{ is defined, } \bigcup C = \bigcup C' \text{ where } \langle C \rangle[\phi] = \langle C', \dots \rangle.$$

2.A.5 Facts**2.A.5.1 Persistence and Preservation**

Here I define two properties of modal formulae in LIC and show which modal formulae have which of the properties.

Definition 27 (Persistence) ϕ is persistent iff $c' \models \phi$ if $c \models \phi$ and $c' \subseteq c$.

(I.e. ϕ 's support persists after more information comes in.)

Fact 3 In general, $\Diamond\phi$ is not persistent. Take a c containing many worlds but only one ϕ -world w . Then $c \models \Diamond\phi$, but $c - \{w\} \subseteq c$ and $c - \{w\} \not\models \Diamond\phi$.

Fact 4 $(\text{if } \phi) \psi$ is persistent if its constituents are. Suppose $c \models (\text{if } \phi) \psi$. Then $c[\phi][\psi] = c[\phi]$. If both ϕ and ψ are persistent and $c' \subseteq c$ then $c'[\phi][\psi] = c'[\phi]$, hence $c'[\phi] \models \psi$ and so $c' \models (\text{if } \phi) \psi$. So $(\text{if } \phi) \psi$ is persistent too.

Remark 1 $\Diamond\phi$ is equivalent to $\neg((\text{if } \phi \vee \neg\phi) \neg\phi)$, so there are non-persistent formulae even in the \Diamond -free fragment.

Fact 5 $\Box\phi$ is persistent if ϕ is. Suppose $c \models \Box\phi$. Then $c \models \phi$. If $c' \subseteq c$ and ϕ is persistent, then $c' \models \phi$ and hence $c' \models \Box\phi$.

Definition 28 (Preservative) ϕ is preservative iff $c'[\phi] \subseteq c[\phi]$ if $c' \subseteq c$.

(I.e. as information grows ϕ continues to exclude any worlds it previously did.)

Fact 6 $\Box\phi$ is not preservative. Consider a c s.t. $(c - c[\phi]) \neq \emptyset$. Then $c[\Box\phi] = \emptyset$. Let $c' = c[\phi]$. Then $c'[\Box\phi] = c'$. So $c' \subseteq c$ but $c'[\Box\phi] \not\subseteq c[\Box\phi]$.

Fact 7 $(\text{if } \phi) \psi$ is not preservative. Consider a c s.t. $(c - c[\phi \wedge \neg\psi]) \neq \emptyset$. Then $c[(\text{if } \phi) \psi] = \emptyset$. Let $c' = c - c[\phi \wedge \neg\psi]$. Then $c'[(\text{if } \phi) \psi] = c'$. So $c' \subseteq c$ but $c'[(\text{if } \phi) \psi] \not\subseteq c[(\text{if } \phi) \psi]$.

2.A.5.2 Validities

Fact 8 (The Inquisitive Conditional is Strict over c)

Let s be a state and c_s the contextual possibilities in that state. Then the effect of $(\text{if } \phi) \psi$ on c_s is identical to the following update just defined on c :

$$c[(\text{if } \phi) \psi] = \begin{cases} \{w \in c \mid c[\phi] \models \psi\} & \text{if } c[\phi] \neq \emptyset \\ \text{Undefined} & \text{otherwise} \end{cases}$$

PROOF Proceed by induction on the complexity of ϕ and ψ . First, suppose they are conditional free, i.e. in \mathcal{Wff}_A . If $s[\phi] = \langle \emptyset, \dots \rangle$ both $s[(\text{if } \phi) \psi]$ and $c[(\text{if } \phi) \psi]$ are undefined. Suppose $s[\phi] \neq \langle \emptyset, \dots \rangle$. Then $c[\phi] \neq \emptyset$. By Definitions 20 and 16.3 $s[(\text{if } \phi) \psi] = \langle \{c \in C \mid \langle C \rangle[\phi] \models \psi\}, \dots \rangle$. It is clear that $\bigcup(\{c \in C \mid \langle C \rangle[\phi] \models \psi\}) = \{w \in c \mid c[\phi] \models \psi\}$, and thus that $(\text{if } \phi) \psi$'s effect on s_c is just the effect on c described by the Fact. Now suppose that ϕ and ψ may contain conditionals and grant the inductive hypothesis that Fact 8 holds for them. Suppose $s[\phi] \neq \langle \emptyset, \dots \rangle$. Then by hypothesis $c[\phi] \neq \emptyset$ and by the same reasoning above, the Fact holds.

Remark 2 When proving a validity $\phi \models \psi$ below, I will follow Definition 25 and assume that $c[\phi][\psi]$ is defined. My goal will be to show that $c[\phi][\psi] = c[\phi]$.

Fact 9 (Modus Ponens) $(\text{if } \phi) \psi, \phi \models \psi$

PROOF Either $c[(\text{if } \phi) \psi] = c$ or $c[(\text{if } \phi) \psi] = \emptyset$. In the former case $c[(\text{if } \phi) \psi][\phi][\psi] = c[(\text{if } \phi) \psi][\phi]$ is equivalent to $c[\phi][\psi] = c[\phi]$, and it is also guaranteed that $c[\phi] \models \psi$ (by Fact 8). By the last point it follows that $c[\phi][\psi] = c[\phi]$ and hence by the equivalence that $c[(\text{if } \phi) \psi][\phi][\psi] = c[(\text{if } \phi) \psi][\phi]$. In the latter case $c[(\text{if } \phi) \psi][\phi][\psi] = \emptyset = c[(\text{if } \phi) \psi][\phi]$.

Fact 10 (Modus Tollens) For preservative ψ , $(\text{if } \phi) \psi, \neg\psi \models \neg\phi$

PROOF Suppose ψ is preservative. If the update with the conclusion is defined, the test imposed by the premise must be successful and so $c[\phi][\psi] = c[\phi]$. To show that the inference is valid, we must show that $c[\neg\psi] \models \neg\phi$. This amounts to $c[\neg\psi][\neg\phi] = c[\neg\psi]$. Since update is eliminative, $c[\neg\psi][\neg\phi] \subseteq c[\neg\psi]$. Hence we must show that $c[\neg\psi] \subseteq c[\neg\psi][\neg\phi]$. This simplifies to $(c - c[\psi]) - (c - c[\psi])[\phi] \subseteq c - c[\psi]$. For reductio, suppose w is not in the set named on the left, but is in the set named on the right. In virtue of the former fact $w \in (c - c[\psi])[\phi]$. If ϕ is preservative, it follows that $w \in c[\phi]$, since $c - c[\psi] \subseteq c$. Then it follows that $w \in c[\phi][\psi]$. Since ψ

is preservative and $c[\phi] \subseteq c$, $w \in c[\psi]$. This is a contradiction since $w \in c - c[\psi]$. If ϕ isn't preservative, the only way for $(c - c[\psi])[\phi] \subseteq c[\phi]$ to fail is for $c[\phi] = \emptyset$ and $(c - c[\psi])[\phi] \neq \emptyset$. But this cannot occur since the premise presupposes that $c[\phi] \neq \emptyset$ and the presupposition is assumed to be met. Hence ϕ need not be preservative.

Remark 3 $(\text{if } p) \Box q, \neg \Box q \not\models \neg p$. Suppose we know that either (i) a and b are squares or (ii) a is a circle and b is a square or (iii) both a and b are circles. Then, if a is a square, b must be a square. Also, it's not the case that b must be a square. But it does not follow that a is not a circle.

Remark 4 $(\text{if } p) ((\text{if } q) r), \neg(\text{if } q) r \not\models \neg p$. Suppose we know that either (i) a , b and c are squares or (ii) b is a square, but a and c are circles. So, if a is a square, then if b is a square c is too. Also, it's false that if b is a square, c is a square; after all b could be a square while c is a circle. Yet it does not follow that a is not a square.

Fact 11 (Contraposition) For preservative ψ , $(\text{if } \phi) \psi \models (\text{if } \neg\psi) \neg\phi$

PROOF Suppose ψ is preservative. If the update with the conclusion is defined, the test imposed by the premise must be successful and so $c[\phi][\psi] = c[\phi]$. To show that the inference is valid, we must show that $c[\neg\psi] \models \neg\phi$. This has already been shown to hold under these conditions in the proof of Fact 10.

Fact 12 (Identity) For persistent ϕ , $\models (\text{if } \phi) \phi$

PROOF By Fact 8, $c[(\text{if } \phi) \phi] = \{w \in c \mid c[\phi] \models \phi\} = \{w \in c \mid c[\phi][\phi] = c[\phi]\}$. Since ϕ is persistent $c[\phi][\phi] = c[\phi]$. So $c[(\text{if } \phi) \phi] = c$ and hence $\models (\text{if } \phi) \phi$.

Remark 5 Consider $(\text{if } \Diamond p \wedge \neg p) (\Diamond p \wedge \neg p)$. This will amount to testing that $c[\Diamond p][\neg p] \models \Diamond p \wedge \neg p$. But this test will fail, since after taking in $\neg p$ the information no longer supports the first conjunct $\Diamond p$.

Fact 13 (Import-Export) $(\text{if } \phi_1) ((\text{if } \phi_2) \psi) \models (\text{if } \phi_1 \wedge \phi_2) \psi$

$$\begin{aligned}
\text{PROOF} \quad c[(\text{if } \phi_1) ((\text{if } \phi_2) \psi)] &= \{w \in c \mid c[\phi_1] \models (\text{if } \phi_2) \psi\} \\
&= \{w \in c \mid c[\phi_1][(\text{if } \phi_2) \psi] = c[\phi_1]\} \\
&= \{w \in c \mid \{w' \in c[\phi_1] \mid c[\phi_1][\phi_2] \models \psi\} = c[\phi_1]\} \\
&= \{w \in c \mid c[\phi_1][\phi_2] \models \psi\} \\
&= \{w \in c \mid c[\phi_1 \wedge \phi_2] \models \psi\} \\
&= c[(\text{if } \phi_1 \wedge \phi_2) \psi]
\end{aligned}$$

Fact 14 (Ant. Strength.) For persistent ψ , $(\text{if } \phi_1) \psi \models (\text{if } \phi_1 \wedge \phi_2) \psi$

PROOF If $c[(\text{if } \phi_1) \psi][(\text{if } \phi_1 \wedge \phi_2) \psi]$ is defined, $c[(\text{if } \phi_1) \psi] = c$ and so $c[\phi_1] \models \psi$. $c[\phi_1][\phi_2] \subseteq c[\phi_1]$ and since ψ is persistent, $c[\phi_1][\phi_2] \models \psi$. Thus, $c[(\text{if } \phi_1 \wedge \phi_2) \psi] = c$ and hence $c[(\text{if } \phi_1) \psi][(\text{if } \phi_1 \wedge \phi_2) \psi] = c[(\text{if } \phi_1) \psi]$.

Remark 6 $(\text{if } \Diamond p) \Diamond p \not\models (\text{if } \Diamond p \wedge \neg p) \Diamond p$. Let c contain some p -world. Then $c[(\text{if } \Diamond p) \Diamond p] = c$. But $c \not\models (\text{if } \Diamond p \wedge \neg p) \Diamond p$, since $c[\Diamond p][\neg p] \not\models \Diamond p$. After all, $c[\Diamond p][\neg p][\Diamond p] = \emptyset$ not c .

Fact 15 (Disj. Ants.) For persistent ψ , $(\text{if } \phi_1 \vee \phi_2) \psi \models (\text{if } \phi_1) \psi \wedge (\text{if } \phi_2) \psi$

PROOF The premise tests that $c[\phi_1] \cup c[\phi_2] \models \psi$. The conclusion presupposes that $c[\phi_1] \neq \emptyset$ and $c[\phi_2] \neq \emptyset$, and tests that $c[\phi_1] \models \psi$ and $c[\phi_2] \models \psi$. Since $c[\phi_1] \subseteq (c[\phi_1] \cup c[\phi_2])$ and $c[\phi_2] \subseteq (c[\phi_1] \cup c[\phi_2])$, this test must be successful when ψ is persistent but may not be successful when ψ isn't persistent.

Remark 7 $(\text{if } p \vee \neg p) \Diamond p \not\models ((\text{if } p) \Diamond p) \wedge ((\text{if } \neg p) \Diamond p)$. If there are both p and $\neg p$ worlds in c all presuppositions will be met and the premise will successfully test c . The second conjunct of the conclusion won't.

Fact 16 (Transitivity) For persistent ψ , $(\text{if } \phi_1) \phi_2, (\text{if } \phi_2) \psi \models (\text{if } \phi_1) \psi$

PROOF If $c[(\text{if } \phi_1) \phi_2][(\text{if } \phi_2) \psi][(\text{if } \phi_1) \psi]$ is defined:

$$(2.28) \quad c[(\text{if } \phi_1) \phi_2][(\text{if } \phi_2) \psi] = c.$$

Thus, we must show that $c[(\text{if } \phi_1) \psi] = c$. By Fact 8 this amounts to showing that $c[\phi_1] \models \psi$, i.e. $c[\phi_1][\psi] = c[\phi_1]$. Fact 8 and (2.28) require $c[\phi_2] \models \psi$, hence:

$$(2.29) \quad c[\phi_2][\psi] = c[\phi_2]$$

Assume ϕ_2 is preservative. Then, since $c[\phi_1] \subseteq c$:

$$(2.30) \quad c[\phi_1][\phi_2] \subseteq c[\phi_2]$$

Together with ψ 's persistence (2.29) and (2.30) entail that $c[\phi_1][\phi_2][\psi] = c[\phi_1][\phi_2]$. But then $c[\phi_1][\psi] = c[\phi_1]$, since $c[\phi_1][\phi_2] = c[\phi_1]$. After all, Fact 8 and (2.28) require that $c[\phi_1] \models \phi_2$ and hence $c[\phi_1][\phi_2] = c[\phi_1]$. If ϕ_2 is not preservative the only way for $c[\phi_1][\phi_2] \subseteq c[\phi_2]$ to fail is for $c[\phi_2] = \emptyset$ and $c[\phi_1][\phi_2] \neq \emptyset$. But that can't happen since $(\text{if } \phi_2) \psi$ presupposes that $c[\phi_2] \neq \emptyset$. Hence the argument above goes through without the assumption that ϕ_2 is preservative.

Remark 8 $(\text{if } \neg \mathbf{p}) \mathbf{q}, (\text{if } \mathbf{q}) \Diamond \mathbf{p} \not\models (\text{if } \neg \mathbf{p}) \Diamond \mathbf{p}$. Let $c = \{w_0, w_1, w_2\}$, where w_0 is a $\mathbf{p} \wedge \mathbf{q}$ -world, w_1 is a $\neg \mathbf{p} \wedge \mathbf{q}$ -world and w_2 is a $\mathbf{p} \wedge \neg \mathbf{q}$ -world. The first premise successfully tests c , since the only $\neg \mathbf{p}$ -world in c is a \mathbf{q} -world, namely w_1 . The second premise is also successful since one of the \mathbf{q} -worlds is a \mathbf{p} -world, namely w_0 . But the conclusion fails: among the $\neg \mathbf{p}$ -worlds in c there are no \mathbf{p} -worlds!

Fact 17 (Might) $(\text{if } \phi) \Diamond \psi \models \Diamond(\phi \wedge \psi)$

$$\begin{aligned} \text{PROOF} \quad c[(\text{if } \phi) \Diamond \psi] &= \{w \in c \mid c[\phi] \models \Diamond \psi\} \\ &= \{w \in c \mid c[\phi][\Diamond \psi] = c[\phi]\} \\ &= \{w \in c \mid c[\phi][\psi] \neq \emptyset\} \\ &= \{w \in c \mid c[\phi \wedge \psi] \neq \emptyset\} \\ &= c[\Diamond(\phi \wedge \psi)] \end{aligned}$$

Fact 18 (Must) $\Box(\text{if } \phi) \psi \models (\text{if } \phi) \psi \models (\text{if } \phi) \Box \psi$

PROOF

$$\begin{aligned}
c[\Box(\text{if } \phi)]\psi &= \{w \in c \mid c[(\text{if } \phi) \psi] = c\} \\
&= \{w \in c \mid c[\phi] \models \psi\} \\
&= c[(\text{if } \phi) \psi] \\
&= \{w \in c \mid c[\phi][\psi] = c[\phi]\} \\
&= \{w \in c \mid c[\phi][\Box\psi] = c[\phi]\} \\
&= \{w \in c \mid c[\phi] \models \Box\psi\} \\
&= c[(\text{if } \phi) \Box\psi]
\end{aligned}$$

e. If Bob were to dance, Leland would dance

Any semantic theory of conditionals must ultimately deliver a uniform analysis of the two species. It must ascribe the same meanings to the constituents they share, e.g. *if*, and derive their semantic commonalities from these meanings. Further, it must explain their semantic differences in terms of the meaning of the constituents they do not share. This is just to accept a very minimal version of compositionality and the fact that the constituents the two species share are not homonyms.²

The requirement of uniformity provides an important constraint for adjudicating between different theories of conditionals. But meeting the requirement of uniformity commands interest even beyond the purview of that debate. Indicative and subjunctive conditionals differ in a semantic dimension that is variously classified as mood or modality. This dimension of meaning and its linguistic encoding sit on the frontier of current semantic theory. Its study has already displayed promise to shape and perhaps revise the prevailing hypothesis that meaning is purely truth-conditional. Furthermore, a prominent semantic difference between indicative and subjunctive conditionals seems to parallel two potentially different kinds of doxastic processes: the *consistent extension* versus the *revision* of an agent's beliefs.³ If this parallel can be established, then a uniform theory of conditionals may facilitate fruitful cross-pollination between the philosophy of language and work on these processes in epistemology and the philosophy of science.⁴

In this chapter I will argue that a uniform analysis which parallels the consistent extension/revision contrast is the best explanation of some key contrasts between

²The cross-linguistic distribution of *if* indicates that it is not homonymous in the two constructions. And, as Tom Donaldson has pointed out to me, the fact that there isn't a subjunctive reading of (3.1) or an indicative reading of (3.2) also sheds doubt on the homonymy hypothesis.

³Many authors have explored this idea. See van Rooy (2006: §5.6).

⁴The latter work draws a distinction between **imaging** and **conditionalization** (e.g. Lewis 1975b; Gärdenfors 1982) or **belief revision** and **belief update** (e.g. Katsuno & Mendelzon 1992).

the two kinds of conditionals (§3.2.1). After advancing a hypothesis about the linguistic encoding of this distinction (§3.2.2), I argue that the leading attempt at a uniform analysis (Stalnaker 1968, 1975) fails on two fronts (§3.2.3). First, despite initial appearances and informal characterizations, it fails to parallel the consistent extension/revision contrast and so fails altogether to explain the key contrasts detailed in §3.2.2. Second, the differences it does derive do not come from the linguistic meanings of the constituents that are unique to each kind. Instead, the differences are derived by positing a new kind of non-semantic significance and imbuing some of those constituents with it. This approach not only involves an unmotivated and underdeveloped posit, but is shown to be incompatible with the hypothesis defended in §3.2.1 about the linguistic encoding of the consistent extension/revision contrast in indicative and subjunctive conditionals.

In §§3.2.4-3.2.6 I show that the semantics for indicative conditionals proposed in Chapter 2 can be transformed into a uniform theory of conditionals that explains the basic contrasts between the two varieties by paralleling the extension/revision contrast. On this theory, the antecedents of indicative and subjunctive conditionals propose different hypothetical changes to the information at stake in a conversation or inquiry. To explicitly encode this difference in the semantics of conditionals, it is necessary to construe the meanings of antecedents (and hence their constituents) in terms of their potential to change a body of information rather than in terms of their (contribution to) truth-conditions. It is thus another instance of the kind of phenomena found in Chapter 2 where it is more fruitful to think of linguistic meaning in terms of how an expression transitions an idealized language user from one state of mind to another. The chapter closes by exploring some of the interesting consequences that this framework and particular analysis have for issues in the logic of subjunctive conditionals. Each of them derives directly from the more nuanced representation of subjunctive antecedents and the dynamic tools needed to make

sense of that representation. While the analysis of subjunctives offered here counts as a variably-strict one in the tradition of Stalnaker (1968) and Lewis (1973), it remedies some serious problems with such an analysis. First, it retains the law of Import-Export which correctly declares subjunctives like (3.3) and (3.4) equivalent.

(3.3) If Bob had danced and Cooper had stayed home, Laura would have danced

(3.4) If Bob had danced then if Cooper had stayed home, Laura would have danced

Second (§3.3.1), it captures intuitively valid inferences, like the one from (3.5a) to (3.5b), containing disjunctive antecedents.

(3.5) a. If Bob had danced or Sarah had sang, Andy would have cried

b. So, if Bob had danced, Andy would have cried, and if Sarah had sang,
Andy would have cried

Third (§3.3.2), the analysis supports a well-motivated pragmatic explanation of the difference between ‘Sobel sequences’ and reversed Sobel sequences, e.g.

(3.6) a. If Sophie had gone to the parade, she would have seen Pedro dance

b. But of course, if Sophie had gone to the parade and been stuck behind
someone tall, she would not have seen Pedro dance

(3.7) a. If Sophie had gone to the parade and been stuck behind someone tall,
she would not have seen Pedro dance

b. # But of course, if Sophie had gone to the parade, she would have seen
Pedro dance

While these three phenomena have been used to argue for a strict-conditional analysis, the variably-strict analysis proposed below shows that the strict analysis is not nec-

essary after all.⁵ I will conclude the chapter by speculating that, particular semantic issues aside, the variably-strict architecture furnishes a more satisfying philosophical picture of what in the world subjunctive conditionals are about.

Before launching into the body of the essay I want to remind the reader of a few key ideas from Chapter 2 (§2.2). As inquiry and conversation proceed, a body of information accumulates. Think of this information as what the agents are taking for granted in some way. A convenient model of this information can be stated in terms of a set of possible worlds (Stalnaker 1978:86). Like information, this set distinguishes ways the world might be (possibilities in the set) from ways it isn't (possibilities excluded from the set). Call this set *c*, short for **contextual possibilities** or **contextual information**. Grice, Lewis, Stalnaker and others view certain information at stake in communication as *mutually* taken for granted.⁶ I will not make any specific assumptions about the attitude that defines *c*, though a final theory will need to do so.

3.2 A Uniform Analysis

One of the most basic contrasts between indicative and subjunctive conditionals is illustrated in (3.8) and (3.9).

(3.8) # Bob never danced. If Bob danced, Leland danced.

(3.9) Bob never danced. If Bob had danced, Leland would have danced.

In both (3.8) and (3.9) the conditionals are interpreted against the information that precedes them. The indicative is anomalous when it's antecedent is used to talk

⁵See: Warmbröd (1981); Lycan (2001); von Fintel (2001); Gillies (2007).

⁶E.g. Lewis (1969, 1979), Grice (1989b) and Stalnaker (1999, 2002). For more see (Fagin *et al.* 1995; Clark 1996: Ch.4).

about a scenario incompatible with that information. But the subjunctive is not. This contrast suggests something like the following hypothesis: indicative conditionals must be used to explore *consistent extensions* of a given body of information while subjunctive ones may be used to explore *revisions* of that body of information.

(3.8) and (3.9) are not the only data to be accounted for by a uniform theory of conditionals. The assertion of a subjunctive conditional often suggests something an ordinary indicative does not:⁷

The Subjunctive Suggestion Assertions of *if Bob had danced, Leland would have danced* often suggest that Bob didn't dance.

The reality of this suggestion is evidenced by the oddity of (3.10).

(3.10) # Bob danced. If Bob had danced, Leland would have danced.

What is the source and status of this 'suggestion'? It is not part of the asserted content, it is not an entailment of that content and it is not a presupposition. (3.11) and (3.12) illustrate these facts.

(3.11) If Jones had taken the arsenic, he would have just exactly those symptoms which he does in fact show (Anderson 1951:37)

(3.12) If the butler had done it, we would have found blood on the kitchen knife.

The knife was clean; therefore, the butler did not do it.

(Stalnaker 1975:71)

In (3.11) the subjunctive conditional is used as an argument for the antecedent and so cannot be construed as presupposing or entailing the antecedent's falsity. (3.12) is a premise in a non-circular argument for the falsity of its antecedent and so cannot

⁷Of course, *I'll be a monkey's uncle if Bob dances* makes more than a suggestion.

presuppose it. Since the second premise is ineliminable the subjunctive cannot alone entail the falsity of the antecedent. These examples make clear that there is no general ‘suggestion of falsity’ for subjunctive conditionals. So, however this suggestion is tied to the conventional meaning of subjunctives, it needs to be weaker than a suggestion of flat out falsity.

3.2.1 Stalnaker’s Distinction

Stalnaker’s (1975: §3) way of drawing the indicative/subjunctive distinction sheds light on the phenomena described above.

Stalnaker’s Distinction An indicative conditional focuses solely on antecedent-worlds among the contextually live possibilities c , which represent what’s being taken for granted in the discourse. A subjunctive conditional focuses on antecedent-worlds that need not be among those possibilities, that is they may be counterfactual from the perspective of the discourse. (Stalnaker 1975: §3)

As Stalnaker (1975: 69) puts it “the idea [for indicative conditionals] is that when a speaker says *if A*, then everything he is presupposing to hold in the actual situation is presupposed to hold in the hypothetical situation in which A is true.” Subjunctive antecedents, on the other hand, signal that in saying *if A* the speaker may be suspending some presuppositions and reaching beyond the contextually live possibilities (Stalnaker 1975: 70).

Stalnaker does not discuss how this distinction bears on the Subjunctive Suggestion, but the following suggests itself. The choice between using a subjunctive and an indicative is the choice between a form that *allows* antecedent worlds from outside the contextual possibilities and a form which does not. If the speaker is assumed to have a rationale for selecting the subjunctive form, that selection can be taken as an indication that some of the intended antecedent worlds are not among the contex-

tual possibilities. This indicates that the antecedent *can* be true in ways that are inconsistent with the contextual information. But this is weaker than suggesting that the antecedent *is* true in a way that is inconsistent with the contextual information. This weakening makes room for cases like (3.11) and (3.12) where it is essential that some of the antecedent worlds are compatible with *c*.⁸ When I talk about *possibly counterfactual* worlds below, I simply mean to follow Stalnaker in thinking that they *may* not be in *c*.

Stalnaker's Distinction sheds light on (3.8) and (3.9).

(3.8) # Bob never danced. But, if Bob danced, Leland danced.

(3.9) Bob never danced. But, if Bob had danced, Leland would have danced.

In (3.8) the indicative conditional is being interpreted against presuppositions which are incompatible with Bob's having danced. But in uttering an indicative conditional a speaker is talking about a situation where those presuppositions hold *and* Bob danced. Since there is no such situation, this will yield a defective utterance — just as it is defective to utter *My sister is running* when it is common ground that I don't have a sister. By contrast, in (3.9) a speaker is talking about a situation where the presuppositions may be suspended, so there may indeed be a situation satisfying the constraints communicated by the speaker's utterance.

Lastly, Stalnaker's Distinction clearly connects the two species to two different ways of combining information. Indicatives involve combining two consistent bodies of information (the antecedent and *c*), while subjunctives involve combining two bodies of information that may very well be inconsistent (the antecedent and *c*).

⁸von Fintel (1999) argues that subjunctives (a) *presuppose* that some antecedent worlds *are not* included in *c*, rather than (b) *asserting* that some antecedent worlds *may not* be included in *c* and characterizing the Subjunctive Suggestion as some kind of implicature. As von Fintel (1999:13-4) notes, none of his data sharply distinguish his theory from a more Stalnakerian one where subjunctives presuppose that some antecedent worlds *may* be included in *c*. He does not discuss the implicature/presupposition issue.

3.2.2 The Ingredients of a Subjunctive Antecedent

How is Stalnaker's Distinction linguistically encoded? To begin answering this question, I will attend to one prominent feature of subjunctive antecedents: they are marked with past tense morphology.⁹

- (3.13) a. If Bob **had** danced, Leland would have danced
 b. If Bob **were** to dance, Leland would dance
 c. If Bob danced**d**, Leland would dance

Surprisingly, this morphology does not have a genuinely past tense meaning. Out of context, the default reading of (3.13a) may very well concern a possibly counterfactual *past* event of Bob dancing. But, the antecedent may be coherently supplemented with *tomorrow* to yield an antecedent that concerns a possibly counterfactual *future* event.

- (3.14) Bob died yesterday. If he had died tomorrow instead, he would have been 98 years old.

As evidenced by (3.16), this is not possible for a genuinely past tense reading of *Bob had died*, like that in (3.15).

- (3.15) Yesterday I went to the Black Lodge. By the time I got there, Bob had died, but Cooper hadn't.

- (3.16) # I will go to the Black Lodge tomorrow. By the time I get there, Bob had died, but Cooper hadn't.

⁹More specifically, the *auxiliaries* in the antecedents of (3.13a) and (3.13b) are marked with what looks like past tense, and the same goes for the main verb in the antecedent of (3.13c). When multiple tenses are layered as in (3.13a) and (3.13b), the tense on the auxiliary determines the overall tense of the sentence. The acceptability of perfective sentences like *By tomorrow, Bob will have danced* makes this clear. Otherwise, such a sentence would be as unacceptable as *#Bob danced tomorrow*.

Thus, the past tense marking in subjunctive antecedents does not have a genuine past tense interpretation.¹⁰ This phenomenon is relevant to contrasting indicative and subjunctive conditionals since it does not occur in the former.

(3.17) # If Bob danced tomorrow, Leland danced tomorrow

At this point, three observations have accumulated. First, Stalnaker's Distinction: an indicative is concerned solely with antecedent-worlds among the contextually live possibilities while a subjunctive concerns possibly counterfactual antecedent-worlds. Second, the past tense morphology in the antecedents of subjunctive conditionals *does not* have its usual past tense meaning. Third, the past tense marking of indicative conditionals *does* have its usual past tense meaning. The contrast highlighted by the second and third observations offers a possible explanation of how Stalnaker's Distinction is linguistically encoded:

Counterfactuality Hypothesis The seemingly past tense morphology in the antecedents of subjunctive conditionals serves a modal function rather than a temporal one.¹¹ It locates the antecedent event among a set of possibilities that may contain counterfactual ones, i.e. ones that may not be among the contextually live possibilities. Past tense morphology serves a purely temporal function in indicative antecedents, and so indicative antecedents remain concerned with the live contextual possibilities.

The basic idea is that these three observations are nicely explained by assuming a *modal* interpretation of past tense morphology in the antecedents of subjunctives

¹⁰Parallel examples for (3.13a) and (3.13b) are available (Iatridou 2000). With subjunctives like (3.13b) there is the additional difference that even with singular subjects the plural conjugation is used. In isolation *Bob were to dance* is ungrammatical, though *The men were (supposed) to dance* is acceptable. Of pertinent curiosity, the latter sentence exhibits the same 'fake past' pattern in that it allows *tomorrow*, *yesterday* and *today*.

¹¹This thesis is defended at length by Iatridou (2000).

gives rise to Stalnaker's Distinction. Any account of how subjunctive conditionals are put together must account for the fact that past tense morphology does not receive its normal temporal interpretation in subjunctive conditionals, but does in the antecedents of indicatives. Stalnaker's Distinction delineates a modal difference between these two kinds of antecedents. Both points are unified by the hypothesis that this past tense morphology takes on a modal interpretation. More specifically, instead of locating the antecedent event, e.g. Bob's dancing, in the past, it locates that event in a possibly counterfactual situation. There are a number of ways one might explain how past tense morphology alternates between these two interpretations.¹² Though this is an important part of the approach, it is not my focus here. The basic analysis can be sketched without settling on a particular account of this detail.¹³ I will introduce a modal operator \triangleleft called **counterfactual expansion**, which is intended to correspond to the modal interpretation of the past tense morphology in subjunctive antecedents. Accordingly, a simple subjunctive conditional will be represented as (if $\triangleleft p$) q and the corresponding indicative as (if p) q . The question is how the semantics of (if \cdot) \cdot and \triangleleft can be given to yield a uniform analysis of

¹²For example, Isard (1974), Lyons (1977) and Iatridou (2000:245-9) propose that there is a single underspecified morpheme that can either locate events in a temporally remote location (the past) or a modally remote location (counterfactual scenarios). The trick is then to find a common denominator between the way past tense locates events in the past and how subjunctive antecedents locate events in counterfactual worlds. Iatridou (2000:246-7) articulates this common denominator as exclusion from the relevant domain (the non-past times or the live possibilities). Following Stalnaker and von Stechow, I would weaken this to *possible exclusion*.

¹³Ippolito (2003:§2.2) claims that any account building on Iatridou's basic ideas is inherently incapable of handling (3.14). But Iatridou is not clear about whether the apparent past tense on *had* or *danced* (or both) gets interpreted modally. I am occupying the position that it is the past tense on *had*. On this approach *Bob had danced* concerns a possibly counterfactual state (a span of time) with an event of Bob-dancing in its past. This does not relate that state or event to the time at which (3.13a) is uttered (the *speech time*). So, it is perfectly coherent to add adverbs which specify that those eventualities are in the past, present or future of the speech time. This kind of analysis is suggested by bare occurrences of perfective constructions like *By tomorrow Bob will have danced*. This sentence says that by tomorrow we will be in a state with an event of Bob's-dancing in its past. Here, the past tense on *danced* does not relate the dancing to the speech time, but rather the state introduced by *will have*. The future perfect locates this state in the future of the speech time.

conditionals. I will begin by evaluating Stalnaker’s proposal for a uniform theory in light of the data and distinctions introduced above. After raising problems for this approach I will argue that once the contribution of \triangleleft to subjunctives is stated, the semantics for indicatives offered in Chapter 2 (§2.5) can be generalized into a uniform analysis.

3.2.3 A First Attempt at Uniformity: Stalnaker

Stalnaker (1968, 1975) provided one of the earliest and most successful attempts at a uniform analysis of conditionals.¹⁴ This analysis treats (if \cdot) \cdot in terms of a two-place sentential connective $>$. (3.18b) is offered as the semantic clause for all conditionals, which can be paraphrased as (3.18a).

Stalnakerian Semantics for Both Species

- (3.18) a. $\phi > \psi$ is true at w iff ψ is true at all of the ϕ -worlds most similar to w
 b. $\llbracket \phi > \psi \rrbracket_{c,f} = \{w \mid f(w, \llbracket \phi \rrbracket_{c,f}) \subseteq \llbracket \psi \rrbracket_{c,f}\}$

The set selection function f takes a world w and a proposition p and delivers the set of p -worlds **most similar** to w .¹⁵ This selection must obey some basic constraints (see Appendix 3.A.1) and is held to be further determined by context (though rarely completely determined). Stalnaker’s core idea is that indicative conditionals are subject to a special selection constraint. Given a set c of contextual possibilities, he requires that “if the conditional is being evaluated at a world in $[c]$, then the world[s] selected must, if possible, be within $[c]$ as well” (Stalnaker 1975:69). The idea is that in evaluating an indicative conditional at a world compatible with what’s

¹⁴See Nolan (2003) and Williams (2008) for related approaches.

¹⁵Stalnaker makes the **uniqueness assumption**: for all w and p there is at most one p -world most similar to w . The above remains neutral on this matter by universally quantifying over a set of the most similar worlds, be it a singleton or more populous set. Throughout, I will translate Stalnaker’s discussion of f into a setting that does not assume uniqueness.

being taken for granted (represented by c), the selection of antecedent worlds should preserve what's taken for granted. Stalnaker says that this amounts to requiring that if $w \in c$ then $f(w, \llbracket \phi \rrbracket_{c,f}) \subseteq c$. Recall that when given a proposition p , f is supposed to select p -worlds. This is enforced in the formal theory by requiring that $f(w, p) \subseteq p$. Stalnaker's requirement can therefore be met by requiring that if $w \in c$, the conditional is evaluated not by considering $f(w, \llbracket \phi \rrbracket_{c,f})$ but rather by considering $f(w, \llbracket \phi \rrbracket_{c,f} \cap c)$. So Stalnaker's proposal is that while the *semantic content* of an indicative conditional is given by (3.18), the assertion of an indicative in a context will express (3.19b) rather than (3.18b). The former is described informally in (3.19a).

Stalnakerian Pragmatics for Indicatives

(3.19) a. $\phi > \psi$ is true in c at w iff:

- (i) If $w \in c$, ψ is true at all of the ϕ -worlds in c most similar to w
- (ii) If $w \notin c$, ψ is simply true at all of the ϕ -worlds which are most similar to w

$$\begin{aligned} \text{b. } \llbracket \phi > \psi \rrbracket_{c,f} &= \{w \mid f(w, \llbracket \phi \rrbracket_{c,f} \cap c) \subseteq \llbracket \psi \rrbracket_{c,f} \text{ if } w \in c \text{ \& } \\ &\quad f(w, \llbracket \phi \rrbracket_{c,f}) \subseteq \llbracket \psi \rrbracket_{c,f} \text{ if } w \notin c\} \end{aligned}$$

This proposal raises a suite of issues which Stalnaker has not explored in print.¹⁶

Here is the first: why didn't Stalnaker adopt the more simple formulation in (3.20), as Nolan (2003: 218) and Williams (2008: 212) do?

¹⁶There is a puzzle worth noting that I cannot discuss in detail. In a context c incompatible with ϕ (i.e. $c \cap \llbracket \phi \rrbracket_{c,f} = \emptyset$), the proposition expressed by an indicative conditional will be true at every world in c , and hence entailed by what's presupposed. In more detail: suppose $c \cap \llbracket \phi \rrbracket_{c,f} = \emptyset$ and let $w \in c$. It follows that $f(w, \llbracket \phi \rrbracket_{c,f} \cap c) = f(w, \emptyset)$. Recall that for all p : $f(w, p) \subseteq p$. So $f(w, \emptyset) = \emptyset$. Since $\emptyset \subseteq \llbracket \psi \rrbracket_{c,f}$, the conditional is true in w , though w was an arbitrary world from c . But then it follows that the inference from $\neg\phi$ to an indicative $\phi > \psi$ should be a reasonable one in the sense of Stalnaker (1975: §4). Yet it is quite odd to say *Bob never danced, so if he danced, Leland danced too*; the spectre of material conditional-like behavior lurks! It can be eliminated only by adding *another* condition to (3.19a): (i) applies only when $w \in c$ and ϕ is compatible with c . Interestingly, this is how Stalnaker (2005: §2), without comment, states his constraint.

(3.20) a. $\phi > \psi$ is true at w iff ψ is true at all of the contextually live ϕ -worlds most similar to w

b. $\llbracket \phi > \psi \rrbracket_{c,f} = \{w \mid f(w, \llbracket \phi \rrbracket_{c,f} \cap c) \subseteq \llbracket \psi \rrbracket_{c,f}\}$

The short answer: such a conditional proposition fails to obey modus ponens.¹⁷ Suppose w is a $\phi \wedge \neg\psi$ -world outside c , and further that ψ is true at all of the ϕ -worlds in c that are most similar to w (i.e. $f(w, \llbracket \phi \rrbracket_{c,f} \cap c) \subseteq \llbracket \psi \rrbracket_{c,f}$). Then the assertion of an indicative $\phi > \psi$ will express a proposition that is true in w , yet w is a world where ϕ is true and ψ is false!¹⁸ Perhaps this is why Stalnaker opted for the more complex (3.19b). Unfortunately, that option also suffers from a serious shortcoming.

Ironically, Stalnaker's (3.19) does not embody Stalnaker's Distinction. Recall that according to Stalnaker's Distinction an indicative conditional makes a claim only about antecedent worlds within c , just as (3.20) decrees. (3.19) is importantly different. It says that the truth-condition ascribed by (3.20) only applies to worlds within c , adding that if $w \notin c$, the conditional is true just in case the consequent is true at all of the antecedent worlds most similar to w , which may very well come from beyond c . So on this theory indicative conditionals *do not* just concern antecedent worlds within c . This is problematic since Stalnaker's Distinction was the basic assumption about conditional semantics that featured in the explanation of two facts in §3.2.1: (i) that the assertion of a subjunctive conditional often suggests that its antecedent is counterfactual and (ii) the contrast in (3.8) and (3.9).

¹⁷Nolan (2003: 222-3) suggests that requiring c to be veridical information (e.g. knowledge) helps the situation, but that is a confusion. All that guarantees is that the actual world does not provide the counterexample to modus ponens. Williams (2008: 212) endorses (3.20) but does not supplement Nolan's strategy. Lycan (2001) rejects modus ponens for essentially the same reasons.

¹⁸There is another kind of counterexample to modus ponens possible here. (3.20b) predicts that an indicative is (vacuously) true at *any* world when there are no contextually live ϕ -worlds. Since the conditional is true at any world when there are no contextually live ϕ -worlds, the conditional will be true at a $\phi \wedge \neg\psi$ world. Hence the truth of $\phi > \psi$ and ϕ do not guarantee the truth of ψ . More formally, suppose $\llbracket \phi \rrbracket_{c,f} \cap c = \emptyset$. By success, for any $w : f(w, \llbracket \phi \rrbracket_{c,f} \cap c) \subseteq \emptyset$, so $f(w, \llbracket \phi \rrbracket_{c,f} \cap c) = \emptyset$. Then for a w where $w \in \llbracket \phi \rrbracket_{c,f}$ and $w \notin \llbracket \psi \rrbracket_{c,f}$, $w \in \llbracket \phi > \psi \rrbracket_{c,f}$.

(3.8) # Bob never danced. If Bob danced, Leland danced.

(3.9) Bob never danced. If Bob had danced, Leland would have danced.

Recall how the explanation of (i) hinged crucially on Stalnaker's Distinction. Given Stalnaker's Distinction, the choice between an indicative and subjunctive conditional is a choice between one which allows antecedent-worlds only within c and one that allows antecedent-worlds beyond c . The assertion of a subjunctive conditional suggests that its antecedent may be false because the speaker is assumed to have a reason for selecting the form that allows antecedent-worlds beyond c . Having indicative conditionals allow antecedent-worlds beyond c , as Stalnaker's official theory (3.19) does, clearly undercuts this explanation. Similarly, one cannot explain the infelicity of (3.8) by appealing to the fact that in uttering *if Bob danced* the speaker is paradoxically attempting to pick out a hypothetical situation where both the conversational presuppositions, which exclude Bob's having danced, and *Bob danced* are true. According to (3.19), in uttering *if Bob danced* in (3.8) a speaker is not exclusively picking out Bob-dancing worlds where the presuppositions are true. (3.19) allows Bob-dancing worlds outside c as well. And so it is that (3.19) fails to yield an explanation of (3.8) and (3.9), while (3.20) invalidates modus ponens.¹⁹

There is a proposition that could serve as the content of an indicative conditional assertion that suffers from neither problem:

$$(3.21) \llbracket \phi > \psi \rrbracket_{c,f} = \{w \in c \mid f(w, \llbracket \phi \rrbracket_{c,f} \cap c) \subseteq \llbracket \psi \rrbracket_{c,f}\}$$

This proposition only concerns antecedent-worlds from within c and it is false at any world outside of c , so modus ponens is safe. The problem is that there is simply no way of deriving this as the asserted content of an indicative conditional by combining

¹⁹I should add that Stalnaker, Nolan and Williams never explicitly offer explanations of (3.8) and (3.9). But it is difficult to see what explanations other than the one given in §3.2.2 or in the next paragraph could be offered.

(3.18) with a constraint on the *selection function*. The reason is simple: (3.21) requires the proposition itself to be restricted to c , not just the *selection* of antecedent-worlds. Indeed, the harder one thinks about Stalnaker's proposal, the more difficult it is to understand how exactly his constraint is to be applied and exactly what kind of constraint it is. This is the source of two other difficulties facing his approach and will make clear why the discussion of §3.2.2 was relevant.

Stalnaker gives a single semantic clause for both indicative and subjunctive conditionals, namely (3.18). However, he takes the *assertion* of an indicative conditional to be subject to a 'pragmatic constraint' on the selection function. This constraint entails that the *assertion* of an indicative conditional expresses an importantly different proposition, namely that listed in (3.19). Here is Stalnaker's clearest statement of the approach:

Both kinds of conditionals... have the same abstract semantics, but a context-dependent parameter of the interpretation — the selection function — is differently constrained by the different grammatical constructions. So, on this theory, the difference between the two kinds of conditionals is a semantic difference in two different senses, but a purely pragmatic difference in a third sense. The difference is semantic, first in the sense that there will normally be a difference in the proposition expressed by the contrasting conditional sentences, even when uttered in similar situations. And it is semantic also in the sense that the difference is marked by a conventional linguistic device (the tense/aspect/mood difference). But the distinction is pragmatic in that the device works by the way it constrains features of the context. The semantic rule that gives the truth conditions of the conditional as a function of the contextual parameter will be the same for both kinds of conditionals (Stalnaker 2005: n.13).

This approach does not coherently connect the semantic differences between the two

kinds of conditionals to their linguistic differences. As I discussed in §3.2.2, subjunctive antecedents invariably contain past tense morphology that behaves differently than the past tense morphology in indicative antecedents. The only proposed explanation of this phenomena is to view the past tense morphology in subjunctive antecedents as taking on a modal meaning which combines with a semantics for *if...then...* to yield a semantics of subjunctive conditionals. That modal meaning was said to allow subjunctives to reach outside c for antecedent worlds. But on Stalnaker's theory, the basic semantic clause that characterizes *if...then...* already allows this and is intended to apply to subjunctives without any other modal contributions from other constituents. This leaves a permanent void in the theory where a hypothesis about the meaning of the tense/aspect/mood combination in subjunctive conditionals should be. In the notation introduced at the end of §3.2.2, Stalnaker's theory is incompatible with representing a simple indicative as $(\text{if } p) q$ and a simple subjunctive as $(\text{if } \triangleleft p) q$ and explaining their differences in terms of the semantics of \triangleleft . This problem is symptomatic of a basic incongruity between Stalnaker's analysis and the hypothesis advanced above: indicatives explore consistent extensions of some information while subjunctives explore revisions of that information. In the latter case, similarity is needed to calculate the minimal changes required by the retraction of accepted information. Since the former case involves a simple consistent extension of information, there's no need for similarity. It is more natural to hold that the selection function comes from the semantics of \triangleleft , and its presence allows language users to select worlds beyond the informational perspective of the discourse (c). It follows automatically then that indicatives will be limited to worlds in c . Just such a theory will be sketched in §3.2.4. Before moving on, it is worth noting that the problem raised here isn't just a problem for Stalnaker's particular theory, it's a problem for all of the theories that analyzed subjunctives in terms of an unconstrained similarity or accessibility relation and then construe indicatives as involving a relation that is

somehow constrained to *c*.

Another related difficulty for the Stalnakerian stems from his attempt to locate the distinction between indicative and subjunctive conditionals outside of semantics proper.²⁰ Consider the plausibility of a parallel account of tense, according to which sentences all have a non-temporal semantics regardless of their tense morphology, but instead provide ‘pragmatic constraints’ on how the time of the described event can relate to the time of utterance, e.g. past, present and future. What kind of indication or significance does this endow tense morphology with? Why should we think that this kind of indication deserves to be treated outside of conventional semantics? How would it work with sentences containing multiple tenses or conditionals, like (3.22) and (3.23)?

(3.22) Cooper believes that Bob danced

(3.23) If Bob is dancing, then if Laura were here she would be dancing too

Without answers to these questions, it is difficult to see what the ‘pragmatic constraints’ at the heart of Stalnaker’s analysis come to. This is not to deny that there is something right about the idea that articulating the difference between the meaning and function of indicative and subjunctive conditionals involves contrasting the way that they relate the antecedent to the contextual possibilities. Since contextual possibilities are defined by the intentions of language users, this does signal the pragmatic status of the antecedent. What is objectionable is the idea that making sense of this requires positing two separate ways in which bits of language signify. In the next section I will show how the approach to meaning developed in Chapters 1 and 2 allows one to characterize the semantic significance of subjunctive antecedents and

²⁰Note that Stalnaker cannot locate the indicative/subjunctive distinction within the domain of *character*, in Kaplan’s (1978) sense. That would require separate semantic clauses for the two kinds of conditionals.

other parts of language in a uniform way. When combined with the approach to conditionals from Chapter 2, a very attractive uniform semantics emerges.

3.2.4 Uniformity

Stalnaker's approach to conditionals takes the meaning of a sentence to be its truth-conditions. In sketching an alternative, I will adopt the more general approach developed in previous chapters. More specifically, I will adopt the semantic apparatus introduced in Chapter 2 (§§2.2-2.5). There, the meaning of a sentence was a function from one state s to another s' , a transition written $s[\phi] = s'$. A state was modeled as a pair $s_1 = \langle C, s_2 \rangle$. C is a body of accepted information and issues, which is modeled as a set of disjoint subsets of the live possibilities c (hence $\bigcup C = c$). Intuitively, these subsets are the incompatible propositions the agents are attempting to decide between. s_2 is a *subordinate state* that records the effects of any hypothetical additions to C . Though semantic values are officially functions from states to states, the effects of some formulas only bear on the set of possibilities C partitions, i.e. c , and some only effect C . In talking about these formulas it is useful to indulge in a convenient notation. An atomic formula \mathbf{p} simply eliminates worlds incompatible with its truth from c , but writing this out in terms of how \mathbf{p} changes a state s is a bit verbose.²¹ Instead, one can just write $c[\mathbf{p}]$ to refer to the set of live possibilities partitioned by C' , where $s[\mathbf{p}] = \langle C', \dots \rangle$. Further, providing the equation $c[\mathbf{p}] = \{w \in c \mid w(\mathbf{p}) = 1\}$ suffices to say what \mathbf{p} 's semantic effect on s is. Analogously $C[?\mathbf{p}]$ can be used to denote C' , where $s[?\mathbf{p}] = \langle C', \dots \rangle$.

My main claim in this section is that a plausible semantics for \triangleleft plus the semantics for conditionals offered in Chapter 2 (§2.5) yields a uniform semantics for conditionals.

²¹ $s[\mathbf{p}] = \langle \{ \{w \in c_0 \mid w(\mathbf{p}) = 1\}, \dots, \{w \in c_n \mid w(\mathbf{p}) = 1\} \}, \langle C_0, \dots \langle C_n \rangle \dots \rangle \rangle$, where $s = \langle C, \langle C_0, \dots \langle C_n \rangle \dots \rangle \rangle$ and $C = \{c_0, \dots, c_n\}$.

This semantics for \triangleleft will, like Stalnaker's semantics for subjunctives, depend on a selection function f . Hence, f needs to be incorporated into my representation of a state. The simplest option is to pair each body of information and issues with a selection function, e.g. $s = \langle C_f, \langle C_{f_0}^0, \dots \langle C_{f_n}^n \rangle \dots \rangle \rangle$, where $C_f := \langle C, f \rangle$. I will omit f where unnecessary and write c_f in cases where the partition structure of C is irrelevant.

3.2.4.1 The Semantics of Counterfactual Expansion \triangleleft

§3.2.2 claimed that the antecedent of a subjunctive is modalized, which may be schematically represented as $\triangleleft\alpha$ — more on this representation below. Given Stalnaker's Distinction, what should \triangleleft 's semantics be? According to Stalnaker's Distinction, the antecedent of a subjunctive conditional focuses on worlds that may not be among c . So \triangleleft 's job is to select α -worlds that may be incompatible with the live possibilities. Different approaches to the semantics of subjunctive conditionals provide different ways of selecting these α -worlds. For example, the familiar approach introduced by Stalnaker (1968, 1975), Stalnaker & Thomason (1970) and Lewis (1973) suggests, roughly, that w is in this set of α -worlds iff it is among the α -worlds most similar to some world or other in c .²²

What $\triangleleft\alpha$ Does Given the contextually live possibilities c , $\triangleleft\alpha$ delivers a set c' of α -worlds that may not be included in c . Under a Lewis-Stalnaker analysis, this set is calculated as follows. Look at each world w in c . If w is an α -world it is allowed into c' .²³ If w is not a α -world, the α -worlds most similar to w are

²²This formulation requires the **limit assumption** which Lewis (1973: §1.4) officially rejected: there is a set of α -worlds *most* similar to w . Though there are good reasons for adopting it, it's a mere convenience here (Pollock 1976; Herzberger 1979; Warmbröd 1982; Stalnaker 1984: 140-6). This formulation does not require, but is compatible with, Stalnaker's **uniqueness assumption**: for any w there is at most one α -world most similar to w . See Appendix 3.A.1 for details.

²³This is enforced by the fact that Lewis-Stalnaker similarity obeys **strong centering**: if $w \in p$

placed into c' in w 's stead. These worlds might not have been in c .

Different approaches to subjunctive conditionals could be developed with variations on this statement. I will adopt Lewis and Stalnaker's familiar approach simply to bring the novel contributions here into bolder relief. This approach is formulated more precisely with the following definition.

Definition 29 (Counterfactual Expansion \triangleleft v1)

Let f be a selection function (see Appendix 3.A.1) and α a literal:

$$c_f[\triangleleft\alpha] = \{w' \mid \exists w \in c : w' \in f(w, \llbracket\alpha\rrbracket)\}_f$$

Definition 29 has two important consequences which can be read off Figure 3.1. First,

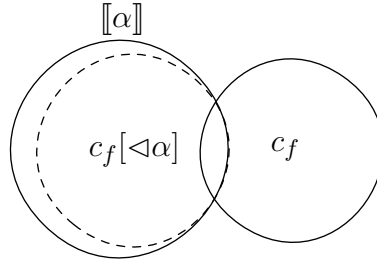


Figure 3.1: Relationship between $\llbracket\alpha\rrbracket$, c_f and $c_f[\triangleleft\alpha]$

in a subjunctive like (3.2), the live Bob-dancing worlds will be a subset of the worlds *If Bob had danced* introduces. That is, the possibilities picked out by a subjunctive antecedent $\triangleleft\alpha$ in a context c_f will include all of the α -worlds in c_f but *may* also reach outside of c_f for α -worlds.²⁴ Fact 19.1 records this fact in full detail, while Fact 19.2 makes it clear that a counterfactual antecedent like *if Bob had danced* may only reach outside the live possibilities when not all of those possibilities are ones where Bob danced.

then $f(w, p) = \{w\}$. But **weak centering** would suffice: if $w \in p$ then $w \in f(w, p)$. Weak centering would allow α -worlds outside of c which may be useful. I will not endeavor to settle the matter here.

²⁴If $c_f[\alpha] \neq c_f$ then there is at least one $\neg\alpha$ -world in c . But it is not guaranteed that f will map this to an α -world outside of c , so it is not guaranteed that $c_f[\triangleleft\alpha] \not\subseteq c_f[\alpha]$. But, f is free to select an α -world outside of c , so it may turn out that $c_f[\triangleleft\alpha] \not\subseteq c_f[\alpha]$.

Fact 19 (Two Consequences)

1. In general: $c_f[\alpha] \subseteq c_f[\triangleleft \alpha]$, $c_f[\triangleleft \alpha] \subseteq \llbracket \alpha \rrbracket$
2. It may be that $c_f[\triangleleft \alpha] \not\subseteq c_f$ iff $c_f[\alpha] \neq c_f$. When $c_f[\alpha] = c_f$, $c_f[\triangleleft \alpha] = c_f$.
 ('It may be that $c_f[\triangleleft \alpha] \not\subseteq c_f$ ' means ' $\exists f : c_f[\triangleleft \alpha] \not\subseteq c_f$ '.)

An important nuance of Definition 29 is that \triangleleft is applied only to literals α (atomics, negations of atomics and further negations thereof). Recall that \triangleleft corresponds to a morpheme that has the same syntax and semantic type as tense. Just as tense cannot 'take scope' over several compounded untensed sentences, \triangleleft cannot take scope over logically complex sentences. Counterfactuals with logically complex antecedents contain literals which are first embedded under \triangleleft and then compounded.

- (3.24) a. If Bob had danced and Sarah had sung, Andy would have cried
- b. $(\text{if } (\triangleleft \mathbf{b} \wedge \triangleleft \mathbf{s})) \mathbf{a}$

In §3.3.1 I will argue that this treatment of complex antecedents offers substantive improvements over the original Lewis-Stalnaker theory. In the interim, I will focus on subjunctives with simple antecedents.

3.2.4.2 Unification

What do you get when you combine the conditional semantics from Chapter 2 (§2.5), the representation of subjunctive conditionals as $(\text{if } \triangleleft \alpha) \psi$ and the semantics for \triangleleft given in Definition 29? Consider a particular pair of indicative and subjunctive conditionals *if Bob danced then Leland danced*, $(\text{if } \mathbf{b}) \mathbf{d}$, and *if Bob had danced then Leland would have danced*, $(\text{if } \triangleleft \mathbf{b}) \mathbf{d}$.

$$(3.25) \quad s[(\text{if } \mathbf{b}) \mathbf{d}] = \begin{cases} ((s \downarrow \text{if } \mathbf{b}) \downarrow \mathbf{b}) \uparrow \mathbf{d} & \text{if } s[\mathbf{b}] \neq \langle \{\emptyset\}, \dots \rangle \\ \text{Undefined} & \text{otherwise} \end{cases}$$

$$(3.26) \quad s[(\text{if } \triangleleft \mathbf{b}) \mathbf{d}] = \begin{cases} ((s \downarrow \text{if } \triangleleft \mathbf{b}) \downarrow \triangleleft \mathbf{b}) \uparrow \mathbf{d} & \text{if } s[\triangleleft \mathbf{b}] \neq \langle \{\emptyset\}_f, \dots \rangle \\ \text{Undefined} & \text{otherwise} \end{cases}$$

The semantics from Chapter 2 was applied to indicative conditionals, and (3.26) carries over a presupposition appropriate for that application: accepting the antecedent must be compatible with the live possibilities. This allowed the semantics to respect the pattern exemplified by (3.8). But subjunctives do not adhere to this pattern, viz. (3.9). So it is not obvious that (3.26) will succeed.

(3.8) # Bob never danced. But, if Bob danced, Leland danced.

(3.9) Bob never danced. But, if Bob had danced, Leland would have danced.

Once it is appreciated that the antecedent of a subjunctive contains \triangleleft , the presupposition changes drastically. If there are no \mathbf{b} -worlds in c , $s[\mathbf{b}] = \langle \{\emptyset\}, \dots \rangle$. So $(\text{if } \mathbf{b}) \mathbf{d}$ will crash — as in (3.8). However, $s[\triangleleft \mathbf{b}] = \langle C'_f, \dots \rangle$ will not suffer the same fate. For each of the $\neg \mathbf{b}$ -worlds in c , $\triangleleft \mathbf{b}$ will find the most similar \mathbf{b} ones.²⁵ Gather these worlds up and you have a non-empty set of worlds. Hence, the pattern in (3.9). Indeed, (3.25) and (3.26) follow Stalnaker's Distinction perfectly, so it is no surprise that they come with its same intuitive explanatory benefits (§3.2.1). While the present analysis enjoys the same explanatory benefits intuitively afforded by Stalnaker's Distinction, the details of this analysis account for more.

Stalnaker's Distinction alone does not explain the oddity of (3.27).

(3.27) # Bob always danced. If Bob had danced, Leland would have danced.

The first sentence limits the live possibilities to ones where Bob danced. The second sentence, according to Stalnaker's Distinction, suggests that there may be some

²⁵There is the possibility that $\forall w \in c, f(w, \llbracket \mathbf{b} \rrbracket) = \emptyset$. In such a case one might say that \mathbf{b} is *un-entertainable* in c_f . Thus, subjunctives do presuppose that their antecedent is, in this sense, entertainable in c_f .

relevant Bob-dancing worlds beyond these live possibilities. It is unclear why should this be infelicitous. The analysis above allows one to say more. After updating with the first sentence, c contains only **b**-worlds, that is $c[\mathbf{b}] = c$. When $c[\mathbf{b}] = c$, $c[\triangleleft \mathbf{b}] = c[\mathbf{b}] = c$ (Fact 19.2). This means that while selecting the subjunctive form in (3.27) suggests that some of the relevant **b**-worlds may be counterfactual (outside c), it asserts that all of them are consistent with what's accepted (within c). After all, the subjunctive asserts that all of the $\triangleleft \mathbf{b}$ -worlds are **d** worlds, the $\triangleleft \mathbf{b}$ -worlds are the relevant **b**-worlds and all of them, in this context, are predicted to be within c . The assertion of (3.27) therefore suggests something which is contradicted by what it asserts and hence its oddity. So, while following Stalnaker's Distinction the present analysis explains more.

The analysis developed above offers a truly uniform account of indicative and subjunctive conditionals. It is worthwhile then to say a bit more about the analysis of subjunctives it provides and how this analysis relates to existing approaches. Consider first two important consequences of the analysis above. First, unlike indicative conditionals, the propositional content of a subjunctive conditional is defined provided that antecedent is entertainable. Second, this propositional content is identical to the one prescribed by a Lewis-Stalnaker theory.

Fact 20 (Simple Subjunctive Conditional Propositions)

1. $s[(\text{if } \triangleleft \alpha) \psi] = ((s \downarrow ? \triangleleft \alpha) \downarrow \triangleleft \alpha) \uparrow \psi$
2. $\llbracket (\text{if } \triangleleft \alpha) \psi \rrbracket_f$ is defined if $\exists w \in c, f(w, \llbracket \mathbf{b} \rrbracket) \neq \emptyset$
3. $\llbracket (\text{if } \triangleleft \alpha) \psi \rrbracket_f = \{w \mid f(w, \llbracket \alpha \rrbracket) \subseteq \llbracket \psi \rrbracket_f\}$ □

Fig. 3.2 below makes this last consequence clearer. In general, the effect of a subjunctive conditional on c is to test that the most similar antecedent worlds ($c[\triangleleft \alpha]$) are consequent worlds. This is stated more precisely in Fact 21.

Fact 21 (Variable Strictness over c)

$$c_f[(\text{if } \triangleleft \alpha) \psi] = \{w \in c_f \mid c_f[\triangleleft \alpha] \models \psi\}$$

□

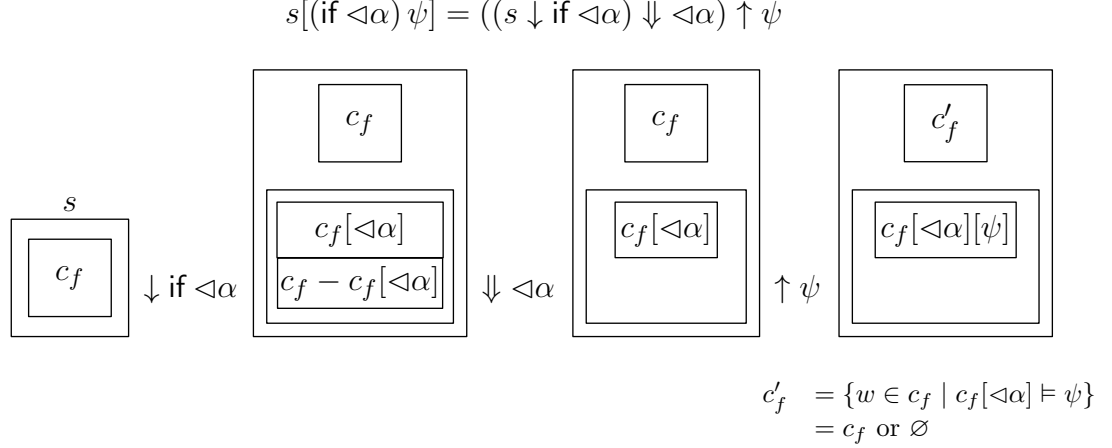


Figure 3.2: Step-by-Step Effects of Subjunctive Conditional Update

If $c = \{w\}$, then updating with a subjunctive amounts to testing whether the α -worlds most similar to w are ψ -worlds, i.e. $f(w, \llbracket \alpha \rrbracket) = f(w, \llbracket \alpha \rrbracket)[\psi]$. So $(\text{if } \triangleleft \alpha) \psi$ is true in w iff the α -worlds most similar to w are ψ -worlds, as the Lewis-Stalnaker theory professes. Though the propositions delivered by this semantics are identical to that assigned on the Lewis-Stalnaker theory, the two approaches will differ in their logic and in the way they understand the use of subjunctives in context. These differences arise from two sources: the different conception of meaning (and hence entailment) at the heart of the present account and its more detailed compositional analysis of subjunctive antecedents. I will not be able to discuss all of the differences in full detail here, but three examples are discussed in §3.3. Before that, I want to illustrate that the present account should indeed be counted as a variably-strict rather than a strict analysis of subjunctives and make a crucial amendment to it. And even before that, I want to note that the present semantics, unlike Lewis and Stalnaker's, validates Import-Export.

Import-Export $(\text{if } \triangleleft \alpha_1) ((\text{if } \triangleleft \alpha_2) \psi) \models (\text{if } \triangleleft \alpha_1 \wedge \triangleleft \alpha_2) \psi$

The proof of Fact 13 from Chapter 2 verifies this. This intuitive principle has often been cited as a reason for dissatisfaction with variably-strict analyses.

3.2.5 This Variably-Strict Analysis is Not Quite Right

I take the important dividing line between strict and variably-strict analyses to be the following two inference patterns.

Antecedent Strengthening $(\text{if } \triangleleft \alpha) \psi \models (\text{if } \triangleleft \alpha \wedge \triangleleft \beta) \psi$

Transitivity $(\text{if } \triangleleft \alpha_1) \alpha_2, (\text{if } \triangleleft \alpha_2) \psi \models (\text{if } \triangleleft \alpha_1) \psi$

Strict analyses validate both while variably-strict analyses validate neither.²⁶ Antecedent Strengthening is indeed *invalid* on the present semantics. Let's see how a particularly simple instance of the inference fails.

$$(3.28) \quad (\text{if } \triangleleft b) d \not\models (\text{if } \triangleleft b \wedge \triangleleft \neg d) d$$

The relevant worlds for (3.28) are listed in Fig. 3.3.

	b	d
w_0	0	0
w_1	0	1
w_2	1	0
w_3	1	1

Figure 3.3: The Relevant Worlds for (3.28)

²⁶Some strict accounts of subjunctive conditionals invalidate these patterns, but in a very specific case (e.g. Gillies 2007; von Stechow 2001). They rely on a case where the presuppositions of the premise are met but the conclusion's are not and cannot be accommodated. Thus, the truth of the premise does not guarantee the truth of the conclusion (and hence isn't dynamically valid either). However, the Strawsonian definition of entailment motivated in Chapter 3 (§3.1) merely requires that the entailment hold in contexts where all presuppositions are satisfied. On this understanding of validity any strict analysis will validate Antecedent Strengthening (and Transitivity). These patterns are invalid on my semantics even when a Strawsonian definition of entailment is adopted. The consideration of (3.28) will make this clear.

Let $c_f = \{w_0\}_f$, $f(w_0, \llbracket \mathbf{b} \rrbracket) = \{w_3\}$ and $f(w_3, \llbracket \neg \mathbf{d} \rrbracket) = \{w_2\}$. Then $c_f[\triangleleft \mathbf{b}] = \{w_3\}$. Since \mathbf{d} is true in w_3 , $c_f[\triangleleft \mathbf{b}] \models \mathbf{d}$ and so $c_f[(\text{if } \triangleleft \mathbf{b}) \mathbf{d}] = c_f$. Now note that $c_f[\triangleleft \mathbf{b}][\triangleleft \neg \mathbf{d}] = \{w_2\}_f$, since $c_f[\triangleleft \mathbf{b}] = \{w_3\}_f$ and $f(w_3, \llbracket \neg \mathbf{d} \rrbracket) = \{w_2\}_f$. Since \mathbf{q} is false in w_2 , $c_f[\triangleleft \mathbf{b}][\triangleleft \neg \mathbf{d}] \not\models \mathbf{d}$ and so $c_f[(\text{if } \triangleleft \mathbf{b} \wedge \triangleleft \neg \mathbf{d}) \mathbf{d}] = \emptyset$. Therefore $c_f[(\text{if } \triangleleft \mathbf{b}) \mathbf{d}] \neq c_f[(\text{if } \triangleleft \mathbf{b}) \mathbf{d}][(\text{if } \triangleleft \mathbf{b} \wedge \triangleleft \neg \mathbf{d}) \mathbf{d}]$. Thus, $(\text{if } \triangleleft \mathbf{b}) \mathbf{d} \not\models (\text{if } \triangleleft \mathbf{b} \wedge \triangleleft \neg \mathbf{d}) \mathbf{d}$.²⁷

If Transitivity is valid, then Antecedent Strengthening is valid. Any reasonable semantics should deliver $\models (\text{if } \triangleleft \alpha \wedge \triangleleft \beta) \alpha$. From this logical necessity and $(\text{if } \triangleleft \alpha) \psi$, $(\text{if } \triangleleft \alpha \wedge \triangleleft \beta) \psi$ follows by Transitivity. But this is just Antecedent Strengthening, which is invalid. Hence Transitivity is invalid too. Or is it?

The semantics sketched in §3.2.4, in particular Definition 29, does not validate $\models (\text{if } \triangleleft \alpha \wedge \triangleleft \beta) \alpha$. So it is not quite right. Let me explain why this is and propose a small amendment to correct this situation.

Consider the following instance of the target conditional.

$$(3.29) \quad (\text{if } \triangleleft \mathbf{b} \wedge \triangleleft \mathbf{d}) \mathbf{b}$$

Let $c_f = \{w_0\}_f$, $f(w_0, \llbracket \mathbf{b} \rrbracket) = \{w_2\}$ and $f(w_2, \llbracket \mathbf{d} \rrbracket) = \{w_1\}$. This conditional will test that $\{w_0\}_f[\triangleleft \mathbf{b}][\triangleleft \mathbf{d}] \models \mathbf{b}$. $\{w_0\}_f[\triangleleft \mathbf{b}] = \{w_2\}_f$ and $\{w_2\}_f[\triangleleft \mathbf{d}] = \{w_1\}_f$. Since \mathbf{b} is false in w_2 this test is failed. The crucial step is where $\{w_2\}_f[\triangleleft \mathbf{d}] = \{w_1\}_f$. This allows, *within* the antecedent of (3.29), the leap to a $\neg \mathbf{b}$ -world. Yet, intuitively, once the possibilities have been expanded to include \mathbf{b} -worlds subsequent expansions in that antecedent should also be required to include \mathbf{b} -worlds (though not necessarily the same ones). If one countenances the possibility that the selection function can change as the result of $\{w_0\}_f[\triangleleft \mathbf{b}]$, then this intuition can be honored. The basic idea is to have f change so that at the crucial step we do not have $\{w_2\}_f[\triangleleft \mathbf{d}]$, but rather $\{w_2\}_{f^{\llbracket \mathbf{b} \rrbracket}}[\triangleleft \mathbf{d}]$, where $f^{\llbracket \mathbf{b} \rrbracket}(w, \llbracket \mathbf{d} \rrbracket) = f(w, \llbracket \mathbf{d} \rrbracket \cap \llbracket \mathbf{b} \rrbracket)$. This shifted function must return

²⁷Recall that $\phi \models \psi$ iff $\forall c : c[\phi] = c[\phi][\psi]$. Of course, I went for the Strawsonian variant in Chapter 2 (§3.1, Definition 6). Since no matters of definedness are in play here, this wrinkle is unnecessary.

w_3 , which is a **b**-world. Hence, the above counterexample (or any other) to the validity of (3.29) will no longer work. A revision of Definition 29 secures this behavior.²⁸

Definition 30 (Counterfactual Expansion \triangleleft v2)

Let f be a selection function, α be a literal and $f^q(w, p) = f(w, p \cap q)$:

$$c_f[\triangleleft \alpha] = \{w' \mid \exists w \in c : w' \in f(w, \llbracket \alpha \rrbracket)\}_{f[\llbracket \alpha \rrbracket]}$$

The basic idea is that when f is used to select some **p**-worlds then subsequent appeals to f within that conditional will continue to select **p**-worlds.

3.2.6 Subjunctives and Interrogatives

Before detailing further consequences of my analysis of subjunctives, I want to address a more idiosyncratic issue. How exactly does that analysis relate to the project of Chapter 2? There, I claimed that *if* contributes the same thing in conditional and interrogative environments. But, extending this semantics to subjunctives encounters a potential difficulty. The *if*-clauses in (3.30) and (3.31) mean very different things.

(3.30) Leland would have danced, if Bob had danced

(3.31) Cooper wonders if Bob had danced (by 11pm last Saturday)

In (3.30), the *if*-clause is about a past, but possibly counterfactual event of Bob dancing. The *if*-clause in (3.31) cannot be about a past event that Cooper believes to be possibly counterfactual. Rather, it is about a past event that Cooper believes to be possible. Indeed, to get any coherent reading of (3.31) a purely past reading of *had danced* must be forced, either by the parenthetical material or context. In this section I will explain this difference not in terms of a difference in *if* but in terms of a difference in what the clause in its scope can coherently be interpreted to mean.

²⁸Morreau (1992) shows that f^p is guaranteed to be a selection function.

Above, I defended the view that the subjunctive reading of *if Bob had danced* in (3.30) arises from interpreting the past tense on *had* as counterfactual expansion. I will now argue that there is no coherent way of doing this in (3.31). The truth of such an interpretation requires a certain condition to hold. However, this condition contradicts something which that interpretation would implicate.

As described in Chapter 2 (§2.5), attitude verbs like *wonder* may be thought of as shifting the evaluation of their complement from the information and issues representing the discourse context to a body of information and issues representing the attitude subject's doxastic state. This was implemented by treating *Cooper wonders* as a relative modality $W_C(\cdot)$ and a sentence like (3.31) was represented as $W_C(\text{if } \mathbf{b})$. This sentence says that Cooper is already entertaining the question $? \mathbf{b}$ and his information does not entail \mathbf{b} . Letting C_f be the body of information and issues representing Cooper's doxastic state in w , $W_C(\text{if } \mathbf{b})$ eliminates worlds w where C_f^w (i) is not already partitioned into \mathbf{b} and $\neg \mathbf{b}$ worlds, i.e. $C_f^w[? \mathbf{b}] \neq C_f^w$ or (ii) entails \mathbf{b} . But as we saw above $\triangleleft \mathbf{b}$ conveys a conflicting message: that some of the relevant \mathbf{b} -worlds are not among the contextual possibilities, in which case $C_f^w[? \triangleleft \mathbf{b}] \neq C_f^w$. After all, $C_f^w[? \triangleleft \mathbf{b}]$ involves updating each cell of C_f^w with $\triangleleft \mathbf{b}$ and at least one of these updates is supposed to bring in a new world. Thus the result cannot include exactly the same partition cells that were there at the outset. And so it is that any use of \triangleleft in an embedded question would convey something that would directly contradict what it would be asserting. Thus, a subjunctive interpretation of the polysemous or underspecified past tense morphology in the *if*-clause of (3.31) is always ruled out on pain of infelicity.

3.3 Two Interesting Results

This section demonstrates that the analysis of subjunctive conditionals developed in §3.2 can explain the two phenomena which have been used to argue for a strict analysis of subjunctives. These phenomena are disjunctive antecedents and reverse Sobel sequences.

3.3.1 Disjunctive Antecedents

Many authors have noted that the Lewis-Stalnaker semantics alone does not yield a satisfying analysis of subjunctive conditionals with disjunctive antecedents.²⁹ While the inference from (3.5a) to (3.5b) sounds impeccable, the Lewis-Stalnaker logic maintains that **SDA** is invalid.

- (3.5) a. If Bob had danced or Sarah had sang, Andy would have cried
 b. So, if Bob had danced, Andy would have cried, and if Sarah had sang,
 Andy would have cried

Simplification of Disjunctive Antecedents (SDA)

$$(\phi_1 \vee \phi_2) > \psi \models (\phi_1 > \psi) \wedge (\phi_2 > \psi)$$

This is not a correctable quirk, but a consequence of the basic idea behind the Lewis-Stalnaker semantics. Suppose that the most similar ϕ_1 -worlds are ψ -worlds, but the most similar ϕ_2 -worlds are $\neg\psi$ -worlds. Since every ϕ_1 -world is a $\phi_1 \vee \phi_2$ -world, it follows that $(\phi_1 \vee \phi_2) > \psi$. SDA would allow it to follow that $\phi_2 > \psi$, but by assumption $\phi_2 > \neg\psi$.

Several responses to this problem have been explored in the literature. Some, like Nute (1975), Warmbrød (1981: §3) and Lycan (2001: 42-6), suggest changing or

²⁹E.g. Fine (1975: 453-4), Nute (1975), Loewer (1976), Ellis *et al.* (1977).

replacing the Lewis-Stalnaker semantics. Others, like Loewer (1976) and Nute (1980), try to address the problem pragmatically. As Warmbrød (1981) and Lycan (2001) observe, their strict-conditional accounts are by far the most successful. Below I will show that the variably-strict analysis developed in §3.2 delivers an equally appealing analysis of disjunctive antecedents.

On the theory advanced in §3.2, (3.5a) corresponds to $(\text{if } (\triangleleft \mathbf{b} \vee \triangleleft \mathbf{s})) \mathbf{a}$. The crucial point is that \triangleleft occurs within *each* disjunct. Recall that the source of counterfactuality \triangleleft , has the syntax of a tense morpheme. As such, it does not take scope over compound sentences but rather attaches directly to a verb. Within a propositional formal language, the best one can do to model this is allowing \triangleleft to attach to literals (atomics and negations thereof). Thus, a disjunctive antecedent does not concern the most similar $\mathbf{b} \vee \mathbf{s}$ -worlds but rather the union — that is what \vee does — of the most similar \mathbf{b} -worlds and the most similar \mathbf{s} -worlds. As a result, $(\text{if } (\triangleleft \mathbf{b} \vee \triangleleft \mathbf{s})) \mathbf{a}$ does *not* test that all of the most similar $\mathbf{b} \vee \mathbf{s}$ -worlds are \mathbf{a} -worlds. Instead, it tests that among the most similar \mathbf{b} -worlds and the most similar \mathbf{s} -worlds there are only \mathbf{a} -worlds. This clearly entails that the most similar \mathbf{b} -worlds are \mathbf{a} -worlds and that the most similar \mathbf{s} -worlds are \mathbf{a} -worlds, and hence that the inference in (3.5) is valid. Indeed, the logic that follows from the semantics in §3.2 delivers:³⁰

Fact 22 (SDA is Valid) For any *literals* α and β

$(\text{if } (\triangleleft \alpha \vee \triangleleft \beta)) \psi \models ((\text{if } \triangleleft \alpha) \psi) \wedge ((\text{if } \triangleleft \beta) \psi)$ (proof in Appendix)

Accordingly, the problem of disjunctive antecedents fades away as an artifact of representing the distinct morphological components of a subjunctive conditional as a single idiomatic connective. There is, however, still one worry that needs to be addressed.³¹

³⁰More generally, if ϕ_1 and ϕ_2 are formulas built up from literals embedded under \triangleleft by \vee and \wedge , then $(\text{if } (\triangleleft \phi_1 \vee \triangleleft \phi_2)) \psi \models ((\text{if } \triangleleft \phi_1) \psi) \wedge ((\text{if } \triangleleft \phi_2) \psi)$.

³¹Yet another is provided by Fine (1975:453-4) who argues that accepting SDA commits one to Antecedent Strengthening, as long as the substitution of equivalents in the antecedents of subjunctive conditionals is allowed. Since \mathbf{p} and $(\mathbf{p} \wedge \mathbf{q}) \vee (\mathbf{p} \wedge \neg \mathbf{q})$ are equivalent, it follows from $\mathbf{p} > \mathbf{r}$ that

McKay & van Inwagen (1977) have claimed that there are counterexamples to SDA, since the inference in (3.32) sounds suspicious.

- (3.32) a. If Spain had fought for the Axis or the Allies, she would have fought for the Axis
- b. # So, if Spain had fought for the Allies, she would have fought for the Axis

But note that (3.32a) really seems to say Spain would never have fought for the Allies. Indeed, the acceptability of (3.32a) is destroyed once the possibility of Spain fighting for the Allies is seriously countenanced.

- (3.33) Spain didn't fight on either the Allied or Axis side. Though she had deep ties to the Axis, she really could have wound up fighting on the Allied side. # But, if she had fought on either side, it would have been the Axis side.

Accordingly, it seems right to say that (3.32a) requires the possibility of Spain fighting for the Allies to be too remote to consider. Thus, the relevant selection function f should deliver $\forall w \in c : f(w, \llbracket \text{allies} \rrbracket) = \emptyset$ (which is only possible if $c \cap \llbracket \text{allies} \rrbracket = \emptyset$).³² Well, if this is the selection function in play then $c_f[\langle \text{allies} \rangle] = \emptyset$. But then $c_f[(\text{if } \langle \text{allies} \rangle) \text{ axis}]$ is undefined, as (3.26) from §3.2.4.2 makes clear. Hence, (3.32) is no more a counterexample to SDA than the instances of contraposition discussed at the end of §3.1 of Chapter 2. It is simply a case where the conclusion's premise is not

$((p \wedge q) \vee (p \wedge \neg q)) > r$, and by SDA $(p \wedge q) > r$. But even though p and $(p \wedge q) \vee (p \wedge \neg q)$ are equivalent, the latter cannot be substituted for the former in $\langle p \rangle$. $\langle ((p \wedge q) \vee (p \wedge \neg q)) \rangle$ is not a well-formed formula, just as it is not possible in natural language to scope a past tense morpheme over, say, a conjunction of tenseless sentences (§3.2.4). While this looks like a violation of the substitutability of equivalents, that is an artifact of the purely propositional syntax. In a first-order setting, \langle would be a predicate modifier taking a predicate as an argument and yielding a complex one. Here there would be no temptation to substitute 'equivalents' of differing syntactic categories.

³²It has recently come to my attention that Warmbröd (1981:284) offers essentially the same observation in his defense of a strict-conditional analysis of subjunctives.

met. This will, of course, involve adopting the Strawsonian definition of entailment advanced there. But that piece of the puzzle is already in place.

This way of handling cases like (3.32) is in possible tension with the fact that (3.34) is possible.³³

- (3.34) a. If Spain had fought for the Axis or the Allies, she would have fought for
 the Axis
- b. If Spain had fought for the Allies, she would have been obliterated by the
 Axis forces in Italy

The antecedent of (3.34b) requires a selection function that delivers some *allies*-worlds. I claimed above that (3.34a) excludes such a selection function. Yet, the sequence in (3.34) is perfectly felicitous. This tension can be alleviated by noting that sequenced conditionals need not appeal to the same selection function. It is most natural to hear (3.34b) as an explanation or argument for (3.34a). (3.34b) seems to achieve this precisely by classifying *allies*-worlds as too remote: in them Spain is obliterated. As such, (3.34b) should not be seen as exploiting the same selection function as (3.34a), but rather justifying the kind of selection function needed to make (3.34a) come out true. It does this by illustrating that *allies*-worlds are just too remote.

3.3.2 Reverse Sobel Sequences

Dynamic strict conditional analyses have been developed to explain the contrast in (3.6) and (3.7) between Sobel sequences and reverse Sobel Sequences (von Fintel 2001; Gillies 2007).

- (3.6) a. If Sophie had gone to the parade, she would have seen Pedro dance

³³I thank James Shaw for bringing this tension to my attention.

- b. But of course, if Sophie had gone to the parade and been stuck behind someone tall, she would not have seen Pedro dance
- (3.7) a. If Sophie had gone to the parade and been stuck behind someone tall, she would not have seen Pedro dance
- b. # But of course, if Sophie had gone to the parade, she would have seen Pedro dance

However, the dynamic variably-strict analysis offered here offers a different explanation of this contrast. This analysis is built on the idea that a phenomena called **modal subordination** (Roberts 1989; Frank & Kamp 1997; Stone 1999) is at work here. Consider (3.35).

- (3.35) a. Your cabin wasn't raided by a coyote.
- b. But if a coyote had raided your cabin, it would have eaten your dinner.
 - c. It would have eaten your meat first.

The anaphoric *it* requires (3.35c) to be interpreted against a background where there is a coyote who entered your cabin and ate your dinner. Since (3.35a) eliminates any such worlds from c , c cannot be this background. What is needed is a hypothetical body of information to which the antecedent and consequent of (3.35b) have been added. The nested contexts built into my analysis of conditionals provides such a body of information. Successfully updating with conditionals like (3.35a), represented (if $\triangleleft c$) d , leave c_f as it was, having guaranteed that all of the most similar coyote-raiding-your-cabin worlds are coyote-ate-your-dinner worlds. However, the subordinate context $c_f[\triangleleft c][d]$ generated by that update remains in the output state of that update. (3.35c) supports this analysis, since it anaphorically targets the subordinate context. While a normal update with a subsequent sentence like (3.35c) targets c_f , a different kind of update targets the subordinate context

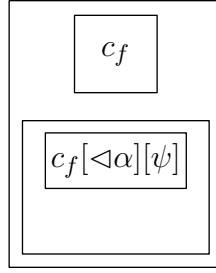


Figure 3.4: The Effect of a Successful Update with $(\text{if } \triangleleft \alpha) \psi$

$c_f[\triangleleft c][d]$. The alternative kind of update I have in mind is what I called Conclusion in Chapter 2 (§2.3, 2.5). In this kind of update the most recently added subordinate context is updated rather than the main context. But, it also tests that the information that update carries was already entailed by the subordinate context.

Definition 31 (Conclusion) Where $s = \langle C, \langle C_0, \dots \langle C_n \rangle \dots \rangle \rangle$:

$$s \uparrow \psi = \langle \{c \in C \mid \langle C_n \rangle \models \psi\}, \langle C_0, \dots \langle C_n, \langle C_n \rangle[\psi] \rangle \dots \rangle$$

On this analysis the intuitive interpretation of (3.35) is $s[\neg c][(\text{if } \triangleleft c) d] \uparrow m$, not $s[\neg c][(\text{if } \triangleleft c) d][m]$.

While the latter is contradictory the former is flawless.

More broadly construed, the idea is that language users track different bodies of information. The intended structure of a given discourse may relate subsequent utterances to the contextual possibilities (C_0) or the most recently introduced hypothetical possibilities (C_n). Understanding when a speaker is relating them one way rather than another will combine linguistic cues, e.g. *would*, with contextual information, e.g. $\neg c$, and general principles of practical rationality. This general way of thinking about the structure of discourse yields a compelling account of modal subordination. I believe it also explains the contrast between Sobel sequences and their reversed counterparts.

Formalized, the Sobel sequence (3.6) comes out as (3.36) and its reversed counterpart (3.7) comes out as (3.37).

$$(3.36) \quad \text{a. } (\text{if } \triangleleft s) d$$

- b. (if $\triangleleft s \wedge \triangleleft t$) $\neg d$
- (3.37) a. (if $\triangleleft s \wedge \triangleleft t$) $\neg d$
- b. # (if $\triangleleft s$) d

According to the semantics advanced above both $s[(\text{if } \triangleleft s) d][(\text{if } \triangleleft s \wedge \triangleleft t) \neg d]$ and $s[(\text{if } \triangleleft s \wedge \triangleleft t) \neg d][(\text{if } \triangleleft s) d]$ are consistent updates. So the semantics by itself does not account for the asymmetry. However, once an alternative structure is countenanced for discourse (3.37), namely $s[(\text{if } \triangleleft s \wedge \triangleleft t) \neg d \uparrow (\text{if } \triangleleft s) d]$, an alternative account is possible. The sequence of changes imposed by this structure does yield inconsistency. On this analysis, this discourse tests whether $c_f[\triangleleft s][\triangleleft t][\neg d][\triangleleft s] \models d$. $c_f[\triangleleft s]$ will deliver a set of s -worlds, some of which may be outside c_f . $c_f[\triangleleft s][\triangleleft t]$ will refine that set to the $s \wedge t$ -worlds. Since c_f was successfully updated with (3.37a), these $s \wedge t$ -worlds must be $\neg d$ -worlds. So updating this set with $\neg d$ has no effect. Updating this set with $\triangleleft s$ will also be ineffectual, since all the worlds in that set are already s -worlds. Clearly this set does not support d since every world in it is a $\neg d$ world. Hence, the test imposed by (3.37) is failed and c_f is reduced to \emptyset , the contradictory body of information. That is why (3.37) is infelicitous. By contrast, (3.36) is consistent no matter how its discourse structure is interpreted.

Additional support for this approach to reverse Sobel sequences: the contrast becomes much sharper when the discourse structure is made explicit with anaphoric pronouns.

- (3.38) a. If Sophie had bought a cupcake, she would have eaten it
- b. But of course, if Sophie had bought it but then dropped it in the sewer,
she would not have eaten it
- (3.39) a. If Sophie had bought a cupcake but then dropped it in the sewer, she
would not have eaten it

- b. # But of course, if Sophie had bought it, she would have eaten it

The occurrences of *it* in (3.38b) must be modally subordinated to the hypothetical context set up by (3.38). This *requires* a discourse structure where the sentences are not simply updated in sequence, but one like Conclusion where the second sentence targets the hypothetical context.

There is a pressing question that this approach must address. If there are two potential discourse structures that can be read into reverse Sobel sequences and one of them is felicitous, why isn't that felicitous interpretation of (3.7) available, particularly since the alternative interpretation is infelicitous? Although there are two structures that can be assigned to a discourse like (3.7), they are not equally plausible. When a possibility involving Sophie going to the parade is evoked and a subsequent sentence also makes reference to such a possibility, there is a strong presumption that the second sentence is commenting on the topic raised by the first. Unless there is something to explicitly defeat this presumption, it will be very difficult to assign a structure to (3.38) where the sentences are simply updated in sequence. But as (Moss 2009: §4) details, there are such cases. Moss imagines a case where the speaker wants to indirectly convey the information that Mary would have turned down a marriage proposal from John.

- (3.40) a. If John had proposed to Mary and she had said *yes*, he would have been really happy
- b. But if John had proposed to Mary, he would have been really unhappy

The antecedents in (3.40) must be about different scenarios. The second scenario of John proposing can't be one where Mary says *yes*. So (3.40b) is not being interpreted against the hypothetical possibilities set up by (3.40) but just the contextual possibilities. This point can be dramatized by witnessing the drastic failure that results from an attempt to anaphorically link a parallel pair of conditionals.

(3.41) Although John was seriously considering a proposal to Mary, he didn't end up proposing. He never even bought a ring.

(3.42) a. If John had offered Mary an engagement ring and she had said *yes*, he would have been really happy

b. # But if John had offered it to Mary, he would have been really unhappy

While (3.40) is a surprise for the von Fintel-Gillies theories, (3.42) is a surprise for Moss's approach. Both are easily handled by the approach here. To be sure, a full comparison of the three approaches would require a lengthier discussion. My emphasis here is that the present analysis of subjunctive conditionals plus independently motivated assumptions about the structure of discourse and modal subordination suffices to explain the phenomena of reverse Sobel sequences.³⁴

3.4 Conclusion

Section §3.3 vindicated a variably-strict analysis in the face of some of the most important empirical challenges it has encountered. In terms of adjudicating between strict and variably-strict analyses this is clearly an important result but my motivations are more general. I have said nothing here about the deepest question about subjunctive conditionals: what about our world makes them true and useful? Within the technical apparatus here, what in the world does f represent and why is it useful to track this? I believe that the best account of f involves interpreting it as tracking

³⁴I should note that the apparatus here also allows one to explain the intuitive validity of many cases of transitivity as well as the asymmetries transitive inferences exhibit. Also, though I have not made any effort to analyze the *would* in the consequent of subjunctive antecedents, it can be represented on my approach as $\Box \triangleleft$. Though I will not elaborate here, it turns out that $(\text{if } \triangleleft \alpha) \beta$ is equivalent to $(\text{if } \triangleleft \alpha) (\Box \triangleleft \beta)$. It is perhaps unsurprising then that $(\text{if } \triangleleft \alpha) (\Diamond \beta)$ yields an analysis of *might*-subjunctives wherein *might* and *would* subjunctives are duals. While this is one of the bragging points of Gillies (2007), it is a controversial thesis that requires further examination.

law-like dependencies between facts. The most successful tools for representing and understanding these dependencies lead one quite directly to a variably-strict analysis (Joyce 1999; Pearl 2000; Thomason 2007). By solving some of the empirical problems for that approach, I hope to have brought us one step closer to addressing the questions about subjunctive conditionals that have made them a justifiably persistent interest of philosophers and cognitive scientists.

Overall, this chapter has demonstrated another fruitful application of the more general idea advanced in this dissertation. The meaning of a sentence resides in the characteristic effect it has on the mental states of language users. Indicative conditionals test that the information compatible with a given state of mind has a certain property: all the antecedent worlds are consequent worlds. Subjunctive conditionals do the same but with respect to information that may be incompatible with that state of mind. Evaluating them involves taking the agent’s view of the world and bending to include a new fact. As I will discuss in the following chapter, this process is intimately related to the process of wishing, commanding and desire-based reasoning about what to do.

3.A Formal Appendix

3.A.1 Counterfactual Expansion

The job of selecting a set of ϕ -worlds most similar to w can be done by a **set selection function** f which maps a world (w) and a proposition (the ϕ -worlds) to a set of worlds (the ϕ -worlds most similar to w).

Definition 32 (Selection Function Constraints) (Let $p, p' \subseteq W$ and $w \in W$)

- (a) $f(w, p) \subseteq p$ **success**
- (b) $f(w, p) = \{w\}$, if $w \in p$ **strong centering**
- (c) $f(w, p) \subseteq p' \ \& \ f(w, p') \subseteq p \implies f(w, p) = f(w, p')$ **uniformity**
- (d) $f(w, p)$ contains *at most* one world **uniqueness**

Remark 5 Stalnaker's theory consists of (a)-(d) while Lewis' — modulo the provision about the limit assumption discussed in note 22 — can be identified with (a)-(c). For both, $\llbracket \phi > \psi \rrbracket_f = \{w \mid f(w, \llbracket \phi \rrbracket) \subseteq \llbracket \psi \rrbracket\}$.

3.A.2 Semantics

Definition 33 (Inquisitive Update Semantics)

Where $C = \{c_0, \dots, c_n\}$, f is a selection function and α is a literal:

- (1) $C[\mathbf{p}] = \{\{w \in c_0 \mid w(\mathbf{p}) = 1\}, \dots, \{w \in c_n \mid w(\mathbf{p}) = 1\}\}$
- (2) $C[\neg\phi] = C - C[\phi]$
- (3) $C[\phi \wedge \psi] = (C[\phi])[\psi]$
- (4) $C[\phi \vee \psi] = C[\phi] \cup C[\psi]$
- (5) $C[?\phi] = C[\phi] \cup (C - C[\phi])$
- (6) $C[\Diamond\phi] = \{c' \mid C[\phi] \neq \{\emptyset\} \ \& \ c' \in C[\phi] \cup (C - C[\phi])\}$
- (7) $C_f[\triangleleft\alpha] = \{\{w' \mid \exists w \in c_0 : w' \in f(w, \llbracket \alpha \rrbracket)\}, \dots, \{w' \mid \exists w \in c_n : w' \in f(w, \llbracket \alpha \rrbracket)\}\}_{f[\alpha]}$

Remark 6 In Definition 33.7 $\llbracket \alpha \rrbracket = \{w \mid \{\{w\}\}[\alpha] = \{\{w\}\}\}$

Chapter 4

The Mark of Mood

4.1 Introduction

These three *sentences* are clearly different.

(4.1) Maya is singing.

(4.2) Is Maya singing?

(4.3) Maya, sing!

They differ in their respective **moods**: *declarative*, *interrogative* and *imperative*. Echoing Hare (1970: 7), I wish to insist that “any complete explanation of the meaning of... a sentence must explain the meaning of its mood.” Yet I wish to deny that this must be done by “specifying the kind of speech act to which that mood is assigned by the conventions that constitute our language” (Hare 1970: 7) or, as (Searle 1969: 30) puts it: “[by having the mood indicate] what illocutionary act the speaker is performing in the utterance of the sentence.” I will therefore be concerned with defending two related theses. First, a sentence’s mood contributes to its compositional semantic meaning in the same way that its tense and other constituents do. Second, a sentence’s mood does *not* directly encode the kind of speech act that is per-

formed by uttering that sentence, i.e. its **illocutionary force** (Austin 1962: 98-100). The point of this second thesis is to rule out meanings for the moods that appeal directly to properties of *speech acts* and instead propose a view where mood and other mediating factors determine illocutionary force. The point of the first thesis is to require meanings for the moods which cohere with a general semantic framework and the conception of meaning it embodies, thereby repudiating Frege's (1918: 294) distinction between *force* and *sense*.

Defending these two theses is just the first step (§4.2.2) in a more elaborate plot. Once they are granted, the existing literature on the semantics of mood provides two main alternatives. The first is **truth-conditional reductionism**: assimilate the semantics of interrogatives and imperatives to familiar truth-conditional models of declarative meaning, e.g. Lewis (1970: §8) and Davidson (1979). The second alternative is **content pluralism**: declaratives, interrogatives and imperatives have different kinds of contents, e.g. Hamblin (1958) on interrogatives and Hausser (1980: §4) on imperatives. In sections 4.2.3 and 4.2.4 I will argue that both approaches suffer from serious conceptual and empirical shortcomings. Yet, these shortcomings also illustrate the strengths of both approaches. The beauty of truth-conditional reductionism is that it employs just one kind of meaning, i.e. truth-conditional content. This presents a uniform picture of what meaning is and seamlessly incorporates non-declaratives into a compositional system. However, this conceptual tidiness does not repay the empirical debt it incurs for homogenizing heterogeneous phenomena. Content pluralism respects this heterogeneity. But, it sacrifices any unifying conception of what meaning is and cannot successfully accommodate sentences with three different kinds of denotata in one compositional system.

In §4.3 I propose a semantics for mood that enjoys these two theory's strengths but eliminates their shortcomings. More specifically, I show that the meaning of all three moods can be conceptualized in the same way: as serving a particular role in

changing the mental states of language users. It is not types of meaning that distinguish them but rather their meaning types: they change an agent's state of mind in importantly different ways. Declaratives add information, interrogatives raise issues and imperatives introduce preferences. This theory maintains an insight that is misarticulated in illocutionary force theories and absent altogether from truth-conditional reductionism and content pluralism: there is something about the meaning of moods that is practical and not representational in character.

Section 4.3.1 sketches three components of a familiar model of intentionality and rational agency: an agent's state of mind embodies (i) *information* by excluding certain possibilities, (ii) *issues* by dividing open possibilities into competing alternatives and (iii) *preferences* by ordering those alternatives. By linking the semantics of each mood to one of these components, I aim to provide a principled explanatory and conceptual foundation for that semantics.

4.2 The Dilemma

It may be tempting to look at written English and assume that the differences between (4.1)-(4.3) are too subtle and covert to have true semantic significance. This tempts the conclusion that they signal purely pragmatic information and therefore lie outside the domain of semantics, e.g. (Dummett 1973:315-6). But closer inspection reveals the extreme naivety of this impression. First, the differences between (4.1)-(4.5) are not so subtle after all. They have glaring differences of word order and inflection, and utterances of them have crucial prosodic differences, all of which are well-known to carry semantic significance. Further, while English uses these means to encode mood, some languages use explicit verbal morphology that mark the mood of every main

and subordinate clause.¹ Indeed, current typological work suggests that English is somewhat of an outlier in lacking mandatory explicit mood morphology or intonation, particularly for the interrogative mood (van der Auwera *et al.* 2008c; Dryer 2008). So to affirm that the indicators of mood have no semantics is to affirm that full paradigms of morphology, intonation and syntactic configuration have no semantics. It is hard to see a principled middle-ground between this and denying that natural language has a semantics.

As mentioned above, mood has diverse realizations. Since no realization comes packaged with a label that allies one realization with another, mood cannot be defined in purely formal terms. Instead, it must be conceived of as a particular pairing of form and function wherein there is relative stability of form and function within a language and relative stability in function across languages. This leads to the question that is at the heart of this paper: *in what terms should we characterize the function of mood?* In reality, this is just to ask how we should specify the meanings of the moods. Ultimately, the moods should not be classified using a pre-theoretic notion of ‘function’ but rather in terms of a semantics for the various sentence types. Semantic convergence of sentence-types from different languages can then be translated into a mature classification of mood. Yet, one must start somewhere. Linguists seem to have made progress in identifying moods by associating them with kinds of speech acts, e.g. (see also Sadock & Zwicky 1985)

...[T]here is a form... which, notionally, simply makes an unqualified assertion... This form is identified as the Declarative. (Palmer 1986:64)

Imperatives... have to do with the expression of a wish of the speaker about a future state of affairs. (van der Auwera *et al.* 2008a)

The second general strategy for signaling polar questions involves the use of distinct

¹Cheyenne (Murray 2010: §2.3) and Kalaallisut (Bittner 2009: §4) are two particularly well-described cases where explicit verbal morphology is used. For more on the semantics of intonation in English see Bartels (1999), Gunlogson (2003), Steedman (2007) and references therein.

interrogative verbal morphology. Most commonly, the verbal morphology may involve an affix that specifically signals that the utterance is a question. . . (Dryer 2008)

There is clearly something to these classifications. After all, they are not arrived at by mere introspection, but rather controlled observations of when it is appropriate to classify certain utterances of certain sentences as assertions, expressions of wish or queries. I therefore propose to take them as my starting point for theorizing about mood and suspect that a mature semantic theory will vindicate them. Indeed, vindicating or contravening these classifications is necessary to answer a pressing foundational question: what is the relationship between a sentence's type and the illocutionary force(s) of its utterances?

A simple answer to this question is that a sentence's mood, and mood alone, determines illocutionary force. This is Searle's (1969) position which is criticized in §4.2.2. A more nuanced answer is that there is a *characteristic* kind of speech act that can be associated with each mood. But, since a sentence's meaning is only one of the factors at play in speech acts, employing that meaning does not inevitably lead to a particular kind of speech act. Nonetheless a *characteristic* illocutionary force can be associated with each mood. This fact, among others, will also be used in §§4.2.3 and 4.2.4 to argue against truth-conditional reductionism and content pluralism. It shown that they either fall into Searle's untenable position or an equally simple and inadequate one: a sentence's mood in *no way* determines the illocutionary force of its utterances.

4.2.1 Preliminary Details

Before moving on, I need to comment on two linguistic details. Even though English forgoes explicit morphological mood markers, I am going to assume the syntactic structures that are to be interpreted contain mood morphemes. As noted above, there are languages that conform to this convenient model. But I will not be able to

determine here whether it is appropriate to analyze every English sentence as having a covert mood morpheme or encoding mood in a more multi-modal combination of intonation, inflection and structure. Most authors have taken the former route.² While there is strong evidence that the declarative sentence form and a particular intonation encode the declarative mood (e.g. Pierrehumbert & Hirschberg 1990: 286; Bartels 1999: Ch.3), the current research on intonation is not conclusive and suggests that it may not be right to think that intonation alone can encode mood (Gunlogson 2003; Hirschberg 2004: §5.4).

Another detail worth commenting on is that the three-way distinction between imperative, interrogative and declarative mood does not cover all of the distinctions that natural languages make. Although that three-way distinction appears to be universal, many languages subdivide the moods into more nuanced flavors, and there are a few outlying constructions like exclamationatives that are controversial (cf. Zanuttini & Portner 2003 vs Rett 2008). One example of the former: English imperatives can be carved into four categories that often correspond to four distinct morphemes (van der Auwera *et al.* 2008a; Dobrushina *et al.* 2008; van der Auwera *et al.* 2008b). First, there are **optative** uses like (4.4) that concern a desired state of affairs but don't appeal to the addressee to bring it about. Second, there are pure imperative uses like (4.5) that do involve such an appeal and it is the addressee alone that is appealed to. Third, there are **hortative** uses like (4.6) and (4.7) that also involve an appeal but don't appeal to the addressee(s) alone.

(4.4) May he sing!

²E.g. Katz & Postal (1964), Rizzi (1997), Cinque (1999) and virtually all of the specific literature on the semantics of interrogatives either implicitly (e.g. Hamblin 1973; Karttunen 1977) or explicitly (e.g. Higginbotham 1993, 1996). Proponents of the 'force-radical' picture have done so as well (e.g. Stenius 1967; Searle 1969; McGinn 1977), as have those that pursued the 'performative reduction' (e.g. Lewis 1970; Cresswell 1973). Han's (2001) recent work on imperatives follows suit.

(4.5) Sing!

(4.6) Let's sing!

(4.7) Let him sing!

(4.8) Don't let him sing!

Fourth, there is a **prohibitive** use in (4.8). I will not aim to show how these distinct uses could be formulated as distinct operators. However, I will endeavor to define an English imperative operator that is flexible enough to capture all four uses and laud this as a point of superiority over competitors. It will unfortunately be entirely beyond the scope of this work to discuss the many other fascinating specializations of mood.

4.2.2 Mood as a Force Operator

The first account to be considered was inspired by Frege's (1918:293-4) distinction between *sense* and *force*. After defining thoughts as senses for which the question of truth can arise, he says:

One does not want to deny sense to an imperative sentence, but this sense is not such that the question of truth could arise for it. Therefore I shall not call the sense of an imperative sentence a thought. . . . An interrogative sentence and an indicative one contain the same thought; but the indicative contains something else as well, namely, the assertion. The interrogative sentence contains something more too, namely a request. Therefore two things must be distinguished in an indicative sentence: the content, which it has in common with the corresponding sentence-question, and the assertion.

Indeed, Frege went so far as to include notation in his *Begriffsschrift* to codify the distinction: $-\phi$ to mark a judgeable content, $\vdash \phi$ to mark the assertion of that content, and $\Vdash \phi$ to stipulate the truth of that content for the purposes of definition (Frege 1893: §5, §27). This is just to distinguish between an act of thought and the

content of that act. Frege (1923:2-3) observed that once this distinction is drawn it is incoherent to conjoin both assertions and thoughts. If conjunction is a logical operation and logic concerns thoughts then conjunction must operate on thoughts, not assertions.

While Frege was interested in natural language only as it intersected his project of designing and applying his *Begriffsschrift*, Austin and Searle were concerned with the study of natural language in its own right. In his pioneering study on performatives and speech acts, Austin (1962:98-109) developed the idea of an **illocutionary act**, which is not an act *of* saying something, but an act of doing something *by* saying something, i.e. informing, ordering, warning, etc. He factored the identity of these acts into their sense and force, the latter being its function in whatever activity the speech is situated. In systemizing Austin's ideas, Searle (1969:30) upholds the distinction between the force of "the illocutionary act and the propositional content of the illocutionary act", but boldly links it to the semantics of natural language by distinguishing two

...elements in the syntactical structure of the sentence, which we might call the propositional indicator and the illocutionary force indicator. The illocutionary force indicator shows how the proposition is to be taken, or to put it another way, what illocutionary force the utterance is to have; that is, what illocutionary act the speaker is performing in the utterance of the sentence. Illocutionary force indicating devices in English include at least: word order, stress, intonation contour, punctuation, the mood of the verb and the so-called performative verbs.

It is helpful to spell this out as a concrete semantic proposal, which assigns meanings to linguistic units.³ On this approach, a semantics for natural language consists in pairing each mood marker with an illocutionary force and each mood-free 'radical' with a proposition. Searle (1969: Ch.3) goes on to propose that to have a certain force

³Searle never offered such a proposal, but he was no skeptic of sentence-meaning and freely admitted that it constrained speaker-meaning.

and propositional content is to have certain *conditions of satisfaction*. But, while a propositional content's conditions of satisfaction are truth-conditions, a force's conditions of satisfaction are of an entirely different kind, call them *force conditions*. Unlike truth-conditions, force-conditions are determined by cultural rules which stipulate what it is to perform a particular kind of act, e.g. a promise. These rules are akin to those that stipulate which happenings constitute a touchdown in football or a move of chess. Thus:

The fact that in French one can make a promise by saying *Je promets* and in English one can make it by saying *I promise* is a matter of convention. But the fact that an utterance of a promising device (under appropriate conditions) counts as the undertaking of an obligation is a matter of rules and not a matter of the conventions of French or English. (Searle 1969: 40)

This thesis about the semantics of mood is the genesis of Searle's thesis that "speaking a language is engaging in a rule-governed form of behavior," and objecting to the characterizations of linguistic meaning offered by Lewis (1969, 1970), Davidson (1967) and Montague (1970b). On Dummett's version of this theory,

...to grasp what it is for a sentence to carry a particular force is to be master of a practice — of what Wittgenstein called a language-game, which has to be learned and whose existence depends upon a common participation in it by the speakers of the language. (Dummett 1976a: 216)

Stenius (1967) develops a similar view wherein each mood's meaning is given by a rule governing a linguistic exchange. For example, the interrogative mood is paired with the following rule:

(4.9) Answer the question by 'yes' or 'no', according as its sentence-radical is true or false (Stenius 1967: 273)

So much for exegesis of the basic view. Can it yield a satisfactory analysis of the moods of natural language? Even without considering the particular analyses of the moods that are on offer, epic difficulties will emerge.

In natural languages, moods can take scope under connectives. But, as Frege observed, connectives cannot simultaneously operate on propositions and illocutionary acts. Pace Dummett (1973: 336), this is evident even with conjunction.

(4.10) a. Paint and don't paint a picture!

b. Paint a picture and don't paint a picture!

(4.11) a. Are Frenesi and Zoyd coming?

b. Is Frenesi coming, and is Zoyd coming?

(4.10a) might be called an *imperative contradiction*. It issues an impossible command, to which one should reply: *I can't do that!* (4.10b) deserves the name *imperative dilemma*, since it issues two conflicting commands to which one should reply: *Well which one will it be!?* Similarly, one can conclusively answer (4.11a) with *No, Zoyd decided to stay home*, while this is at best an incomplete answer to (4.11b). To make matters worse, different moods can be conjoined.⁴

(4.12) You look in the library and I'll look in the lounge

(4.13) You look in the library or I'll look in the lounge

(4.14) Gabe ate, but did Josh eat?

(4.15) Karen is in Brooklyn, or is she in Montreal?

Disjunctions also provide conclusive evidence.

(4.16) (You are prohibited from doing both of your chores.) So, either don't mow the lawn or don't water the lawn

⁴Note that (4.12) is not the kind of conjunction that favors a conditional reading, e.g. *Eat that frog and you'll be sorry*. I shall have something more to say about those cases later. Note also that it is not cheating to involve the commas and corresponding pauses in (4.14) and (4.15). There is a tight connection between intonation and mood, so it is no surprise that clearly distinguished intonational contours are needed to combine moods.

(4.17) Don't mow or water the lawn!

(4.18) a. Did you mow or water the lawn?

(without contrastive focus on *mow* and *water*)⁵

b. Yes

(4.19) a. Did you mow the lawn or did you water the lawn?

(without contrastive focus on *mow* and *water*)

b. #Yes

Conditional interrogatives and imperatives raise an interesting issue. Dummett (1973: 338-48) labors at length to argue that conditionals like (4.20) and (4.21) involve a force operator scoping over a declarative conditional.

(4.20) If Zoyd comes, hide your prescription drugs!

(4.21) If Zoyd comes, will you hide your prescription drugs?

But this maneuver is pointless, regardless of whether it yields a plausible interpretation. Languages with verbal mood morphemes tag the verb in each main clause with the imperative or interrogative morpheme. Since these morphemes operate on the *verb*, no question of 'two sentential scopes' can arise. They simply have to be interpreted where they appear. Dummett's considerations aim to show the implausibility of treating (4.20) as making a command when the antecedent is true and saying nothing when the antecedent is false. This implausibility should not be avoided by giving the imperative mood wide scope, but rather by maintaining the imperative mood does not directly encode the force of a command. We need to explain how the

⁵Intonation is key with disjunctions and interrogatives. Without contrastive focus on *mow* and *water* (4.18) is synonymous with *Is it the case that you mowed or watered the lawn?* This can be answered with *yes*, whereas that is not a complete answer to (4.19). The inquisitor would respond *Yes you mowed? Or, yes you watered?*

mood in the consequent compositionally interacts with the antecedent to yield a *conditionalized imperative*. Similarly, any equivalences between disjoined verb or noun phrases and disjoined sentences need to be explained, not stipulated syntactically.

One last data point comes from Karttunen (1977:32) who noted that quantifiers often appear to scope over the interrogative operator.

(4.22) a. What grade does each student deserve?

b. Abe deserves a D, Betty deserves an A and Carl deserves an A

(4.23) For each student x : what grade does x deserve?

Engaging in a bit of wishful thinking and reasoning from false generalizations about impoverished data, Dummett (1973:348) grants that sometimes force-operators appear to take scope under connectives but contends that they are interpreted in an ad hoc way and cannot systematically embed in even larger constructions. To the contrary, there are quite systematic patterns here that yield predictable results. The fact that every instance of each possible combination does not yield a natural sentence is more plausibly attributed to the fact that the different moods serve different discourse functions which do not always nicely cohere. When this is scaled up to multiple connectives, limits of intelligibility, which also exist in complex declaratives, are proportionally scaled up. The force-operator approach is in trouble, but there's one last hope.

Surprisingly, Searle (1969:32-3) fully embraces force-operators occurring under the scope of connectives. In fact, he offers these occurrences as evidence for his doctrine of force-indicators in natural language. How does he circumvent Frege's observation? He analyzes an illocutionary force in terms of a set of conditions of satisfaction, which spell out the necessary and sufficient conditions for having successfully performed a certain kind of speech act. These conditions are specified "as a set of propositions such that the conjunction of the members of the set entails the proposition that

the speaker made a successful and non-defective” speech act (Searle 1969: 54). For examples, the act of a speaker *S* asking a hearer *H* the question *Is Paris pretty?* is analyzed in terms of the following conditions of satisfaction:

(4.24) **Questioning** (Searle 1969: 66)

- a. *S* does not know if it is true that Paris is pretty (*preparatory*)
- b. *S* wants to know this information (*sincerity*)
- c. *S*’s utterance counts as an attempt to elicit this information from *H*
(*essential*)

This kind of treatment allows one to extend the truth-conditional analysis of connectives to illocutionary acts. For example, a conjunction of questions will just conjoin the conditions of satisfaction of each question. This certainly solves the problem, since a sentence containing a force operator $F(p)$ is, in effect, treated as shorthand for the conjunction of its conditions of satisfaction: $Prep(p) \wedge Sinc(p) \wedge Ess(p)$. So the conjunction of two such sentences is unproblematic.⁶ But this is a really a form of truth-conditional reductionism. Force turns out to be constructible from propositional contents and in reality all speech acts involve proffering a conjunction of those propositions. This form of reductionism is even less plausible than the versions I will consider later in §4.2.3. Unlike those accounts, it offers no principled explanation of why non-declaratives are not truth-evaluable.

I have not yet mentioned two of the force-operator approach’s most serious failings. These failings will be relevant to the construction of an adequate theory and to the evaluation of other approaches, so persistence here is not purely sadistic. One of these failings also concerns embeddings. Mood morphemes embed under attitude

⁶The fact that this is the format of Searle’s analysis becomes even more evident when he attempts to formalize it (Searle & Vanderveken 1985). This work, titled, *The Foundations of Illocutionary Logic*, would be more aptly titled *The Foundations of Some Abbreviations within Classical Logic*.

verbs. The problem is not just that they embed but that they do not indicate the force of a *speech act*.

(4.25) Junior wondered **whether** Jonah was home

In uttering (4.25) I do not ask a question. For those who might deny that *whether* is an interrogative mood marker, it is relevant to note that English once used *whether* also as the marker of unembedded interrogatives (Allen 1980). This is not a historic or rare pattern. The polar interrogative morpheme *li* in Bulgarian (Rudin *et al.* 1999: 543, 580) is one among many other examples.

Though it has traditionally been claimed that imperatives do not embed (e.g. Sadock & Zwicky 1985), this is far from clear. Pak *et al.* (2004) discuss constructions in Korean which, though differing morphologically from root imperatives, seem to qualify as embedded imperatives. Rus (2005) demonstrates conclusively that Slovenian embeds imperatives. As Rivero (1994) notes, the Spanish infinitival *A correr!* (*lit. To run!*) is often the preferred command-issuing root clause and can embed under numerous verbs with the marker of indirect discourse *que*. Though dated, English permits the use of *To run!* as a root clause, but it has an optative meaning, i.e. it expresses the speaker's wish to run. When this clause is embedded it seems capable of either an imperative or an optative meaning: *John was ordered to run* vs *John wanted to run*. It might even be plausible to think of English infinitives like (4.26) and (4.27) as embedded imperatives.

(4.26) John ordered that you go

(4.27) a. John ordered you to go

b. John wants you to go

So although root and putative embedded imperatives often have differences in form, it is undeniable that at least a semantic analog of embedded imperatives exist in

natural language. To claim that subordinate clauses cannot contain mood morphemes is simply to hide one's head in the sand.

The force-operator approach says that mood indicates force. Yet, mood alone does not seem to determine force, at least if *force* is meant to classify a speech act. After all, classifying speech acts involves appealing to the intentional, social and physical context of an utterance. The literature has offered many cases aimed at illustrating this, and Davidson (1979: 110) mentions the most common ones. He says that someone can ask a question by uttering *I'd like to know your telephone number* or *Tell me who won the race* or issue a command with *In this house we remove our shoes before entering*. Similarly, he suggests that one can make an assertion by uttering *Did you notice that Joan is wearing her purple hat again?* or *Notice that Joan is wearing her purple hat again*. He also contends that declaratives issued in pretense, fiction, humor or sarcasm do not constitute assertions. Now, at the time Davidson was writing Searle had already offered analyses of these cases, so it is a bit puzzling that Davidson did not discuss Searle's analyses.⁷ But I shall not discuss these analyses either because I do not think the data they cover are essential to showing that Searle's thesis about the connection between mood and force is wrong. Consider instead that a friend may offer advice by saying *Do 12 hours of community service per month* while a judge could use the same sentence to issue a command. Similarly, a declarative like *This is John Searle* can be used as a true assertion to identify Searle but also performatively to baptize Searle with his name. The interrogative sentence *Where is Tunisia?* can be used to ask a more informed party for the correct answer, or to identify a topic of mutual ignorance among the conversationalists or to test the hearer's geographical knowledge. How can Searle account for this illocutionary

⁷Davidson (1979) was written in 1976, while indirect speech acts and fictional discourse are the topics of Searle (1975a,b).

diversity?

Searle frequently says that mood indicates force (Searle 1969: 30), but occasionally he says that mood together with context determine force (Searle & Vanderveken 1985: 2-3). So perhaps the mapping from mood to force can be made context-sensitive on analogy with Kaplan's (1978) semantics for indexicals. First, I will catalogue the variability and then consider accommodating it as a species of context-sensitivity. Consider the Tunisia example. Searle (1975a: 13) treats interrogatives as a kind of *directive*, since their utterance is said to count as an attempt to get the hearer to answer the question (this is their *essential condition* or *illocutionary point*).⁸ But even this is subject to counterexample. As I mentioned above, interrogatives can be used purely to identify a topic of mutual ignorance. Suppose we are the hotshots of the geography class and commune after class to compare exam grades. We all got 99% because we did not know where Tunisia was. Later in the evening, under the bliss of drink I proclaim that we know everything about geography. Your utterance of *Really, where is Tunisia?* would not be an attempt to get me to tell you where Tunisia is, but rather to identify the fact that there's something we don't know about geography. The preparatory condition of an interrogative is said to be that the speaker does not know the answer (Searle 1969: 66). The use of interrogatives in exam settings is a counterexample to this and the sincerity condition, which is that the speaker wants to know the answer (Searle 1969: 66). In the exam case, the preparatory condition seems to be that I know the answer and the sincerity condition seems to be that I want to know whether you know the answer.

⁸Scholars of Searle's opus will note that illocutionary forces are actually made up of seven components: (1) *illocutionary point*, (2) *degree of strength of illocutionary point*, (4) *propositional content conditions*, (5) *preparatory conditions*, (6) *sincerity conditions* and (7) *degree of strength of sincerity conditions* (Searle & Vanderveken 1985: Ch.1, §3). Interrogatives are only constrained by (1), (5) and (6) so I will ignore the rest in my discussion above.

So, all three of the main conditions of satisfaction can vary. Now consider which features of context they vary with. In the geography hotshots case, the actual illocutionary point was that we don't know the answer. What feature of the context made this point effective? Well, the fact that none of us knew the answer. Now, what is it that is distinctive about exam contexts that could be responsible for the shift in preparatory conditions? Well, the fact that in exam situations the examiner knows the answer. What about the sincerity conditions? It is the fact that the examiner wants to know whether the examinees know the answer. I hope the problem is now evident. Searle's various *conditions of satisfaction* just are relevant components of the context, so there is no way to write down any synoptic mapping from contexts to them. All one can come up with is a list of different forces. Further, each major component of each force on that list can vary and the only common theme to the variation in our example was that answers were involved. So it seems that it wasn't really the separation of forces into various conditions of satisfaction that tracked what was distinctive about interrogative meaning at all. This demonstrates a fundamental difficulty for specifying the meaning of moods in terms of force. Force varies with context but in a large part, force *is* context so there will be no regularities in that variation that can be captured by writing down a function from contexts to forces. Since the meanings of mood are what's responsible for the regularities in the mood-force mapping, they aren't forces and they certainly are functions from contexts to forces.

Let me summarize. Even putting aside fictional discourse, metaphor and indirect speech acts, there is not a direct mapping from mood to force. Indeed, each of the three main components of force can vary. Since the force of a speech act is largely *constituted* by the context it occurs in, there will be no regularities that can be captured in a mapping from contexts to forces. The goal of a semantics of mood is to capture the regularities in the mood-force mapping, so that semantics must not be

a mapping from contexts to forces. This problem, together with the two embedding problems, show that the force-operator approach is mistaken. With these failures in mind, I will move on to consider the existing alternatives.

4.2.3 Truth-Conditional Reductionism

4.2.3.1 The Performative Analysis

The first version of truth-conditional reductionism that I will consider is called the **performative analysis** and is defended by Ross (1970), Lewis (1970: §8) and Cresswell (1973: Ch.14). Any theory which attempts to reduce every sentence to a declarative must explain why non-declaratives are not capable of truth or falsehood. The performative analysis takes a creative angle on this issue. It begins by pointing out that **performatives** like (4.28) are grammatically declarative yet resistant to evaluation for truth.

- (4.28) a. I do take this woman to be my lawful wedded wife
 b. I name this ship the Queen Elizabeth
 c. I give and bequeath my watch to my brother

Indeed, Austin (1962: 5-6) says that “[n]one of the utterances cited is either true or false: I assert this as obvious and do not argue for it.” As Lewis (1970: §8) notes, preventing the assignment of propositions to declarative sentences like (4.28) would be a serious obstacle for a compositional semantics of English. Lewis (1970: 59) contends that performatives do have truth-values but these are easily ignored “because it is hard for a performative to be anything but true.” And, since the point of the utterance is not that it is true but that the speaker is making it true, it is no surprise that this trivial truth-value is eclipsed altogether. As Lewis (1970: 59) puts it “To utter *I am speaking* is to speak, but it is also to speak the truth.” With this view of

performatives in hand the basic performative analysis can be stated simply. Each non-declarative below is transformed into the b-relative below it before it is interpreted by the semantic rules.

(4.29) a. Dance, Maya!

b. I command Maya to dance

(4.30) a. Is Maya dancing?

b. I ask whether Maya is dancing

Thus non-declaratives are genuinely treated as abbreviations for declaratives. Yet, since the declaratives they abbreviate are performatives, they resist being evaluated for truth.

One difficulty for this approach is that the framework and assumptions of transformational grammar it depends on have long been discredited, since they were ultimately seen to yield grammars of unlimited generative capacity. There are also some clear worries about claiming that (4.29a) and (4.29b) are synonymous. I can issue (4.29b) to my henchman for relay to Maya, but (4.29a) has no such use. Further, imperatives have a wide range of uses which will be obscured by the transformation. The offer *Have a banana!* will come out as *I command you to have a banana*. The optative *Rain!* will come out as *I command you to rain* and the hortative *Let's dance* as *I command you to let's dance*. Finally, the prohibitive *Don't let Maya dance* comes out as *I command you to don't let Maya dance*. Yet, the major difficulties are still to come!

Recall from §4.2.2 that *whether* in Old English and *li* in Bulgarian instantiate a common pattern of using the same marker in embedded and root interrogatives. Consider how the analysis in (4.30) would apply to Old English. A root *whether* interrogative would be turned into an embedded *whether* interrogative. It is clear why this fails as a semantic analysis of the interrogative *whether*-morpheme, and in

reality modern English is no different. By paraphrasing a root interrogative in terms of an embedded interrogative the performative ‘analysis’ just pushes the problem back. We now need an analysis of the embedded occurrence that doesn’t treat it as a performative since that would lead to an infinite regress. So the performative analysis has no analysis of interrogative morphemes after all. The same will be true for its attempt to analyze the imperative mood.

Consider further the status of declarative mood markers in the performative analysis. If $\text{DEC}(S)$ is analyzed in the same way it will come out as something like *I assert that S'* . But this is doubly problematic since it gets the truth-conditions of $\text{DEC}(S)$ wrong and itself will contain an additional declarative morpheme that will set off an infinite regress. So the performative analysis must refuse to assign meanings to the world’s declarative mood morphemes. That property alone discredits the theory, but taken together with the other problems recounted above there is sufficient reason to declare the performative analysis a failure.

4.2.3.2 The Paratactic Account

Davidson (1979) does not present a full-fledged semantics for mood but gestures at an impression of one. Summarizing the view would require filling it out, so I will simply quote the key passages.

We may think of non-[declarative] sentences... as [declarative] sentences plus an expression that syntactically represents the appropriate transformation; call this expression the *mood-setter*. And just as a non-[declarative] sentence may be decomposed into [a declarative] sentence and a mood-setter, so an utterance of a of a non-[declarative] sentence may be decomposed into two distinct speech acts, one the utterance of [a declarative] sentence and the other the utterance of a mood-setter. (Davidson 1979: 119)

If we were to represent in linear form the utterance of, say, the imperative sentence *Put on your hat*, it would come out as the utterance of a sentence like *My next utterance is imperatival in force*, followed by an utterance of *You will put on your hat*. This suggests the semantic situation, but syntax makes it wrong. The mood-setter cannot be any actual sentence of English, since it represents a certain transformation. I do

not want to claim that imperative sentences are two indicative sentences. Rather, we can give the semantics of the utterance of an imperative sentence by considering two specifications of truth conditions, the truth conditions of the utterance of an indicative sentence got by transforming the original imperative, and the truth conditions of the mood-setter. The mood-setter of an utterance of *Put on your hat* is true if and only if the utterance of the indicative core is imperatival in force. (Davidson 1979: 120)

... If I am right, the utterance of a non-[declarative] sentence cannot be said to have a truth value. For each utterance of a non-[declarative] has its mood-setter, and so must be viewed semantically as consisting in two utterances. Each of the utterances has a truth-value, but the combined utterance is not the utterance of a conjunction, and so does not have a truth value. (Davidson 1979: 121)

Insofar as the contours of this impression are intelligible, they are wrong. Davidson says that we *can* give the semantics of an imperative by *considering* the truth-conditions of two utterances. But how exactly? What operation does ‘considering’ amount to? It can’t be a truth-conditional operation, because it cannot output a truth-value. So whatever ‘considering’ involves it will be a different kind of interpretive process than applying a truth predicate. So, unlike the performative analysis, the meaning of a non-declarative cannot be explicitly stated in a truth-theory.⁹ This is not a reduction of non-declarative meaning, it’s a denial! Further, stating non-declarative meanings implicitly in this manner requires the quizzical dictum that an imperative utterance is actually composed of one declarative utterance and one utterance of an unspecified (unspecifiable?) sentence type. Neither component contains the utterance of a non-declarative morpheme, so the *existence of such utterances* is ultimately also denied.

⁹Lepore & Ludwig (2007b: 270-1) suggest that maybe there can be some kind of syntactic transformation rule that maps non-declaratives to it’s mood-setter and core before the truth-theory is applied. But if the theory itself is going to explicitly interpret the non-declarative, it will have to somehow synthesize and record the evaluation of these two truth-conditional components. Since this synthesis can’t generate a truth-value, the theory must involve some kind of interpretation that is not truth-conditional.

Declarative morphemes pose another problem. At the outset, Davidson (1979: 119) assumes that there are no declarative mood morphemes. If there were, he'd be committed to the ridiculous to claim that an imperative consists of an imperative morpheme and a declarative one, since non-declaratives are composed of a mood-setter and a declarative. Also, since one of the sentences by which we understand a sentence with mood is a declarative, the same regress that plagued the performative analysis will result. There are declarative morphemes, so Davidson's theory must be altered.

One idea is to make both the mood-setter and the transformed core moodless. But this actually makes matters worse. First, Davidson's truth-theory needs to apply to utterances of the mood-setter and the core. Since these are moodless, that means that the truth-theory can apply to ungrammatical utterances. So each of our apparently singular grammatical utterances turns out to be two ungrammatical utterances! Second, if the mood-setter and core are moodless then the force of their utterance is unconstrained, so it should be possible for an utterance of *Go home* to have a force that corresponds to *Is my next utterance imperatival in force? You will go home?*, whatever that may be. Third, and most decisively, this alteration would require Davidson to accept that declaratives don't have truth-values. Recall, he says that non-declaratives don't have truth-values because their utterances involve two utterances.

These difficulties in formulating Davidson's proposal stem from its most basic features so its prospects for improvement are discouraging. But even if they could be overcome, Davidson's theory would not be worth applying to natural language. His method of treating non-declaratives as an anomalous combination of two expressions prevents it from applying to the mood morphemes that occur in the scope of connectives, attitude verbs and subordinate clauses more generally (cf. §4.2.2). Further, the theory leaves force and mood entirely unanalyzed and thereby accomplishes nothing in explaining how mood constrains force. Davidson thought this was a great virtue

since he held that virtually any speech act could be performed with a given sentence type. But more careful consideration of so-called indirect speech acts makes clear that not just any sentence is available for indirect uses and there are complicated layers of intonation and pragmatic reasoning involved.

4.2.4 Content Pluralism

Belnap (1990:5) states the central thesis of content pluralism perfectly:

Strict avoidance of the Declarative Fallacy... requires the recognition that interrogatives and imperatives are not just marked differently from declaratives but possess fundamentally different underlying content structures.

Yet, this approach to the semantics of mood has not developed as the organized program of one author, but rather as the evolving credo of researchers in formal semantics. The basic details were already outlined in one of the founding documents of formal semantics:

In connection with imperatives and interrogatives truth and entailment conditions are of course inappropriate, and would be replaced by fulfillment conditions and a characterization of the semantic content of a correct answer. (Montague 1973:n3)

Montague's proposal to treat the meaning of an interrogative in terms of its **answerhood conditions** is originally due to Hamblin (1958:162): "knowing what counts as an answer is equivalent to knowing the question." Hamblin (1973) and Karttunen (1977) synchronized this proposal with Montague's framework by treating propositions as sets of possible worlds (or equivalently as functions from worlds to truth-values), answers as propositions and questions as sets of propositions (or equivalently as functions from propositions to truth-values). Thus, the basic idea is to treat the content of an interrogative as a set of propositions, namely the set of propositions

that count as complete and direct answers to that interrogative.¹⁰ It is now standard to refer to this kind of content as a **question**, reserving the term *interrogative* for its linguistic analog. So the question listed in (4.31b) is the content of the interrogative (4.31a), S being the worlds where Maya is singing and \overline{S} its complement.

- (4.31) a. Is Maya singing?
 b. $\{S, \overline{S}\}$
 c. Maya is singing
 d. S

The corresponding declarative (4.31c) is assigned the propositional content (4.31d). This proposal allows one to formulate an explicit proposal about what interrogative mood means. It takes a proposition and yields a question, in this case the question will contain the original proposition and its negation.¹¹ The proposal can account for the use of interrogative phrases under attitude verbs by saying that e.g. *wonder* expresses a relation between an agent and a question. Additionally, the theory has a principled account of why interrogatives are not truth-evaluable. To be true, a semantic object must not exclude the actual world. To be false, a semantic object must exclude the actual world. Since a question is not in the business of excluding worlds, but rather propositions, it is not capable of truth or falsity. Finally, the theory avoids conflating mood and force. Before discussing imperatives, I will raise two challenges to the current component of the theory.

The pluralist approach to interrogatives precludes the assignment of a meaning to the declarative mood. The moodless component involved in the composition of an

¹⁰Karttunen (1977) restricts this to *true answers*, but for no real gain. Groenendijk & Stokhof (1982) blend the two proposals to capture various entailments.

¹¹In what follows I will discuss only polar (aka yes/no) interrogatives. But the theories discussed and issues faced apply to content (aka *wh*) interrogatives as well. However, some complications would be necessary to discuss the formulation of interrogative morphemes for content interrogatives.

interrogative is a proposition. If the declarative mood were required to build propositions, absurdity would result: interrogatives would need to contain a declarative morpheme. Since natural languages have declarative mood morphemes and intonation, there are legitimate linguistic meanings that the pluralist theory cannot render.

The occurrence of mood morphemes under connectives (cf. §4.2.2) also presents challenges. To render the meaning of a conditional with a declarative consequent, one must treat the conditional as a binary operation on propositions. But when an interrogative occurs in the consequent a different operation is needed. (4.32) and (4.33) suggest that union gives the right results for both the disjunction of interrogatives and declaratives.

(4.32) a. John mowed the lawn, or John watered the lawn.

b. $M \cup W$

(4.33) a. Did John mow the lawn, or did John water the lawn?

b. $\{M, \overline{M}\} \cup \{W, \overline{W}\} = \{M, \overline{M}, W, \overline{W}\}$

But intersection does not work for conjoining interrogatives, as (4.35) attests.

(4.34) a. John mowed the lawn, and John watered the lawn.

b. $M \cap W$

(4.35) a. Did John mow the lawn, and did John water the lawn?

b. $\{M, \overline{M}\} \cap \{W, \overline{W}\} = \emptyset$

One option is to ‘raise the type’ of declaratives to singleton sets of propositions and use pointwise intersection \mathbb{M} . This will be necessary anyway to accommodate a mixed example like (4.14a) from §4.2.2.

(4.14) a. Gabe ate, but did Josh eat?

b. $G \cap \{J, \overline{J}\} = \emptyset$

$$c. \{G\} \cap \{J, \bar{J}\} = \{G \cap J, G \cap \bar{J}\}$$

Pointwise intersection also delivers the right results for pure conjunctions.

(4.36) a. John mowed the lawn, and he watered the lawn.

$$b. \{M\} \cap \{W\} = \{M \cap W\}$$

(4.37) a. Did John mow the lawn, and did John water the lawn?

$$b. \{M, \bar{M}\} \cap \{W, \bar{W}\} = \{M \cap W, M \cap \bar{W}, \bar{M} \cap W, \bar{M} \cap \bar{W}\}$$

But disjunction can no longer be treated as union, since that would make (4.32a) come out as a question and hence not truth-evaluable: $\{M\} \cup \{W\} = \{M, W\}$.¹² Moving to pointwise union yields the wrong answerhood conditions for (4.33a): $\{M, \bar{M}\} \cup \{W, \bar{W}\} = \{M \cup W, M \cup \bar{W}, \bar{M} \cup W, \bar{M} \cup \bar{W}\}$. This would wrongly predict that (4.38b) is a complete answer to (4.33a), repeated as (4.38a).

(4.38) a. Did John mow the lawn, or did John water the lawn?

b. John mowed or watered the lawn

(4.18) Did John mow or water the lawn?

(without contrastive focus on *mow* and *water*)

This conflates (4.38a) and (4.18) from §4.2.2. Avoiding such conflation was one of the motivations of the pluralist view. Evidently, even the resources of that view are insufficient for analyzing disjoined and conjoined interrogatives.

I will now turn to the pluralist's treatment of imperatives. There are many theories that seem to be allied with content pluralism, but turn out to assign contents to

¹²One cannot remedy the situation by noting that this 'question', unlike real questions, (probably) excludes some possibilities from the answers. Presumably $p \vee \neg p$ is true, yet the answers in $\{P, \bar{P}\}$ do not exclude any possibilities.

imperatives that are indistinguishable from propositions.¹³ Sometimes these even *are* propositions, and it is said that we choose to apply an importantly different evaluative concept to them (Huntley 1984; Hamblin 1987: 151). But more frequently they are primitive semantic values that parallel ‘true’ and ‘false’, like satisfied/unsatisfied (Hofstadter & McKinsey 1939; Ross 1944; Sosa 1967; Rescher 1966; McGinn 1977), fulfilled/unfulfilled (McGinn 1977), obeyed/disobeyed (Boisvert & Ludwig 2006), justified/unjustified (Castañeda 1960), and in-force/not-in-force (Lemmon 1965). As Hamblin noted these values apply in a way that parallels truth-values so closely that the two are distinguishable in name alone:

...[T]he theory of *fiats* of Hofstadter and McKinsey...or the phrastic-neustic logic of Hare...can be modeled by saying that *fiats* (or Harean imperatives) are arbitrary subsets of worlds. Thus *Let it be the case that Mao swam in Yangzi* picks out, as an ‘enjoined’ subset, the same subset of worlds as the statement that Mao actually did swim in the Yangzi. The *fiat* is *satisfied* if and only if the real world is a member of the [enjoined] subset, namely in the same circumstances as those in which the corresponding statement is true; and the difference between the semantics of the two cases is one of terminology only. (Hamblin 1987: 139-40)

Yet granting that the content of imperatives are propositions and saying that we choose to apply a truly distinguishable notion of satisfaction to them (Hamblin 1987: Ch.4) or that we don’t deictically index them to the actual world as we do with ‘declarative propositions’ (Huntley 1984: 119-20) is equally unsatisfactory.¹⁴ In this case their difference from declaratives is a matter of our evaluative whimsy alone. True content-pluralists about imperatives are a rarer breed: Hausser (1980: §4), Portner (2004a, 2007), Segerberg (1990) and Vranas (2008). Hausser and Portner model

¹³Those not cited in the text below: Hare (1949, 1970), Chellas (1971), von Wright (1963) and Prior (1971: 65-72).

¹⁴The latter is particularly implausible given that imperatives *are* tied to the ‘actual world’ in the same way as indicatives. Just as you can’t consistently accept *I will run* and *I won’t run* you can’t accept *I will run* and *Don’t run!* Just as you can’t say *If Bill were to run, I will run* you can’t say *If Bill were to run, Run!*

imperative contents as properties, while Segerberg and Vranas develop variants of a rather different idea. Segerberg represents imperative contents in terms of sets of relations on worlds (**command sets**) while Vranas renders imperative contents as a pairs of sets of worlds (**prescriptions**). I will consider the property view first.

4.2.4.1 Properties as Imperative Content

Hausser (1980: §4) states his proposal in Montagovian semantics, so (4.39a) is first translated as (4.39b) and then subjected to model-theoretic interpretation. Thus, the content of (4.39a) is the function denoted by (4.39b).¹⁵

(4.39) a. Leave!

b. $\lambda x.\lambda w.\text{Addressee}(x, w_c) \wedge \text{Leaves}(x, w)$

This function pairs each world w with the individuals who are both addressees in the world of the context (w_c) and who leave in w . According to Hausser (1980: 84), each verb like *leave* translates as $\lambda x.\lambda w.\text{Verb}(x, w)$ and for each basic verb like this there is also an imperative form of the verb *leave!* which has a separate schema for translation, namely $\lambda x.\lambda w.\text{Addressee}(x, w_c) \wedge \text{Verb}(x, w)$. This theory clearly imparts a meaning on ! but fails to explicitly represent it with a lexical meaning. This failure is not immediately remediable, since there is no term α such that $\lambda x[\lambda w.\text{Verb}(x, w)](\alpha)$ or $\alpha(\lambda x.\lambda w.\text{Verb}(x, w))$ reduces to (4.39b) by λ -conversion. But I will bracket this issue for the moment.

On Hausser's analysis there is genuinely no syntactic or semantic subject in (4.39a). This leads to an immediate problem. When an explicit subject is added, as in *Everybody leave!* or *Leave John!* the bare imperative is concatenated with

¹⁵Following Church (1940: 58) brackets indicating the scope of λ are often omitted in favor of ‘.’ which means that the λ takes the widest scope consistent with well-formedness.

something it that it can apply to or be applied to, as in (4.40b). This will reduce to a proposition, as in (4.40c).

(4.40) a. Leave John!

b. $\lambda x[\lambda w.\text{Addressee}(x, w_c) \wedge \text{Leaves}(x, w)](\text{john})$

c. $\lambda w.\text{Addressee}(\text{john}, w_c) \wedge \text{Leaves}(\text{john}, w)$

Portner (2004a) also maintains that the semantics of (4.39a) is given by (4.39b), but maintains that there is in fact a syntactic and semantic subject called ADDR, namely something like an unpronounced second-person pronoun. This is what contributes the ‘Addressee(x, w_c)’ component. Cases with overt subjects are treated like *John, you are beautiful* (Portner 2004b). ADDR contributes $\lambda x.\lambda w.\text{Addressee}(x, w_c)$ and combines with the verb meaning $\lambda x.\lambda w.\text{Leaves}(x, w)$ to form (4.39a). This is composition is not λ -conversion, but rather a rule amounting to conjunctive predicate modification (Portner 2004b: 3-4). However, this encounters the same difficulties as Hausser’s analysis. Why can’t function application be applied to $[[\text{ADDR leave}] \text{John}]$ or $[\text{Nobody} [\text{ADDR leave}]]$ to yield propositional denotations? I have provided no general argument that this worry cannot be addressed, but it does present a serious question that the current form of this semantics has not addressed. Further, and more importantly, no meaning for imperative morphemes is stated. In Hausser’s case, there was a meaning but it could not be stated in his framework. And, even if that meaning were statable, it seems like the kind of meaning that is more plausible to attribute it an unpronounced subject or some kind of person agreement morphology. Agreeing with this, however, lands Portner’s theory in an even worse position: no meaning is even indirectly attributable to an imperative morpheme. So the imperative morphemes of the world are, like their declarative brethren, relegated to insignificance.

Recall from §4.2.2 that imperatives occur in the consequents of conditionals and also mix with declaratives in conjunctions and disjunctions. Perhaps in the former

case one can still treat the content as a property, as in (4.41).

(4.41) a. If John is crying, leave!

b. $\lambda x.\lambda w'.\text{Addressee}(x, w_c) \wedge (\text{Crying}(\text{john}, w') \rightarrow \text{Leaves}(x, w'))$

But there is a serious puzzle about how this property is derived compositionally. The only analyses of the conditional available to the pluralist will have the conditional looking for a second propositional argument, a la (4.42).

(4.42) a. $\lambda q.\lambda w'.\text{Crying}(\text{john}, w') \rightarrow q(w')$ (*connective*)

b. $\lambda q.\lambda w'.\text{MODAL}(\text{Crying}(\text{john}, w'), q(w'))$ (*restrictor*)

While this combines flawlessly with $\lambda w.\text{Leave}(\text{john}, w)$ to yield a conditional proposition, there is no motivated composition operation for combining this with (4.39b) to yield (4.41b). The same issue will arise for other connectives, though in the case of conjunction the problem is not just compositional.

(4.43) a. Pick up a taco and I'll meet you at 3rd Street

b. $\lambda x.\lambda w.\text{Addressee}(x, w_c) \wedge \text{Pickuptaco}(x, w) \wedge \text{Meet}(\text{me}, x, \text{3rd}, w)$

Analyzing (4.43a) as (4.43b) misses the fact that I've asserted that I'll meet you at 3rd Street, even if the city turns out to be in a taco famine.

Initially, it seems that this theory has no problem with disjunctions and conjunctions consisting of two imperatives, but difficulties lurk here as well. Predicates can be conjoined, so there must be some compositional operation for turning two predicates into a conjunctive predicate.

(4.44) a. Leave and don't come back!

b. $\lambda x.\lambda w.\text{Addressee}(x, w_c) \wedge \text{Leaves}(x, w)$

c. $\lambda x.\lambda w.\text{Addressee}(x, w_c) \wedge \neg \text{Comeback}(x, w)$

d. $\lambda x.\lambda w.\text{Addressee}(x, w_c) \wedge \text{Leaves}(x, w) \wedge \neg \text{Comeback}(x, w)$

Precisely this operation can be used to combine (4.44b) and (4.44c) to yield the desired translation of (4.44a), namely (4.44d). Recall from §4.2.2 that there was a real difference between an imperative contradiction *Paint and don't paint a picture!* and an imperative dilemma *Paint a picture and don't paint a picture!* This difference cannot be respected on the property analysis. Both yield:

$$\lambda x. \lambda w. \text{Addressee}(x, w_c) \wedge \text{Paint}(x, w) \wedge \neg \text{Paint}(x, w)$$

The property theory's treatment of disjunction confronts a classic puzzle raised by Ross (1944). There is a clear sense in which there is a logic of imperatives. If you accept the conjunctive command *Pay the fine and renew your license!* you've committed yourself to the commands *Pay the fine!* and *Renew your license!* Similarly, if you accept the conditional command *If you are driving, carry your license* and you are driving, you've committed yourself to the command *Carry your license!* Within the content pluralist's framework, logical consequence is truth-preservation. Given the property theory, the most natural extension of this to imperatives is given below.

Imperative Consequence $!\phi$ entails $!\psi$ iff every world in which the property denoted by $!\phi$ is true of an agent a , the property denoted by $!\psi$ is true of a

This works nicely for the conjunctive and conditional examples, but veers surprisingly off-course with disjunction. As Ross (1944: 38) points out, accepting (4.45a) does not commit an agent to (4.45b).

- (4.45) a. Post the letter!
- b. Post or burn the letter!
- c. Post the letter or burn the letter!

If I accept (4.45a) and it turns out that all postal services have been closed, I'm not committed to burning the letter. But if (4.45a) entails (4.45b) I am. And, unfortunately, the property theory predicts that (4.45a) entails (4.45b), since anytime

I post the letter I either post it or burn it. (4.45c) presents the same problem. Portner’s (2004a) theory contains a pragmatic component that he has recently used to address this feature of disjunctive imperatives (Portner 2010: §4). According to Portner, a discourse context C is a triple $\langle G, Q, T \rangle$. G is the **common ground**, which is the set of propositions mutually accepted by the discourse participants for the purposes of their exchange. Q is the set of **questions under discussion**. T is the **to-do list**, which is a function that assigns each participant a a set of properties $T(a)$ that they count, for the purposes of the conversation, as committed to making true. Since imperatives denote properties that could only be true of the addressee, the ‘natural consequence’ of their utterance is for that property to be added to the addressee’s to-do list. This consequence is taken to be the reflex of a pragmatic process, call it **imperative update**, which speakers can be assumed to carry out in virtue of being rational.

Imperative Update (v1) Let $C = \langle a, G, Q, T \rangle$, a be the addressee and $T_{\langle a, \llbracket !\phi \rrbracket \rangle} := (T - T(a)) \cup \{ \langle a, T(a) \cup \{ \llbracket !\phi \rrbracket \} \} \}$: $C + \llbracket !\phi \rrbracket = \langle G, Q, T_{\langle a, \llbracket !\phi \rrbracket \rangle} \rangle$

The key component of Portner’s model is confusingly left out of his definition of contexts, but is necessary to include. He proposes that there is an ordering function $<$ which assigns each participant a an ordering $<_a$ of the worlds left open by the information in G , i.e. $\bigcap G$. This ordering is determined by the properties in $T(a)$: $w \leq_a w'$ iff (i) there’s some to-do property that w' makes true and w doesn’t and (ii) every to-do property w makes true, w' also makes true.¹⁶ Portner (2004a: §3.2) holds that this ordering provides a norm of rationality for conversationalists. To be rational, the actions of a participant a in any $w \in \bigcap G$ should make it more likely that there is no world in $\bigcap G$ that is better than w , i.e. $\nexists w' \in \bigcap G$ such that $w \leq_a w'$. So

¹⁶More formally, $\forall w, w' \in \bigcap G \ \& \ \forall a, w \leq_a w' \iff$ (i) $\exists P \in T(a)$ s.t. $P(a)(w) = 1 \ \& \ P(a)(w') = 0$ and (ii) $\forall Q \in T(a) : Q(a)(w') = 1$ if $Q(a)(w) = 1$.

a context C has the form $\langle G, Q, T, O(G, T) \rangle$ where O maps G and T to an ordering function $<$. Since an imperative update will change the ordering function assigned by O , the definition above must be redefined accordingly.

Imperative Update (v2) Let $C = \langle a, G, Q, T, O(G, T) \rangle$, a be the addressee and

$$T_{\langle a, \llbracket !\phi \rrbracket \rangle} := (T - T(a)) \cup \{ \langle a, T(a) \cup \{ \llbracket !\phi \rrbracket \} \rangle \}: C + \llbracket !\phi \rrbracket = \langle G, Q, T_{\langle a, \llbracket !\phi \rrbracket \rangle}, O(G, T_{\langle a, \llbracket !\phi \rrbracket \rangle}) \rangle$$

The ordering is essential since Portner goes on to formulate his definition of imperative consequence in terms of O . The idea is that $!\psi$ is a consequence of $!\phi$ when updating a context with $!\phi$ will lead to an ordering which updating with $!\psi$ will not change.

Imperative Consequence (vPortner)

Let $C = \langle a_C, G_C, Q_C, T_C, O_C(G_C, T_C) \rangle$, $(C + \llbracket !\phi \rrbracket) = C'$ and $C' + \llbracket !\psi \rrbracket = C''$:

$!\phi$ warrants $!\psi$ iff for all C : $O_{C'}(G_{C'}, T_{C'}) = O_{C''}(G_{C''}, T_{C''})$

Together with the rationality postulate Portner correlates with the ordering, this definition amounts to the following. When $!\phi$ entails $!\psi$ accepting $!\psi$ after accepting $!\phi$ will not require an agent to change the possibilities that their actions are aimed at realizing.

How does this account for Ross's puzzle? Suppose there are just two worlds consistent with the common ground:

- w_1 : addressee posts the letter
- w_2 : addressee burns the letter

Further, let there be no to-do items. After accepting *Post the letter!*, w_1 will be ordered over w_2 . Subsequently accepted *Post or burn the letter!* will change this ordering. Since the addressee has the property of burning the letter in w_2 but not in w_1 , w_1 can no longer be ranked over w_2 . Thus, *Post the letter!* does not warrant *Post or burn the letter!* This key element of this analysis — the dynamics of an

ordering relation — is elegant and powerful, but its supporting elements deserve reconsideration.¹⁷

On Portner’s approach, warrant is a pragmatic concept since it appeals to the pragmatic operation of imperative update. Recall that imperative update is supposed to be something an agent does in virtue of their rational competence, not in virtue of their linguistic competence. Is Portner then offering no semantic consequence relationship for imperatives? This would conjure a surprising distinction between imperatives and other clause types with no reason or motivation, so I assume that it is not Portner’s intention. Perhaps the explanation is instead supposed to follow the form of Stalnaker’s (1975) definition and use of the concept of **reasonable inference**. Stalnaker’s conditional semantics does not validate the intuitively compelling inference from *Either the butler did it or the gardener did it* to *If the butler didn’t do it, the gardener did it*. But he was able to show that this inference was nevertheless reasonable in the following sense. If you take any context and add the premise to the common ground of that context, then the conclusion will express a true proposition when asserted in that augmented context. Since Stalnaker also took the augmentation of a context to be part of pragmatics, the use of reasonable inference has the following form. While our linguistic competence alone does not render certain patterns valid, when situated in the dynamic process of rational conversation the worlds that would pose counterexamples to the validity will be eliminated from consideration. But this is radically different from Portner’s use of warrant. On the only reasonable definition of consequence based on the *semantics* of imperatives, Ross’s inference is valid. Further, Portner has not shown that a pragmatically augmented version of that consequence relation (somehow) rules in worlds that are counterexamples. Instead, he has presented an entirely different pragmatic relation. But then unlike in Stalnaker’s

¹⁷van Rooy (2000) also proposes that imperatives update an ordering.

explanation, there's no accounting for how the judgements furnished by our linguistic competence are filtered out when augmented with pragmatic reasoning. So it is hard to see how Portner's explanation makes sense as a pragmatic one. Recall also that Portner's analysis failed to assign any lexical content to imperative morphemes. This alone should lead one to reconsider the status of imperative update. But now that imperative update seems to be where the action is with imperative consequence, its relegation to pragmatics should be reconsidered. Indeed, the claim that the natural thing for rational agents to do with properties is add them to a to-do list sounds outlandish. There are many uses properties are put to by rational agents. As I will suggest in §4.2.4.3, this is an instance of a more general problem for content pluralism.

For the reasons outlined above, semantizing imperative update seems to be the most promising strategy for developing a semantic analysis of imperatives. This would require a specification and conceptualization of linguistic meaning that departs significantly from the content pluralist framework. But it will be just such a departure that I explore in §4.3. This departure will also do away with the key thesis of Portner's semantic analysis linking imperatives to properties. This should not be so surprising, since the key element of the pragmatic explanation really made no essential use of the semantic content of imperatives. It would have worked just as well if the to-do list were composed of propositions about addressees. Since treating the contents of imperatives as properties led to so many compositionality problems, this choice carries the promise for additional benefits. Indeed, I will show that thinking of imperative sentences as updating an ordering on the common ground allows one to give a seamless compositional analysis of the data involving conjunctions, disjunctions and conditionals that plagued the property analysis above. Parallel benefits will emerge for interrogatives.

4.2.4.2 Imperatives, Command Sets and Prescriptions

As I indicated above, I intend to develop the idea that an imperative's semantics be understood in terms of how it updates an ordering on the common ground. While this requires severing the identification of meaning and content, meaning will still be understood in terms of how a linguistic item modifies the content of a mental state. So I will still need to say what these contents are, and I don't think it is very enlightening to just say that it is 'an ordering'. Segerberg and Vranas have advanced pluralist proposals that I think help identify appropriate contents for imperatives, i.e. contents which in virtue of their structure order the common ground. In the course of presenting the relevant details of these proposals, I will also highlight where they need to be improved, and will be in §4.3.

Segerberg (1990) develops a modal logic that also contains *action terms*, i.e. a dynamic logic (Harel 1984), reminiscent of von Wright's (1963) df-calculus. A basic action term is constructed from an atomic sentence and the δ operator. Intuitively, the action term δp refers to the action of bringing it about that p . This content is modeled as a relation R on possible worlds. The idea is that a pair $\langle w, w' \rangle \in R$ represents a transition from w to w' . To make this a transition of making p true, the end point w' is required to be a p -world. Taken together, these pairs describe the transitions to that are to be made from any world w to end up in a p -world w' . This is what Segerberg calls the *action of bringing it about that p* . Imperatives are constructed from action terms with the $!$ operator, e.g. $!\delta p$. To give the semantics of this operator, Segerberg introduces the idea of a **command set** for each world w , written Γ_w . Γ_w represents the actions required by the powers that be in w . It is therefore modeled as a set of actions. Γ_w is then used to define a notion of **requirement**, written $\Gamma_w \models !\delta p$: $\Gamma_w \models !\delta p$ iff $\llbracket \delta p \rrbracket \in \Gamma_w$, i.e. the action denoted by δp is among the actions commanded by Γ_w . The content of $!\delta p$ can then be modeled as

the set of command sets that require it, i.e. the ones $\llbracket \delta p \rrbracket$ belongs to:¹⁸

Segerberg Semantics $\llbracket !\delta p \rrbracket = \{\Gamma_w \mid \llbracket \delta p \rrbracket \in \Gamma_w\}$, where $\Gamma_w \subseteq \mathcal{P}(\Omega^2)$

Grasping this content amounts to knowing which command sets require the action δp . So competence with an imperative not only consists in grasping the associated action, but knowing which worlds that action is prescribed in. Consequence is also be defined in terms of requirement:

Segerberg Consequence $!\delta\alpha \models !\delta\alpha'$ iff for all command sets Γ_w : $\Gamma_w \models !\delta\alpha'$ if $\Gamma_w \models !\delta\alpha$

Since the action of bringing it about that $p \vee q$ involves transitioning to some $\neg p \wedge q$ -worlds, the fact that $\llbracket \delta p \rrbracket \in \Gamma_w$ does not entail that $\llbracket \delta(p \vee q) \rrbracket \in \Gamma_w$. So by the requirement-conditions of $!\delta p$, Γ_w can require $!\delta p$ without requiring $!\delta(p \vee q)$. This seems to solve Ross's puzzle, but there are two important caveats. First, as Segerberg (1990:217) notes, his definitions also predict that $!\delta(p \wedge q)$ does not require $!\delta p$ or $!\delta q$. After all, δp will involve some transitions to $\neg q$ -worlds, so $\llbracket \delta(p \wedge q) \rrbracket \in \Gamma_w$ in no way entails that $\llbracket \delta p \rrbracket \in \Gamma_w$, and similarly for δq . This, of course, does not mirror the semantics of natural language imperatives. Second, and more importantly, Segerberg's theory does not invalidate the equally problematic inference from $!\delta p$ to $!\delta p \vee !\delta q$. His requirement clause for sentential connectives (Segerberg 1990:211) entails that $\Gamma_w \models !\delta p \vee !\delta q$ iff either $\Gamma_w \models !\delta p$ or $\Gamma_w \models !\delta q$. So Ross's puzzle lives on. Indeed, the treatment of connectives is generally inadequate for natural language. As discussed above, natural language furnishes sentences like $!\delta p \wedge q$. But on Segerberg's semantics $\llbracket !\delta p \wedge q \rrbracket = \llbracket !\delta p \rrbracket \cap \llbracket q \rrbracket = \emptyset$, since the first term denotes sets of command sets and the later denotes a set of worlds. Nevertheless, the idea that a relation between

¹⁸Frustratingly, Segerberg (1990) does not explicitly define intensions for imperatives. But the above suggests itself.

worlds can model an action is a helpful one, since it offers an intuitive picture of what an ordering of worlds represents in a theory of imperatives. By implication, the idea that the content of an imperative should be understood in terms of certain *prescribed* actions is also helpful. These ideas will be reincarnated in my analysis below.

Vranas (2008: 533) proposes that an imperative's content is a **prescription**, which is a pair $\langle S, V \rangle$ of logically incompatible propositions. S is the *satisfaction proposition* while V is the *violation proposition*. For example, the prescription denoted by *Dance!* will be $\langle D, \overline{D} \rangle$, where D is the set of worlds where the addressee dances. In general, if S is true, the prescription is **satisfied**. If V is true, the prescription is **violated**. But prescriptions are not required to be exhaustive. A non-exhaustive prescription is **avoided** if neither S nor V are true. Avoidance conditions are central to his analysis of conditional imperatives, but for my purposes it will suffice to consider atomic imperatives and conjunctions and disjunctions thereof. For these constructions prescriptions are exhaustive, i.e. always either violated or satisfied. Given this simplification, Vranas's semantics for the connectives amounts to:

Simplified Vranas Semantics

- $\llbracket !p \rrbracket = \langle \llbracket p \rrbracket, \overline{\llbracket p \rrbracket} \rangle$
- $\llbracket !p \wedge !q \rrbracket = \langle \llbracket p \rrbracket \cap \llbracket q \rrbracket, \overline{\llbracket p \rrbracket \cap \llbracket q \rrbracket} \rangle$
- $\llbracket !p \vee !q \rrbracket = \langle \llbracket p \rrbracket \cup \llbracket q \rrbracket, \overline{\llbracket p \rrbracket \cup \llbracket q \rrbracket} \rangle$

Obviously, these connectives cannot be employed in declaratives or interrogatives, so the theory must postulate unseemly ambiguities. This is not *just* unseemly. It precludes an analysis of imperatives conjoined or disjoined with declaratives. The semantics also conflates imperative contradictions $!(p \wedge \neg p)$ and imperative dilemmas $!p \wedge !\neg p$. As for imperative consequence, there is only one reasonable definition: entailment of satisfaction propositions.

Satisfaction Consequence Let $\llbracket !\phi \rrbracket = \langle S_{! \phi}, V_{! \phi} \rangle$ and $\llbracket !\psi \rrbracket = \langle S_{! \psi}, V_{! \psi} \rangle$.

$$! \phi \models ! \psi \text{ iff } S_{! \phi} \subseteq S_{! \psi}$$

Unfortunately, this leads to the Ross patterns being valid: $!p \models !p \vee !q$ and $!p \models !(p \vee q)$.¹⁹ Despite these difficulties of execution, Vranas makes a valuable proposal about imperative content. Treating them as pairs of propositions allows one to incorporate the insights of both Portner and Segerberg’s analysis. These contents order the satisfaction worlds over the violation worlds. They can also be understood as representing an action, that of changing violation worlds into satisfaction worlds. However, by only explicitly pairing logically incompatible worlds, that representation, unlike Segerberg’s, makes sense of the fact that an imperative is felicitous only when there is at least one world in the common ground where it is violated and at least one world where it is satisfied. To reasonably order someone to do something, it must be common ground that it can be done and that it isn’t going to ‘do itself’. As I will demonstrate below, these benefits can be liberated from the drawbacks of Vranas’s implementation by distinguishing linguistic meaning and content.

4.2.4.3 Conclusion

This section demonstrated a systematic weakness in the content pluralist program. Despite assigning different contents to different kinds of sentences, the approach did not culminate in the successful assignment of explicit meanings to imperative and declarative mood morphemes. While these distinct contents explained the fact that

¹⁹Vranas (2010) suggests that once non-exhaustive prescriptions are in play satisfaction consequence is no longer the obvious choice. He attempts to address Ross’s patterns by building on the fact that they are valid on one reasonable notion of consequence but not another (Vranas 2010: §5.3). However, the consequences of modeling non-exhaustive prescriptions are irrelevant to Ross’s patterns. As Vranas shows, those prescriptions only arise when conditionals are involved. The Ross patterns do not contain conditionals, so any genuine solution to the trouble they pose must translate to the setting of exhaustive prescriptions. Since the different notions of consequence Vranas appeals to collapse in such a setting (Vranas 2010: §4.2), his proposed treatment cannot be a genuine solution to Ross’s puzzle.

only declaratives are truth-evaluable and that the different sentence types embed in different contexts, it made it difficult to give an acceptable account of how they compositionally interact with connectives. In fact, we saw cases where it is impossible for a pluralist theory to do this (interrogative conjunction/disjunction). This empirical problem can be seen as a symptom of a more general conceptual problem with the pluralist approach.

Part of the project of semantics is to furnish a general theory of what linguistic meaning is. So even if it is determined that the three different sentence types correspond to three different kinds of contents we should still look for a more general property that they all share which underlies their connection to these different content structures. Indeed, it is easy to become suspicious that contents alone suffice to explain why the various sentence types are particularly apt for making assertions, asking questions or issuing directives. It is therefore easy to suspect that there simply must be something more to meaning.

A declarative sentence ϕ and an embedded instance of it in *that* ϕ both denote propositional contents, yet it is only the former which counts as a move in ‘the language-game’ (Wittgenstein 1953: §22). Similarly, once we understand propositions to be sets of worlds, we cannot thereby assert that John is tired by referring to the worlds where John is tired.²⁰ This may seem like a corny objection. But it must be granted that no content — whether it distinguishes the ways the world could be or the propositions that count as answers or the propositions that count as prescribed and prohibited — itself forces *any* particular use of a representation with that content. This is precisely why Frege distinguished sense and force, as Wittgenstein noted:

Imagine a picture representing a boxer in a particular stance. Now, this picture may be used to tell someone how he should stand, should hold himself; or how he should

²⁰Stanton (1999) makes the same point for interrogatives.

not hold himself; or how a particular man did stand in such-and-such a place; and so on. One might (using the language of chemistry) call this picture a proposition-radical. This will be how Frege thought of the [“thought”]. (Wittgenstein 1953: Note to §22)

Wittgenstein, of course, took the point in a radical direction.

... Well, suppose that a picture does come before your mind when you hear the word “cube”, say the drawing of a cube. In what sense can this picture fit or fail to fit a use of the word “cube”? — Perhaps you say: “It’s quite simple; — if that picture occurs to me and I point to the triangular prism for instance, and say it is a cube, then this use of the word doesn’t fit the picture.” — But doesn’t it fit? I have purposely so chosen the example that it is quite easy to imagine a *method of projection* according to which the picture does fit after all. The picture of the cube did indeed *suggest* a certain use to us, but it was possible for me to use it differently — Perhaps I see before me a schema shewing the method of projection: say a picture of two cubes connected by lines of projection. — But does this really get me any further? Can’t I now imagine different applications of this schema too? (Wittgenstein 1953: §§140-1, see also §86)

It is a short step from here to the famous observation that any use of an expression can be interpreted as fitting its associated content, i.e. rule (Wittgenstein 1953: §198). If one maintains with Wittgenstein that whatever meaning is, it is manifested in use, then one is tempted by the conclusion that there is no systematic connection between meaning and content, and even that there is no thing one can coherently attribute to a *linguistic item* and call *meaning*. The theory of meaning becomes the cartography of human activities in which language features, not the abstract analysis of linguistic patterns. But, a more moderate view is feasible.

4.3 A Semantics for the Moods

Let me remind you how I got from doing semantics to quoting Wittgenstein. Having no unified model of linguistic meaning made content pluralism empirically inadequate. But this lack of uniformity also flouted the importance of a unified understanding of meaning. Furthermore, since the meaning of certain sentence types does make them

particularly apt for certain uses but content seems incapable of doing that it seems that there must be something more to meaning than content. In the remainder of this essay I will demonstrate that this situation can be addressed by redrawing the relationship between language, meaning and content. The basic idea is that the linguistic meaning of an expression is the characteristic role it plays in modifying the mental state of a language user.

I will begin with a familiar assumption about the mental states language operates upon. For the purposes of explaining linguistic and other forms of intelligent human behavior, the level of content is the appropriate level of abstraction for specifying mental states (Stalnaker 1984; Harman 1988; Dretske 1998). Thus, the meaning of a linguistic expression can be thought of as function that maps an ‘input content’ to an ‘output content’, much like the operation of imperative update (§4.2.4.1). By developing the insights of content pluralism, I will show that the different moods change different components of the input content. These dynamic specifications of meaning are not to be thought of as internally represented rules that linguistic agents follow. They are abstract characterizations of the linguistic actions a sentence is used to execute and are therefore regularities in nature. There is no puzzle as to why having such a semantic property correlates with a sentence being particularly apt for a given use. That meaning just *is* what its various uses have in common. This proposal provides a uniform *conceptualization* of linguistic meaning that applies to all sentence types and underlies their communion with distinct content structures. It is no surprise that it achieves empirical adequacy where content pluralism foundered.

4.3.1 Intentionality, Inquiry and Rational Action

I will model informational content just as the pluralist proposals of §4.2.4 did:

Informational content can be understood in terms of possibilities. The information admits some possibilities and excludes others. Its content is given by the division of

possibilities into the admitted ones and the excluded ones. The information is that some one of *these* possibilities is realized, not any of *those*. (Lewis 1983: 4)

Formally, an informational content (*proposition*) can be identified with a set of possible worlds (Stalnaker 1976). This set distinguishes ways the world might be (worlds in the set) from ways it isn't (worlds excluded from the set).

Contextual Possibilities (*c*) As communication and inquiry unfold, a body of information accumulates. Think of this information as what the agents are taking for granted in some way. I call the set of worlds embodying this information *c*, short for *contextual possibilities*.

Grice, Lewis, Stalnaker and others view this background information as what's *mutually* taken for granted.²¹ I will not be so specific about the attitude that defines *c*. Getting that right requires more space than I have.

It is not just information that accumulates in communication and inquiry. As Bromberger (1966) proposes, a science is partly defined by the questions it is out to settle. More detailed and recent work in epistemology, semantics and pragmatics corroborates this idea by demonstrating the theoretical benefits of representing the issues at stake in inquiry and communication.²² This can be achieved by grouping the worlds in *c* into *alternatives*.

Alternatives (*C*) Alternatives represent open, competing propositions the agents are concerned with deciding between; their **issues**.²³ Formally, this grouping of *c* may be identified with a set of sets of worlds; call it *C*.

²¹E.g. Lewis (1969, 1979), Grice (1989b) and Stalnaker (1999, 2002). For more on the representation of this attitude see Fagin *et al.* (1995); Clark (1996: Ch.4).

²²E.g. Jeffrey (1990: Ch.11), Schaffer (2004), Groenendijk (1999), Roberts (2004) and Yalcin (2008).

²³*Open* since they are composed from worlds in *c*. *Competing* because they are distinct. Objects of concern, since they are the alternatives in *c*.

For example, suppose there are just two worlds w_0 and w_1 . In w_0 Maya is singing and in w_1 she is not. The agents have ruled out neither world so $c = \{w_0, w_1\}$, but this does not fully specify their progress. We must also know how those possibilities are grouped. Given their space of possibilities, a natural issue for them to be concerned with is whether Maya is singing, e.g. $C = \{\{w_0\}, \{w_1\}\}$. In this case the alternatives are exclusive and exhaustive, but that needn't be the case. When the agents have some information they will have eliminated some possibilities. Those possibilities will not be among any of the alternatives. Further, overlapping alternatives will be necessary for analyzing mood morphemes under the scope of connectives. Summary: new information eliminates worlds from the members of C and new issues modify the groupings in C .

Agents not only gather information and identify competing alternatives, they form **preferences** regarding those alternatives. This has been one of the driving ideas in thinking about rational decision and choice since perhaps Ramsey (1931b). While identifying an issue introduces the goal of finding *any* answer, forming a preference introduces the goal of finding a particular answer. Sometimes, this goal reflects a hunch or, more precisely, a higher credence in one of the answers. Sometimes, this goal reflects a desire for one of the answers to be true. Often, both factors are interwoven in preferences, as Ramsey (1931b), von Neumann & Morgenstern (1944), Savage (1954) and many others have discussed in detail. The body of preferences, issues and information at stake in conversation or inquiry can be represented as a binary *preference relation* on alternatives.

Preference State (R) R is a binary relation on a set of alternatives. It represents the agents' preferences that are being taken for granted for the purposes of conversation or inquiry. $R(a, a')$ means that a is preferred to a' . The set of alternatives over which R is defined is C_R . The set of worlds among those alternatives is c_R . R induces an ordering on c_R : $w \succ_R w'$ iff $w \in a, w' \in$

$$a' \& R(a, a').$$

Work on preferences has discussed at length the kinds of preferences that rational agents should aspire to.²⁴ The following seem particularly plausible.

Exclusivity $\forall a, a' : a \cap a' = \emptyset$ if $R(a, a')$

Irreflexivity $\forall a : \langle a, a \rangle \notin R$

Transitivity $\forall a_1, a_2, a_3 : R(a_1, a_3)$ if $R(a_1, a_2) \& R(a_2, a_3)$

Antisymmetry $\forall a, a' : \langle a', a \rangle \notin R$ if $\langle a, a' \rangle \in R$

No Absurdity $\forall a \neq \emptyset : \langle a, \emptyset \rangle \in R \& \langle \emptyset, a \rangle \notin R$

Exclusivity entails irreflexivity (for $a \neq \emptyset$), which together with transitivity entails antisymmetry. So it is sufficient to take exclusivity and transitivity as the basic constraints. In my *semantics*, I will not require R to have these properties. After all, words can be used to induce irrational states of mind. However, I will propose that rational speakers aim to obey exclusivity, transitivity and no absurdity. This norm will allow me to give precise characterizations of pragmatic inferences involved in language use.

By representing a group of agents' progress in communication or inquiry with R , I am able to capture the three key dimensions of that progress. This independently motivated representation provides the foundations for my semantics of mood. Each mood effects one of these dimensions. Declaratives provide information (c), interrogatives raise issues (C) and imperatives introduce preferences (R).²⁵ This proposal will

²⁴For a survey of that literature and references see Hansson & Grüne-Yanoff (2009).

²⁵Several other authors have proposed dynamic theories of imperatives (Han 1998; van Eijck 2000; van Rooy 2000; Žarnić 2003; Lascarides & Asher 2003; Mastop 2005) and some of them have even drawn similar connections to preferences (Yamada 2008). I cannot provide a full comparison of my analysis with these here, but I can guarantee the reader that my analysis improves on them in several respects.

be made precise below in a new predicate logic with explicit mood operators, called the **Logic of Mood** (LM). There, it will also be shown that it offers a successful analysis of all the phenomena used above to evaluate other proposals. But the basic proposal can be illustrated without filling in all of these details.

4.3.2 A Basic Illustration of LM

Sentences in each mood receive the kinds of translations illustrated below.

(4.1) a. Maya is singing.

b. $\triangleright \text{Sing}(\text{maya})$

(4.2) a. Is Maya singing?

b. $? \text{Sing}(\text{maya})$

(4.5) a. Sing, Maya!

b. $! \text{Sing}(\text{maya})$

The meaning of a sentence ϕ is specified as a function from one preference state R to another R' , written $R[\phi] = R'$ (meaning: $[\phi](R) = R'$).²⁶ For simplicity, suppose there are only two worlds, and the conversation is in the initial state R_0 , where there is no information and no substantive issues or preferences:

- w_0 : Maya is singing
- w_1 : Maya is not singing
- $R_0 = \{\langle \{w_0, w_1\}, \emptyset \rangle\}$

Each kind of sentence will effect the following transitions between states.

²⁶This kind of specification originates with Veltman (1996).

$$(4.46) \quad \{\langle\{w_0, w_1\}, \emptyset\rangle\}[\triangleright\text{Sing}(\text{maya})] = \{\langle\{w_0\}, \emptyset\rangle\}$$

$$(4.47) \quad \{\langle\{w_0, w_1\}, \emptyset\rangle\}[\text{?Sing}(\text{maya})] = \{\langle\{w_0\}, \emptyset\rangle, \langle\{w_1\}, \emptyset\rangle\}$$

$$(4.48) \quad \{\langle\{w_0, w_1\}, \emptyset\rangle\}[\text{!Sing}(\text{maya})] = \{\langle\{w_0\}, \{w_1\}\rangle, \langle\{w_0, w_1\}, \emptyset\rangle\}$$

The declarative provides information by eliminating the world where Maya is not singing. The interrogative raises a new issue by distinguishing the alternative where Maya sings from the one where she does not. The imperative adds a new (exclusive) preference for the Maya-singing alternative over the Maya-not-singing alternative. Disjunctions, conjunctions and conditionals can be given a successful uniform semantics that works for all three moods (and mixes thereof). As I have suggested throughout, this is linked to the fact that the present approach also gives a uniform conceptualization of meaning.

So far I have talked about the contents of mental states, but not the contents of sentences. To vindicate the intuition that only declaratives express truth-evaluable contents this will need to be corrected. The content of a declarative $\llbracket \triangleright\phi \rrbracket$ is the set of worlds where $\triangleright\phi$ provides no information. This is the set of w such that updating a preference state whose information is $\{w\}$ with $\triangleright\phi$ yields a state whose information is also $\{w\}$, i.e. the worlds where $\triangleright\phi$ is **true**.

Declarative Content

- $\llbracket \triangleright\phi \rrbracket := \{w \mid \forall R : c_{R[\triangleright\phi]} = c_R \text{ if } c_R = \{w\}\}$
- (Truth in w) $w \models \triangleright\phi \iff \forall R : c_{R[\triangleright\phi]} = c_R \text{ if } c_R = \{w\}$
- E.g. $\llbracket \triangleright\text{Sing}(\text{maya}) \rrbracket = \{w_0\}$

The content of an interrogative $\llbracket \text{?}\phi \rrbracket$ is the set of alternatives with respect to which $\text{?}\phi$ raises no issues.²⁷ This is the set of alternatives a_0, \dots, a_n such that updating

²⁷There may be many such sets, but the minimal set of maximal alternatives is the most perspicuous one. So, officially the definition of interrogative content contains an additional condition,

any preference state whose alternatives are $\{a_0, \dots, a_n\}$ with $? \phi$ yields a state whose alternatives are also $\{a_0, \dots, a_n\}$.

Interrogative Content

- $\llbracket ?\phi \rrbracket := \{a_0, \dots, a_n \mid \forall R : C_{R[?\phi]} = C_R \text{ if } \{a_0, \dots, a_n\} = C_R\}$
- E.g. $\llbracket ?\text{Sing(maya)} \rrbracket = \{\{w_0\}, \{w_1\}\}$

The content of an imperative $\llbracket !\phi \rrbracket$ is the set of preferences with respect to which $!\phi$ introduces only redundant preferences.²⁸ Updating any preference state containing these preferences with $!\phi$ results in the same state.

Imperative Content

- $\llbracket !\phi \rrbracket := \{r_0, \dots, r_n \mid \forall R : R[!\phi] = R \text{ if } r_0, \dots, r_n \in R\}$
- E.g. $\llbracket !\text{Sing(maya)} \rrbracket = \{\langle \{w_0\}, \{w_1\} \rangle\}$

The present account can explain why non-declaratives aren't truth-evaluable in the same way that content pluralists did. It might be objected that the definition of truth proposed above in terms of informational redundancy can also be applied to interrogatives and imperatives. But since these kinds of sentences never provide information they will always be true. Hence evaluating them for truth is vacuous. Indeed, the content pluralist must maintain a parallel position. According to them, ϕ

namely: $\min\max(a_0, \dots, a_n)$, defined as follows. (i) $\forall a_i \in \{a_0, \dots, a_n\} : C_{R[?\phi]} \neq C_R$ if $C_R = (\{a_0, \dots, a_n\} - \{a_i\})$ and (ii) $\nexists a_i, \dots, a_m \forall R : C_{R[?\phi]} = C_R$ if $\{a_i, \dots, a_m\} = C_R$, and $a_1 \subset a_i$ or \dots or $a_n \subset a_m$. Consider the example above, but add another Maya-singing world w_2 and another Maya-not-singing world w_3 . Constraint (ii) ensures that $\llbracket ?\text{Sing(maya)} \rrbracket = \{\{w_0, w_2\}, \{w_1, w_3\}\}$ rather than $\llbracket ?\text{Sing(maya)} \rrbracket = \{\{w_0\}, \{w_1\}, \{w_2\}, \{w_3\}\}$. Constraint (i) rules out supersets of $\{\{w_0, w_2\}, \{w_1, w_3\}\}$ containing inessential alternatives. For simplicity, this detail is omitted in this basic illustration.

²⁸I am simplifying here, as I did with interrogatives (see note 4.3.2). Officially, an imperative content is the minimal set of maximal preferences: (i) $\forall r_i \in \{r_0, \dots, r_n\} : R[!\phi] \neq R$ if $(\{r_0, \dots, r_n\} - \{r_i\}) \subseteq R$ and (ii) $\nexists r_i, \dots, r_m \forall R : R[!\phi] = R$ if $r_i, \dots, r_m \in R$, and $a_{r_i} \subset a_{r_j}$ and $a'_{r_i} \subset a'_{r_j}$ where $r_i = \langle a_{r_i}, a'_{r_i} \rangle$ and $r_j = \langle a_{r_j}, a'_{r_j} \rangle$. Consider again the example from note 4.3.2. Condition (ii) ensures that $\llbracket !\text{Sing(maya)} \rrbracket = \{\langle \{w_0, w_2\}, \{w_1, w_3\} \rangle\}$ instead of $\{\langle \{w_0\}, \{w_1\} \rangle, \langle \{w_2\}, \{w_3\} \rangle\}$. Condition (i) ensures that inessential preferences like $\langle \Omega, \emptyset \rangle$ are not included.

is true in w just in case $w \in \llbracket \phi \rrbracket$. Since the content of interrogatives and imperatives aren't sets of worlds, they are always false. Both positions vindicate the idea that the question of truth cannot sensibly arise for interrogatives and imperatives.

4.3.3 The Logic of Mood (LM)

The Logic of Mood (LM) contains radicals and sentences. **Radicals** are built from an n -ary predicate P and n names: $P(n_0, \dots, n_n)$. Further, if ρ is a radical then $\neg\rho$ is too. An **atomic sentence** is built from a radical and either the declarative \triangleright , interrogative $?$ or imperative $!$ mood marker: $\triangleright\rho, ?\rho, !\rho$. If ϕ and ψ are sentences, then so is their conjunction $\phi \wedge \psi$ and disjunction $\phi \vee \psi$. If ϕ is a sentence built only from declarative sentences and ψ is a sentence then $(\text{if } \phi) \psi$ is a sentence.²⁹ There are two things to note about this syntax. First, moods cannot scope over sentential connectives. Second, negation must scope under mood. Indeed, LM follows Horn (1989:465) in claiming that there is no sentential negation in natural language.³⁰ This may seem peculiar, but it is syntactically and semantically well-motivated. For example, mood cannot be negated and *not* cannot be added on the left periphery of a sentence to yield a new one. Instead, *not* occurs as a predicate modifier. How is a sentence like *It's not true that Gabe ran and Josh slept* represented? By using a sentential predicate, just as in natural language: $\triangleright\neg\text{Tr}(\triangleright\text{Ran}(\text{gabe}) \wedge \triangleright\text{Slept}(\text{josh}))$. Negation still modifies a predicate, but in this case it is a *sentential* predicate.

In the semantics for LM, there are three key elements. First, there is a non-empty set of **entities** D . Second, there is a non-empty set of **worlds** Ω . But, there is a twist

²⁹Of course, my opinion is that the antecedents of conditionals are actually in the interrogative mood (Chapter 2), but I won't assume that here.

³⁰This is a claim about the word *not*, not the abstract expression of negative meaning. So this does not rule out a connective like *neither...nor* which incorporates a negative meaning. It just claims that *not* never modifies a *sentence*.

on ordinary possible-worlds semantics.³¹ Worlds are not primitive points, they are constructed out of entities. A world consists of arbitrarily many **extensions**, which can be a set of entities, a set of pairs of entities or a set of triplets of entities. A world need not put every member of D in one of these groups, so not every member of D ‘exists’ in every world. On this view, a world is a scheme for dividing entities into groups. The third element is an **interpretation** I , which assigns referents to names and predicates. I maps each name to an entity in D . I maps each n -ary predicate to an n -ary property. An n -ary property is a function from each world w to an n -ary extension that is part of w , intuitively this extension is the collection of things that have that property in that world. With these three elements in place, the semantics can be stated.

Radicals are the informational core of all sentences, but they are not sentences. They therefore receive a semantics only in terms of the information they provide. This is stated in terms of a function from one state of information c to another. Since radicals come in two varieties, there are two clauses.

Radical Semantics

1. $c[\mathbf{P}(\mathbf{n}_0, \dots, \mathbf{n}_n)] = \{w \in c \mid I(\mathbf{n}_0, \dots, \mathbf{n}_n) \in I(\mathbf{P})(w)\}$
2. $c[\neg\rho] = c - c[\rho]$

The first clause says that the radical eliminates worlds where the referent(s) of the name(s) are not in the extension of the predicate. The second clause says that negated radicals eliminate worlds compatible with their scope. The use of a sentential predicate like Tr (*it is true that*), creates the need to interpret a radical like $\text{Tr}(\phi)$, where ϕ is an atomic or complex declarative. To achieve this, I will need to be extended to map Tr to an extension for each world and ϕ to a referent in each world.

³¹This twist is not necessary, but it makes the system much more elegant.

(1) below proposes that the extension of the truth predicate in w is $\{w\}$. After all, the truth in w is $\{w\}$. (2) treats ϕ as referring to w in w if it is true there and the absurd world \emptyset if it is not (truth was defined in §4.3.2).

Second-Level Radical Semantics (Tr)

1. $\forall w : I(\text{Tr})(w) = \{w\}$
2. $\forall w : I(\phi)(w) = \begin{cases} w & \text{if } w \models \phi \\ \emptyset & \text{otherwise} \end{cases}$
3. $c[\text{Tr}(\phi)] = \{w \in c \mid I(\phi)(w) \in I(\text{Tr})(w)\}$
4. $c[\neg \text{Tr}(\phi)] = c - c[\text{Tr}(\phi)]$

With (1) and (2) in place, the same basic semantics for basic radicals can be extended to second-level ones. According to this semantics w will survive an update with $\text{Tr}(\phi)$ just in case $w \models \phi$.

In the sections that follow I present and discuss the semantics for each of the mood markers. I will conclude this introduction by presenting the semantics for the connectives. Connectives only occur in sentences, so their semantics is stated in terms of a function from one preference state R to another.

Connective Semantics

1. $R[\phi \wedge \psi] = (R[\phi])[\psi]$
2. $R[\phi \vee \psi] = R[\phi] \cup R[\psi]$
3. $R[(\text{if } \phi) \psi] = \{r \in (R \cup (R[\phi])[\psi]) \mid c_{R[\phi]} = c_{(R[\phi])[\psi]}\}$

Conjunction is analyzed as sequenced update. For pure declaratives, this means that ϕ will provide some information and ψ will add to it. For pure interrogatives, ϕ will raise an issue by dividing c_R into new alternatives and ψ will raise another issue by further dividing those alternatives. For pure imperatives, this means that ϕ will introduce a preference and ψ will also add preference, but to a state where the first

preference is in place. This means that the worlds satisfying both preferences will be the best. Disjunction simply unions the result of updating R separately with ϕ and ψ . For pure interrogatives, this amounts to accepting the alternatives introduced by both ϕ and ψ but *not* combining them. Similarly for pure imperatives, this will amount accepting the preference introduced by both ϕ and ψ but *not* combining them. So worlds satisfying both preferences will be no better than those satisfying one of them. Conditionals test that upon adding the antecedent to R the conclusion is informationally redundant.³² If ψ is declarative, this will amount to all of the ϕ -worlds in c being ψ -worlds. Since interrogatives and imperatives never provide information, they will always pass this test. When the test is passed, the results of updating R with ϕ and ψ are added to R . If ψ is a declarative this will simply amount to bringing the $\phi \wedge \psi$ worlds ‘into view’. If ψ is an interrogative, this will amount to adding a $\phi \wedge \psi$ alternative and a $\phi \wedge \neg\psi$ alternative. One can settle that issue by providing either piece of information or eliminate the issue entirely by eliminating the ϕ -worlds. Finally, if ψ is an imperative, this will introduce a preference for the $\phi \wedge \psi$ -worlds over the $\phi \wedge \neg\psi$ -worlds. One can satisfy this preference if the antecedent is true by making the consequent true. The preference becomes irrelevant if the information that $\neg\phi$ comes in. I will discuss the merits of these proposals in the corresponding sections below. However, it is worth noting that the account of conditionals already meets the desiderata of contemporary approaches to conditional interrogatives (Isaacs & Rawlins 2008) and conditional imperatives (Kaufmann & Schwager in press), but for the first time presents them as part of the same analysis.

³²Recall that this is informational upshot of the conditional semantics I developed in Chapter 2. (See Ch.2 §3.1, Fact 1.)

4.3.4 Declaratives

While radicals provide information in the abstract, their semantics does not determine how that information can be brought to bear on a conversation or inquiry. In the present setting, this is just to say that it is not determined how their information can be brought to bear on a preference state. According to the semantics for LM this is exactly the function mood markers serve. In particular, the declarative mood brings that information to bear on each alternative in the preference state and highlights that this is the information that has been proposed.³³ This ‘highlighting’ can be thought of as the *attentional* contribution of the declarative mood, and is accomplished with the last preference listed in the definition below.³⁴

Declarative Semantics Let $R = \{\langle a_0, a_1 \rangle, \dots, \langle a_n, a_{n+1} \rangle\}$

$$R[\triangleright \rho] = \{\langle a_0[\rho], a_1[\rho] \rangle, \dots, \langle a_n[\rho], a_{n+1}[\rho] \rangle, \langle c_R[\rho], \emptyset \rangle\}$$

The real action, however comes in how the declarative alters each alternative. Since those alternatives together make up the information at stake in the conversation, this has the effect of adding the information carried by ρ to the informational perspective of that conversation. This is what Stalnaker (1978: 86) calls the *essential effect* of an assertion. By encoding this as the semantic effect of a sentence two embarrassments of content pluralism are avoided. First, the declarative mood is given a meaning. Second, this meaning explains why declarative sentences are particularly apt for making assertions. As I discussed in §4.2.4.3, rational agents can do indefinitely many things with the propositions they come in contact with. So nothing in

³³These two functions parallel what Murray (in press) calls the *two components of assertion*. As she argues, the Cheyenne grammatical evidential system can be seen as decomposing the declarative mood into a number of variations on this theme. The highlighting effect of the English declarative is non-truth-conditional and is not made *at-issue* by the utterance. However, the not-at-issue contribution of evidentials is not just highlighting, it also provides a truth-conditional evidential relation on c .

³⁴It’s effects can illustrated with propositional anaphora and other phenomena that fall beyond the scope of this work.

the pluralist semantics explains why declaratives are apt for assertion and nothing in the general theory of rationality does either.

One worry that might be raised about this semantics is that it makes declarative sentences too powerful: they take the conversationalists on a forced march from one state of mind to another. But this worry is misplaced. All the semantics says is that interpreting a declarative takes us from one state of mind to another. Since it is not assumed that that state of mind reflects the agents' private beliefs, declaratives do not directly reach into their beliefs and change them. Further, nothing in the semantics says that the agent has to stay in the state interpreting the declarative puts her in. If a declarative takes us into a state of mind that we don't want to be in, we are free to reject that sentence. Indeed, it seems plausible that we come to reject it by provisionally putting ourselves in the position of accepting it and inspecting the merits of that position.

4.3.5 Interrogatives

Just as the declarative mood use the information carried by a radical to augment the information at stake in a conversation, the interrogative use that information to create new alternatives. This is accomplished with the first two lines below.

Interrogative Semantics Let $R = \{\langle a_0, a_1 \rangle, \dots, \langle a_n, a_{n+1} \rangle\}$

$$\begin{aligned}
 R[?\rho] = & \{\langle a_0[\rho], a_1[\rho] \rangle, \dots, \langle a_n[\rho], a_{n+1}[\rho] \rangle, \\
 & \langle a_0 - a_0[\rho], a_1 - a_1[\rho] \rangle, \dots, \langle a_n - a_n[\rho], a_{n+1} - a_{n+1}[\rho] \rangle \\
 & \langle c_R[\rho], \emptyset \rangle, \langle c_R - c_R[\rho], \emptyset \rangle\}
 \end{aligned}$$

The appearance of this definition belies its extreme simplicity. Each line corresponds to a simple operation.

1. Augment each alternative in C_R with the information carried by ρ

2. Augment each alternative in C_R with the information carried by $\neg\rho$
3. Introduce an alternative containing all of the ρ -worlds in c_R and an alternative containing all of $\neg\rho$ -worlds

Steps (1) and (2) cause each alternative in C_R to be split into two alternatives, one where ρ is true and one where it is false. As a result, the issue of whether or not ρ is true becomes one of the axes along which the conversation distinguishes possibilities. Step (3) is the interrogative version of the highlighting effect described for declaratives in §4.3.4. In this case, the two alternatives introduced do not highlight the information provided, but rather the two pieces of information that could be provided to directly and completely settle the issue that has been raised. In other words, they highlight the two complete answers: $c_R[\rho]$ is the affirmative answer and $c_R - c_R[\rho]$ is the negative answer. By making these two alternatives available, the interrogative sets the stage for a *yes* or *no* response.

When combined with the semantics for connectives proposed in §4.3.3, this analysis of interrogatives accounts for the conjoined and disjoined interrogatives discussed in §§4.2.2, 4.2.4. Consider conjunction first.

4.3.5.1 Interrogatives and Conjunction

Recall from the discussion in §§4.2.2, 4.2.4, that an adequate semantics for interrogatives must distinguish the following.

- (4.11) a. Are Frenesi and Zoyd coming?
- b. Is Frenesi coming, and is Zoyd coming?

Like classical first-order logic, **LM** has no means of representing nominal conjunction. But the answerhood conditions of (4.11a) seem equivalent to *Is it true both that Frenesi is coming and that Zoyd is coming?* This can be represented in **LM** as (4.11a').

$$(4.11a') \quad ?\text{Tr}(\triangleright\text{Coming}(\text{frenesi}) \wedge \triangleright\text{Coming}(\text{zoyd}))$$

(4.11b) comes out as (4.11b').

$$(4.11b') \quad ?\text{Coming}(\text{frenesi}) \wedge ?\text{Coming}(\text{zoyd})$$

Consider a simplified setting:

- w_0 : Frenesi is coming, Zoyd is coming
- w_1 : Frenesi is coming, Zoyd is not coming
- w_2 : Frenesi is not coming, Zoyd is coming
- w_3 : Frenesi is not coming, Zoyd is not coming
- $R_0 = \{\langle \Omega, \emptyset \rangle\}$, $\Omega = \{w_0, w_1, w_2, w_3\}$

The interpretation of (4.11a') in R_0 is detailed below:³⁵

$$\begin{aligned} R_0[(4.11a')] &= \{ \langle \Omega[\text{Tr}(\triangleright\text{Coming}(\text{frenesi}) \wedge \triangleright\text{Coming}(\text{zoyd}))], \emptyset \rangle, \\ &\quad \langle \Omega - \Omega[\text{Tr}(\triangleright\text{Coming}(\text{frenesi}) \wedge \triangleright\text{Coming}(\text{zoyd}))], \emptyset \rangle \} \\ &= \{ \langle \{w_0\}, \emptyset \rangle, \langle \{w_1, w_2, w_3\}, \emptyset \rangle \} \end{aligned}$$

Recall from §4.3.2 that w survives an update with $\text{Tr}(\triangleright\rho)$ just in case $\triangleright\rho$ is true in w . This leads to the results above, since $\triangleright\text{Coming}(\text{frenesi}) \wedge \triangleright\text{Coming}(\text{zoyd})$ is true only in w_0 . This correctly predicts that (4.11a) has two complete and direct answers: *Yes* ($\{w_0\}$) and *No* ($\{w_1, w_2, w_3\}$).

³⁵I omit the chore of updating the null alternative \emptyset . Also note that since $c_{R_0} = \Omega$ there's no need to separately construct $\langle c_{R_0}[\rho], \emptyset \rangle$ and $\langle c_{R_0} - c_{R_0}[\rho], \emptyset \rangle$.

The interpretation of (4.11b') in R_0 is detailed below:

$$\begin{aligned}
R_0[(4.11b')] &= (R_0[?Coming(frenesi)])[?Coming(zoyd)] \\
&= \{ \langle \Omega[Coming(frenesi)], \emptyset \rangle, \langle \Omega - \Omega[Coming(frenesi)], \emptyset \rangle \} [?Coming(zoyd)] \\
&= \{ \langle \{w_0, w_1\}, \emptyset \rangle, \langle \{w_2, w_3\}, \emptyset \rangle \} [?Coming(zoyd)] \\
&= \{ \langle \{w_0, w_1\}[Coming(zoyd)], \emptyset \rangle, \langle \{w_2, w_3\}[Coming(zoyd)], \emptyset \rangle, \\
&\quad \langle \{w_0, w_1\} - \{w_0, w_1\}[Coming(zoyd)], \emptyset \rangle, \langle \{w_2, w_3\} - \{w_2, w_3\}[Coming(zoyd)], \emptyset \rangle, \\
&\quad \langle \Omega[Coming(zoyd)], \emptyset \rangle, \langle \Omega - \Omega[Coming(zoyd)], \emptyset \rangle \} \\
&= \{ \langle \{w_0\}, \emptyset \rangle, \langle \{w_2\}, \emptyset \rangle, \langle \{w_1\}, \emptyset \rangle, \langle \{w_3\}, \emptyset \rangle, \tag{4.49}
\end{aligned}$$

$$\langle \{w_0, w_2\}, \emptyset \rangle, \langle \{w_1, w_3\}, \emptyset \rangle \} \tag{4.50}$$

The result of this interpretation, split across lines (4.49) and (4.50), amounts to the following. Line (4.50) indicates that the most recently introduced issue is whether or not Zoyd will come. However, line (4.49) means that addressing this recent issue will not settle the issues that have accumulated. So *Yes, Zoyd will come* and *No, Zoyd won't come* aren't complete and direct answers. There are *four* complete and direct answers, all of which would also settle the most recent question raised, i.e. $\{\{w_0, w_2\}, \{w_1, w_3\}\}$:

1. Both Frenesi and Zoyd are coming ($\{w_0\}$)
2. Frenesi is coming, but Zoyd is not ($\{w_1\}$)
3. Zoyd is coming, but Frenesi is not ($\{w_2\}$)
4. Neither Frenesi nor Zoyd is coming ($\{w_3\}$)

This corresponds exactly to the intuitive answerhood conditions of the original English sentence (4.11b) and clearly distinguishes it from (4.11a) which involved an interrogative marker scoped over a conjunction.

An adequate semantics of interrogatives must also deal with mixed conjunctions like (4.14), which receives the LM translation in (4.14').

(4.14) Gabe ate, but did Josh eat?

(4.14') $\triangleright \text{Ate}(\text{gabe}) \wedge ?\text{Ate}(\text{josh})$

The predictions are again easily demonstrated by considering a simple case.

- w_0 : Both Gabe and Josh ate
- w_1 : Gabe ate, Josh didn't
- w_2 : Gabe didn't eat, Josh did
- w_3 : Neither Gabe nor Josh ate
- $R_0 = \{\langle \{w_0, w_1, w_2, w_3\}, \emptyset \rangle\}$

Since (4.14') is in a conjunction, we must first calculate $R_0[\triangleright \text{Ate}(\text{gabe})]$. It is clear from the forgoing that this delivers $\{\langle \{w_0, w_1\}, \emptyset \rangle\}$. Interpreting $? \text{Ate}(\text{josh})$ in this state will deliver $\{\langle \{w_0\}, \emptyset \rangle, \langle \{w_1\}, \emptyset \rangle\}$. This makes precisely the correct prediction. (4.14) provides the information that Gabe ate and against the background of that information raises the issue as to whether Josh ate.

So far I have demonstrated that the present analysis yields the correct results for interrogatives and their interaction with conjunction. But as I discussed in §4.2.4, content pluralism can also achieve this. However, the pluralist could not simultaneously provide a correct analysis of the interaction of interrogatives and disjunction. I will now show that my analysis can simultaneously provide a correct analysis of both phenomena. Together with the analysis of conditional interrogatives described at the end of §4.3.2, this achievement will constitute a serious advantage for the present analysis over pluralist ones.

4.3.5.2 Interrogatives and Disjunction

Here are the phenomena to be accounted for.

(4.18) a. Did John mow or water the lawn?

(without contrastive focus on *mow* and *water*)

b. Yes/No

(4.19) a. Did John mow the lawn or did John water the lawn?

(without contrastive focus on *mow* and *water*)

b. #Yes/#No

Return to the simplified setting.

- w_0 : John mowed and watered
- w_1 : John mowed but didn't water
- w_2 : John didn't mow, but did water
- w_3 : John didn't mow and didn't water
- $R_0 = \{\langle \{w_0, w_1, w_2, w_3\}, \emptyset \rangle\}$

(4.18a) and (4.19a) receive the following LM translations.

(4.18a') $?Tr(\triangleright Mow(john) \vee \triangleright Water(john))$

(4.19a') $?Mow(john) \vee ?Water(john)$

(4.18a') will partition the worlds of R_0 into the ones where $\triangleright Mow(john) \vee \triangleright Water(john)$ is true ($\{w_0, w_1, w_2\}$) and the ones where it is false ($\{w_3\}$). Thus:

$$R_0[(4.18a')] = \{\langle \{w_0, w_1, w_2\}, \emptyset \rangle, \langle \{w_3\}, \emptyset \rangle\}$$

This correctly predicts exactly two answers for (4.18). The *Yes* answer is the first alternative and the *No* answer is the second one.

Interpreting (4.19a') is quite different. Interpreting this sentence involves first separately updating R_0 with each disjunct.

$$R_0[?Mow(john)] = \{\langle\{w_0, w_1\}, \emptyset\rangle, \langle\{w_2, w_3\}, \emptyset\rangle\}$$

$$R_0[?Water(john)] = \{\langle\{w_0, w_2\}, \emptyset\rangle, \langle\{w_1, w_3\}, \emptyset\rangle\}$$

Next, these results are unioned, delivering:

$$\{\langle\{w_0, w_1\}, \emptyset\rangle, \langle\{w_2, w_3\}, \emptyset\rangle, \langle\{w_0, w_2\}, \emptyset\rangle, \langle\{w_1, w_3\}, \emptyset\rangle\}$$

Yes/no answers are out of place here, since there are more than two alternatives to be chosen between. The issue represented by the first two alternatives can be settled with *John mowed* or *John didn't mow*. The issue represented by the third and fourth can be settled with *John watered* or *John didn't water*. So on this analysis, the issues raised by (4.19a) can only be completely and directly answered with an appropriate conjunction, e.g. *John mowed and watered*. While this sounds correct to my ear, there is something unexpected about responding to (4.19a) with such a conjunction. But it is not hard to say why this is. Recall from the discussion of (4.11b) in §4.3.5.1 that the corresponding conjunction would also raise issues that could only be completely settled by one of these conjunctions. However, in this case the alternatives were $\{w_0\}, \{w_1\}, \{w_2\}, \{w_3\}$. Eliminating any one of these alternatives *requires* a conjunctive response that addresses both interrogatives. By contrast, any one of the alternatives can be eliminated from the disjunctive state by responding with *one* of the conjuncts. Thus, the only reason for using disjoined interrogatives rather than conjoined interrogatives is if you suspect that the hearer may only be able to provide one of the conjuncts. This would allow the conversation to conform to the canonical script of raising and eliminating alternatives, even if the hearer cannot provide all the information the speaker is after. This explains both why the conjunctive answer seems to be the one that settles every issue raised by (4.19a), but

also seems unexpected.³⁶

Embedded interrogatives can be analyzed using the same basic ideas employed in the semantics for sentences containing the *Tr* predicate. One innovation is required. Each agent $a \in D$ is assigned a preference state R_a^w in each world w . This represents their personal beliefs, questions and preferences in w .

Second-Level Radical Semantics (Wond) Let ϕ be an interrogative

1. $\forall w : I(\mathbf{Wond})(w) = \{\langle d, C_{R_d^w} \rangle \mid d \in D\}$
2. $\forall w : I(\mathbf{n}, \phi)(w) = \begin{cases} \langle I(\mathbf{n}), C_{R_{I(\mathbf{n})}^w} \rangle & \text{if } C_{R_{I(\mathbf{n})}^w}[\phi] = C_{R_{I(\mathbf{n})}^w} \\ \langle I(\mathbf{n}), \emptyset \rangle & \text{otherwise} \end{cases}$
3. $c[\mathbf{Wond}(\mathbf{n}, \phi)] = \{w \in c \mid I(\mathbf{n}, \phi)(w) \in I(\mathbf{Wond})(w)\}$
4. $c[\neg \mathbf{Wond}(\phi)] = c - c[\mathbf{Wond}(\phi)]$

Clause (1) says that the extension of **Wond** in each world w is the set of pairs consisting of an entity d and their private alternatives in w , i.e. $C_{R_d^w}$. (2) says that in each world w , $I(\mathbf{n}, \phi)$ delivers the pair consisting of $I(\mathbf{n})$ and $I(\mathbf{n})$'s alternatives in w if no new alternatives would arise from $I(\mathbf{n})$ accepting ϕ , i.e. the issues raised by ϕ are already in place. Otherwise, $I(\mathbf{n}, \phi)$ delivers the pair consisting of $I(\mathbf{n})$ and the set of no alternatives. It is evident why this predicate is only suited for interrogative ϕ . Declaratives don't generally raise issues, so the issues they raise will already be in place for every agent in every world. Hence embedding them under *wonder* would yield a trivial truth.

4.3.6 Imperatives

The declarative mood used the information carried by a radical to augment the information at stake in a conversation. The interrogative mood used that information

³⁶Note that this semantics for (4.19a') requires overlapping alternatives.

to create new alternatives. The imperative mood uses that information to create new preferences.

Imperative Semantics Let $R = \{\langle a_0, a_1 \rangle, \dots, \langle a_{n-1}, a_n \rangle\}$

$$R[!\rho] = R \cup \{\langle a[\rho], a - a[\rho] \rangle \mid a \in C_R - \{\emptyset\} \text{ or } a = c_R\}$$

This definition can be separated into three steps.

1. Admit all of the preferences in R
2. For each non-empty alternative a in C_R , introduce a preference for the ρ -worlds in a over the $\neg\rho$ -worlds in a
3. Introduce a preference for all of the ρ -worlds in c_R over the $\neg\rho$ -worlds

Step (3) corresponds to the highlighting effects discussed for declaratives and interrogatives above. In this case it serves to make explicit which possibilities need to be realized to satisfy the preference introduced by the imperative. To demonstrate this definition and one of its explanatory benefits, I will again consider a simplified setting. I will be considering an utterance of *Jimmy, kiss Nessi*, Nessi being the Loch Ness Monster. There are four possibilities.

- w_0 : Jimmy kisses Nessi and Jimmy is happy
- w_1 : Jimmy kisses Nessi and Jimmy is not happy
- w_2 : Jimmy doesn't kiss Nessi and Jimmy is happy
- w_3 : Jimmy doesn't kiss Nessi and Jimmy is not happy

Suppose, however that it is common ground between me and Jimmy that Nessi doesn't exist and therefore that Jimmy can't kiss Nessi. Yet, it is not common ground whether or not Jimmy is happy. Then the LM translation of the sentence I uttered,

!Kiss(jimmy, nessi), will be interpreted in the state $R_0 = \{\langle\{w_2, w_3\}, \emptyset\rangle\}$. The result:

$$\{ \langle\{w_2, w_3\}, \emptyset\rangle, \langle\emptyset, \{w_2, w_3\}\rangle \}$$

The first preference carries over from R_0 . The second is the lone preference generated by steps (2) and (3) described above. There is no semantic crash that results from doing this, but the preferences that result are both *unsatisfiable* and *irrational*. Realizing any of the live possibilities would violate one of the preferences. The second preference is prohibited by no absurdity. By transitivity, the speaker is also committed to $\langle\{w_2, w_3\}, \{w_2, w_3\}\rangle$ which is specifically prohibited by irreflexivity (or exclusivity). The present theory therefore predicts that it is *irrational* to make unsatisfiable commands. Similarly, consider the corresponding negative imperative $\neg\text{!Kiss(jimmy, nessi)}$ used to issue a negative command in the same context. This will attempt to introduce a preference for non-kissing-worlds over kissing-worlds. Since there are none of the latter, the imperative update will idle. It is plausible to hold that the introduction of a preference is a necessary condition for commanding. It then follows that this utterance will be a defective attempt to prohibit you from kissing Nessi.

Now that the basic details of my imperative semantics are at hand, I will move on to showing that it accounts for the phenomena that were discussed in my criticisms of other approaches. The first will concern the imperatives and conjunction.

4.3.6.1 Imperatives and Conjunction

As discussed in §4.2.2, (4.10a) is an imperative contradiction while (4.10b) is an imperative dilemma.

(4.10) a. Paint and don't paint a picture!

b. Paint a picture and don't paint a picture!

These sentences can be translated into LM as

(4.10') a. $\text{!Tr}(\triangleright \text{Paint}(u, \text{pic}) \wedge \triangleright \neg \text{Paint}(u, \text{pic}))$

b. $\text{!Paint}(u, \text{pic}) \wedge \text{!}\neg \text{Paint}(u, \text{pic})$

The difference between these can be illustrated with a simple example.

- w_0 : You paint
- w_1 : You don't paint
- $R_0 = \{\langle \{w_0, w_1\}, \emptyset \rangle\}$

(4.10a') will introduce a preference for the worlds where it is true that you both paint and don't paint over the worlds where it isn't. Since there are no worlds where you both paint and don't paint this preference comes out as $\langle \emptyset, \{w_0, w_1\} \rangle$. Combined with the preference already in R_0 , this addition results in the following state:

$$\{\langle \{w_0, w_1\}, \emptyset \rangle, \langle \emptyset, \{w_0, w_1\} \rangle\}$$

As discussed above, this kind of preference state is both unsatisfiable and irrational. Furthermore, the only way of making it rational is eliminating the only change brought about by the imperative. The interpretation of (4.10b') leads to an importantly different state. The first conjunct turns R_0 into

$$\{\langle \{w_0, w_1\}, \emptyset \rangle, \langle \{w_0\}, \{w_1\} \rangle\}$$

The second conjunct transforms this into

$$\{\langle \{w_0, w_1\}, \emptyset \rangle, \langle \{w_0\}, \{w_1\} \rangle, \langle \{w_1\}, \{w_0\} \rangle, \langle \{w_0\}, \emptyset \rangle, \langle \emptyset, \{w_1\} \rangle\}$$

This is also an irrational and unsatisfiable state. However, there are two ways of making it rational that don't completely eliminate the changes brought about by the imperative. Either $\langle \{w_0\}, \{w_1\} \rangle$ and $\langle \emptyset, \{w_1\} \rangle$ can be eliminated, or $\langle \{w_1\}, \{w_0\} \rangle$ and $\langle \emptyset, \{w_1\} \rangle$ can be eliminated. As such, (4.10b') presents a *dilemma*. The speaker

has imposed irrational preferences, but implicit in them is a choice between two rational preferences. These analyses of (4.10) explain why it makes sense to respond to (4.10b) by saying *Well, which one will it be?*, while the only response to (4.10a) is *I can't do that!* The ability to distinguish these two sentences results from the fact that the present architecture can adequately represent the difference between a dilemma and contradiction. The inability to do this has plagued deontic logic from its outset, leading to the problem of *deontic explosion* and various puzzles (see Goble 2005; McNamara 2010: §4). This suggests that the framework proposed here also has potential for clarifying these puzzles.

Imperatives can be conjoined with declaratives, and this fact caused problems for pluralist accounts (§§4.2.4.1, 4.2.4.2).

(4.12) You look in the library and I'll look in the lounge

This translates into LM as (4.12').

(4.12') $\text{!LibraryLook}(u) \wedge \triangleright \text{LoungeLook}(i)$

Lay out the possibilities:

- w_0 : You look in the library and I look in the lounge
- w_1 : You look in the library and I don't look in the lounge
- w_2 : You don't look in the library and I look in the lounge
- w_3 : You don't look in the library and I don't look in the lounge
- $R_0 = \{ \langle \{w_0, w_1, w_2, w_3\}, \emptyset \rangle \}$

The first conjunct of (4.12') turns R_0 into

$$\{ \langle \{w_0, w_1, w_2, w_3\}, \emptyset \rangle, \langle \{w_0, w_1\}, \{w_2, w_3\} \rangle \}$$

The second conjunct transforms this into

$$\{ \langle \{w_0, w_2\}, \emptyset \rangle, \langle \{w_0\}, \{w_2\} \rangle \}$$

According to this result, the command issued by (4.12) instructs the hearer to see to it that a world where they look in the library and the speaker look in the lounge is realized rather than a world where they don't look in the library and the speaker looks in the lounge. While this seems correct, there is another interpretation of (4.12) which means that I will look in the lounge *if* you look in the library. This reading is more prominent in a sentence like *Kiss the dog and you'll get fleas*. Initially, it may seem like this interpretation is enigmatic (Dummett 1973), but it is a natural consequence of the fact that an imperative highlights its satisfaction alternative. This alternative can be elaborated upon in further discourse as if it represented the live possibilities of the conversation.

(4.51) Take 27 to Albany Street. You will see Johnson & Johnson on the right.

This is just another instance of the phenomena of **modal subordination** discussed in Chapter 3 (§3.2). As I discussed there, this phenomena can be analyzed using the architecture proposed in Chapter 2 for *hypothetical inquiries*. This architecture makes certain lexically specified bodies of information available for elaboration in subsequent updates. In the case of imperatives, this would mean that they make their satisfaction alternative available for subsequent elaboration. While this hypothesis about conditional readings of conjunctive imperatives is not new here (Han 1998: Ch.5; Russell 2007) and I will not develop it in detail, it should be enough to convince the reader that these readings do not pose a difficulty for my semantics.

4.3.6.2 Imperatives and Disjunction

Pluralist analyses of imperatives had problems with disjunction. In particular, they could not provide adequate solutions to Ross's puzzle. In this section I will show

that the semantics proposed above provides a successful solution. Since that puzzle concerns imperative entailment, my first task will be to define an entailment relation for imperatives.

Imperative Entailment For imperatives $\phi_1, \dots, \phi_n, \psi$

1. $\phi_1, \dots, \phi_n \models \psi \iff \forall R : \succ_R = \succ_{R'[\psi]} \text{ if } R[\phi_1] \cdots [\phi_n] = R'$
2. $\forall w, w' \in c_R : w \succ_R w' \iff \exists \langle a, a' \rangle \in R : w \in a \ \& \ w' \in a'$

According to this definition, ϕ_1, \dots, ϕ_n entail ψ just in case updating any preference state R with those premises leads to a state R' where updating with the conclusion does not change the ordering on worlds already induced by R' . Intuitively, this means that after the premises have been accepted any preferences that the conclusion might introduce are already implicitly accepted. This parallels exactly the definition of declarative entailment that I have advocated in other chapters. This definition says that after accepting the premises, the information carried by the conclusion is already implicitly accepted.

Declarative Entailment For declaratives $\phi_1, \dots, \phi_n, \psi$

$$\phi_1, \dots, \phi_n \models \psi \iff \forall R : c_R = c_{R'[\psi]} \text{ if } R[\phi_1] \cdots [\phi_n] = R'$$

Ross's puzzle was that neither (4.45b) nor (4.45c) follow from (4.45a).

- (4.45) a. Post the letter!
- b. Post or burn the letter!
- c. Post the letter or burn the letter!

These sentences are represented as:

- (4.45') a. !Post(u, letter)
- b. !Tr(\triangleright Post(u, letter) \vee \triangleright Burn(u, letter))

$$c. \text{!Post}(u, \text{letter}) \vee \text{!Burn}(u, \text{letter})$$

You know the routine:

- w_0 : You post the letter and burn it
- w_1 : You post the letter and don't burn it
- w_2 : You don't post the letter and burn it
- w_3 : You don't post the letter and you don't burn it
- $R_0 = \{ \langle \{w_0, w_1, w_2, w_3\}, \emptyset \rangle \}$

It is reasonable to assume that w_0 is ruled out by world-knowledge, but I will include it to demonstrate that this has no effect on the analysis. Updating R_0 with (4.45a') produces R_1 .

$$\begin{aligned} R_0[\text{!Post}(u, \text{letter})] &= \{ \langle \{w_0, w_1, w_2, w_3\}, \emptyset \rangle, \langle \{w_0, w_1\}, \{w_2, w_3\} \rangle \} \\ &= R_1 \end{aligned}$$

Here is the question: does updating R_1 with (4.45b') or (4.45'c) change yield an ordering distinct from \succ_{R_1} ? The answer in both cases is *yes*. Updating R_1 with $\text{!Tr}(\triangleright \text{Post}(u, \text{letter}) \vee \triangleright \text{Burn}(u, \text{letter}))$ involves transforming each of the three non-empty alternatives in R_1 into a new preference $\langle a[\rho], a - a[\rho] \rangle$ using the information carried by the radical $\text{Tr}(\triangleright \text{Post}(u, \text{letter}) \vee \triangleright \text{Burn}(u, \text{letter}))$. This radical eliminates the world where both disjuncts are false. So the first alternative generates $\langle \{w_0, w_1, w_2\}, \{w_3\} \rangle$ and the second generates the familiar $\langle \{w_0, w_1\}, \emptyset \rangle$. The third generates $\langle \{w_2\}, \{w_3\} \rangle$. The imperative also admits the preferences from R_1 , so the final product of updating R_1 with (4.45b') is R_2 .

$$\begin{aligned} R_1[(4.45b')] &= \{ \langle \{w_0, w_1, w_2, w_3\}, \emptyset \rangle, \langle \{w_0, w_1\}, \emptyset \rangle, \\ &\quad \langle \{w_0, w_1, w_2\}, \{w_3\} \rangle, \langle \{w_2\}, \{w_3\} \rangle \} \\ &= R_2 \end{aligned}$$

These new preferences entail that $w_2 \succ_{R_2} w_3$, but $w_2 \not\succ_{R_1} w_3$. Therefore updating R_1 with (4.45b') yields a distinct ordering. By the definition of entailment above, it follows that (4.45a') does not entail (4.45b'). What about (4.45c')? In this case, R_1 is updated separately with each disjunct and the results are unioned. The first disjunct !Post(u, letter) has already been added to R_1 so updating with it will simply return R_1 . The second disjunct !Burn(u, letter) will create a preference from each of the three alternatives in R_1 . The first alternative yields $\langle \{w_0, w_2\}, \{w_1, w_3\} \rangle$. The second generates $\langle \{w_0\}, \{w_1\} \rangle$, while the third results in $\langle \{w_2\}, \{w_3\} \rangle$. Recall that the imperative also admits the preferences from the input state, so the final result of interpreting the second disjunct is:

$$\{ \langle \{w_0, w_1, w_2, w_3\}, \emptyset \rangle, \langle \{w_0, w_1\}, \{w_2, w_3\} \rangle, \\ \langle \{w_0, w_2\}, \{w_1, w_3\} \rangle, \langle \{w_0\}, \{w_1\} \rangle, \langle \{w_2\}, \{w_3\} \rangle \}$$

Thus, the result of interpreting the whole disjunction is the result of unioning this with the result for the first disjunct: R_1 . This was already done, so the state above is our final result; call it R_3 . Like the last case, $w_2 \succ_{R_3} w_3$, but $w_2 \not\succ_{R_1} w_3$. It follows that the conclusion brings a change in the ordering and therefore that the inference from (4.45a') to (4.45c') is not valid. This is much like the semantic analysis suggested by Portner (§4.2.4.1), only it is the real thing.

This account of disjunction, also provides a successful analysis of mixed cases. It has often been noted that sentences like (4.13) seem to express a kind of conditional threat. This often said to be an enigmatic, ad hoc reanalysis of disjunction (Dummett 1973; Krifka 2001).

(4.13) You look in the library or I'll look in the lounge

(4.13') !LibraryLook(u) \vee \triangleright LoungeLook(i)

But this conflates ignorance and enigma. Consider the possibilities.

- w_0 : You look in the library and I look in the lounge
- w_1 : You look in the library and I don't look in the lounge
- w_2 : You don't look in the library and I look in the lounge
- w_3 : You don't look in the library and I don't look in the lounge
- $R_0 = \{\langle w_1, w_2, w_3 \rangle, \emptyset\}$

Since (4.13) cannot be used in a context where w_0 is a live possibility, I will assume it has been eliminated from R_0 . The first disjunct turns R_0 into

$$\{ \langle \{w_1, w_2, w_3\}, \emptyset \rangle, \langle \{w_1\}, \{w_2, w_3\} \rangle \}$$

The second disjunct turns R_0 into

$$\{ \langle \{w_2\}, \emptyset \rangle \}$$

These are unioned to yield the final state.

$$R_1 = \{ \langle \{w_1, w_2, w_3\}, \emptyset \rangle, \langle \{w_1\}, \{w_2, w_3\} \rangle, \langle \{w_2\}, \emptyset \rangle \}$$

The crucial fact about this state is that the ideal alternative is one where I don't look in the lounge. This means that if you follow the command I won't look in the library, but if you don't I could look in the library. So taken together with an observation about the contexts in which (4.13) is felicitous, the semantics on offer here clarifies the alleged enigma of (4.13).

4.3.6.3 Open Ends

The semantics above is certainly a worthy competitor with contemporaries, but there are a few important topics I have not been able to touch on here.

Illocutionary Variability

Imperatives can be used to issue commands, but they can be used to express wishes,

advice, curses, warnings, permission and more (Hamblin 1987; Schwager 2005). The present analysis has the potential to account for this since there is so much flexibility in the concept of preference. For example, permissive uses like *Have a banana* can be seen as introducing a preference that conflicts with a preference to not have a banana that is common ground as a matter of politeness. For the resulting preferences to be made rational, the agents must eliminate one or both of the preferences. Further, relationships like authority will play a large role in the degree to which the conversational preference state will be assumed to correspond to the private preference states of the conversationalists. When preferences are expressed for states of affairs that are not within the control of any of the conversationalists, it is clear how they could take on the significance of a wish. When those preferences are for states of affairs only within the control of all of the conversationalist, it's clear how it could have a hortative meaning. So although it is beyond the scope of the present work, the theory proposed here shows promise for accommodating the illocutionary variability of imperatives. Best of all, this can be accomplished without adopting a propositional semantics like Hamblin or Schwager.

Deontic Modals

Accepting an imperative like *Post the letter* seems to commit an agent to accepting corresponding deontic modals like *You ought to post the letter*, *You should post the letter* and in some cases *You must post the letter*. While I will not offer a semantics for deontic modals, I will remark that the use of preferences to represent the content of imperatives makes it clear how such a semantics could be developed. Since preferences induce an ordering on the live possibilities and deontic modals seem to be sensitive to such an ordering, the necessary materials for linking their semantics is in place.

4.4 Conclusion

We have come a long way, but it has been worth the effort. I began by explaining why mood cannot indicate illocutionary force (§4.2.2). Force is a function of linguistic meaning, but is also partially constituted by pragmatic contextual factors. Further, illocutionary force indicators cannot have the semantic and syntactic distribution as mood morphemes. Attempts to assimilate non-declaratives to declaratives ironically lead to saying that the declarative mood was meaningless (§4.2.3) and similarly embarrassing views about embedded mood morphemes. These failures gave way to the radical new thesis of content pluralism. But this approach failed to adequately analyze the interactions between mood morphemes, conditionals, conjunctions and disjunctions (§4.2.4). These inadequacies were the consequence of attempting to mix three different content structures in one compositional system. These empirical problems reflected a conceptual concern about content pluralism: it offers no singular answer to the question *what is linguistic meaning?* This concern was pressed by the realization that content cannot explain why certain sentences are particularly apt for performing certain speech acts, and neither can the general theory of rationality (§4.2.4.3). But the project of semantically analyzing the moods can be saved by embracing a different way of thinking about linguistic meaning. The linguistic meaning of an expression can be modeled as a function from one mental state to another. This function represents a regularity in nature, namely the fact that interpreting that expression causes certain characteristic changes in the agent's state of mind. By specifying these states of mind in terms of their content, a linguistic expression's content can be reconstructed in terms of its meaning and the insights of content pluralism can be retained. But this content is not what composes to determine the meanings of sentences and does not determine which patterns of inference are valid. Together, these features led to a successful analysis of all the phenomena that sunk content pluralism (§§4.3.4-4.3.6). This included analyses of the interactions between mood, conditionals, conjunction

and disjunction, and the analysis of mood morphemes embedded under sentential predicates. In particular, the analysis of imperatives proposed here provided a new and more successful analysis of Ross's paradox and imperative inference in terms of preference induced orderings. Together, these achievements constitute a powerful argument for the view of meaning and mood developed here.

4.A The Logic of Mood (LM)

4.A.1 Syntax

Definition 34 (LM Syntax)

- (1) $\mathcal{Pred}_1 = \{P_0^1, P_1^1, \dots, P_n^1\}$ (1-Place Predicates)
 - (2) $\mathcal{Pred}_2 = \{P_0^2, P_1^2, \dots, P_n^2\}$ (2-Place Predicates)
 - (3) $\mathcal{Pred}_3 = \{P_0^3, P_1^3, \dots, P_n^3\}$ (3-Place Predicates)
 - (4) $\mathcal{Name} = \{n_0, n_1, \dots, n_n\}$ (Names)
-
- (5) $P(n_0, \dots, n_n) \in \mathcal{Rad}$ if $P \in \mathcal{Pred}_n$ & $n_0, \dots, n_n \in \mathcal{Name}$
 - (6) $\neg\rho \in \mathcal{Rad}$ if $\rho \in \mathcal{Rad}$
-
- (7) $\triangleright\rho \in \triangleright\mathcal{At}$ if $\rho \in \mathcal{Rad}$
 - (8) $?\rho \in ?\mathcal{At}$ if $\rho \in \mathcal{Rad}$
 - (9) $!\rho \in !\mathcal{At}$ if $\rho \in \mathcal{Rad}$
-
- (10) $\phi \in \mathcal{Wff}$ if $\phi \in \triangleright\mathcal{At} \cup ?\mathcal{At} \cup !\mathcal{At}$
 - (11) $(\phi \wedge \psi) \in \mathcal{Wff}$ if $\phi, \psi \in \mathcal{Wff}$
 - (12) $(\phi \vee \psi) \in \mathcal{Wff}$ if $\phi, \psi \in \mathcal{Wff}$
 - (13) $(\text{if } \phi) \psi \in \mathcal{Wff}$ if $\phi \in \triangleright\mathcal{Wff}$ & $\psi \in \mathcal{Wff}$
-
- (14) $\text{Tr}(\phi) \in \mathcal{Rad}_2$ if $\phi \in \triangleright\mathcal{Wff}$
 - (15) $\text{Wond}(n, \phi) \in \mathcal{Rad}_2$ if $\phi \in ?\mathcal{Wff}$
 - (16) $\neg\rho \in \mathcal{Rad}_2$ if $\rho \in \mathcal{Rad}_2$
-
- (17) $\triangleright\rho \in \mathcal{Wff}$ if $\rho \in \mathcal{Rad}_2$
 - (18) $?\rho \in \mathcal{Wff}$ if $\rho \in \mathcal{Rad}_2$
 - (19) $!\rho \in \mathcal{Wff}$ if $\rho \in \mathcal{Rad}_2$

4.A.2 Semantics

Definition 35 (Entities) $\Delta := \{D \mid D \neq \emptyset\}$

Definition 36 (Worlds)

- Worlds consist of sets of entities, sets of pairs and sets of triplets

$$- \Omega := \{w \subseteq \mathcal{P}(D) \cup \mathcal{P}(D^2) \cup \mathcal{P}(D^3) \mid w \neq \emptyset\}$$

Definition 37 (Interpretations)

1. *Name interpretations* I_n assign each name to an entity

$$• I_n \in \mathcal{I}_n : Name \mapsto D$$

2. *N-ary properties* P_n map each world to a set of n -tuples in that world

$$• \mathcal{P}_n := \{P_n : \Omega \mapsto \mathcal{P}(D^n) \mid P_n(w) \in w\}, \text{ for } 1 \leq n \leq 3$$

3. *Predicate interpretations* I_p assign n -ary predicates to n -ary properties

$$• I_p \in \mathcal{I}_p : (\mathcal{Pred}_1 \mapsto \mathcal{P}_1) \cup (\mathcal{Pred}_2 \mapsto \mathcal{P}_2) \cup (\mathcal{Pred}_3 \mapsto \mathcal{P}_3)$$

4. *Interpretations* I combine a name and a predicate interpretation

$$• \mathcal{I} := \{I_n \cup I_p \mid I_n \in \mathcal{I}_n \ \& \ I_p \in \mathcal{I}_p\}$$

Definition 38 (Information States)

- An information state c is a set of worlds

$$- c \in \pi := \mathcal{P}(\Omega)$$

Definition 39 (Alternative States)

1. An alternative state C is a non-empty set of sets of worlds

$$\bullet \Pi := \{C \subseteq \pi \mid C \neq \emptyset\}$$

2. $a_0, \dots, a_n \in C$ are called *alternatives*

3. The information embodied by C is $\bigcup C$

Definition 40 (Preference States)

1. A preference state R is a binary relation on alternatives

$$\bullet \mathcal{R} := \{R \subseteq (\mathcal{P}(\Omega))^2 \mid R \neq \emptyset\}$$

2. The information embodied by R is $c_R := \bigcup \{a \mid \langle a, a' \rangle \in R \text{ or } \langle a', a \rangle \in R\}$

3. The issues embodied by R are $C_R := \{a \mid \langle a, a' \rangle \in R \text{ or } \langle a', a \rangle \in R\}$

Definition 41 (Radical Semantics)

1. $c[\mathbf{P}(\mathbf{n}_0, \dots, \mathbf{n}_n)] = \{w \in c \mid I(\mathbf{n}_0, \dots, \mathbf{n}_n) \in I(\mathbf{P})(w)\}$

2. $c[\neg \rho] = c - c[\rho]$

Definition 42 (Second-Level Radical Semantics (\mathbf{Tr}))

Let ϕ be a declarative

1. $\forall w : I(\mathbf{Tr})(w) = \{w\}$

$$2. \forall w : I(\phi)(w) = \begin{cases} w & \text{if } w \models \phi \\ \emptyset & \text{otherwise} \end{cases}$$

3. $c[\mathbf{Tr}(\phi)] = \{w \in c \mid I(\phi)(w) \in I(\mathbf{Tr})(w)\}$

4. $c[\neg \mathbf{Tr}(\phi)] = c - c[\mathbf{Tr}(\phi)]$

Definition 43 (Second-Level Radical Semantics (Wond))

Let ϕ be an interrogative

1. $\forall w : I(\text{Wond})(w) = \{\langle d, C_{R_d^w} \rangle \mid d \in D\}$
2. $\forall w : I(\mathbf{n}, \phi)(w) = \begin{cases} \langle I(\mathbf{n}), C_{R_{I(\mathbf{n})}^w} \rangle & \text{if } C_{R_{I(\mathbf{n})}^w}[\phi] = C_{R_{I(\mathbf{n})}^w} \\ \langle I(\mathbf{n}), \emptyset \rangle & \text{otherwise} \end{cases}$
3. $c[\text{Wond}(\mathbf{n}, \phi)] = \{w \in c \mid I(\mathbf{n}, \phi)(w) \in I(\text{Wond})(w)\}$
4. $c[\neg \text{Wond}(\phi)] = c - c[\text{Wond}(\phi)]$

Definition 44 (Declarative Semantics) $R = \{\langle a_0, a_1 \rangle, \dots, \langle a_n, a_{n+1} \rangle\}$

$$R[\triangleright \rho] = \{\langle a_0[\rho], a_1[\rho] \rangle, \dots, \langle a_n[\rho], a_{n+1}[\rho] \rangle, \langle c_R[\rho], \emptyset \rangle\}$$

Definition 45 (Interrogative Semantics) $R = \{\langle a_0, a_1 \rangle, \dots, \langle a_n, a_{n+1} \rangle\}$

$$\begin{aligned} R[? \rho] = & \{\langle a_0[\rho], a_1[\rho] \rangle, \dots, \langle a_n[\rho], a_{n+1}[\rho] \rangle, \\ & \langle a_0 - a_0[\rho], a_1 - a_1[\rho] \rangle, \dots, \langle a_n - a_n[\rho], a_{n+1} - a_{n+1}[\rho] \rangle \\ & \langle c_R[\rho], \emptyset \rangle, \langle c_R - c_R[\rho], \emptyset \rangle\} \end{aligned}$$

Definition 46 (Imperative Semantics) $R = \{\langle a_0, a_1 \rangle, \dots, \langle a_{n-1}, a_n \rangle\}$

$$R[! \rho] = R \cup \{\langle a[\rho], a - a[\rho] \rangle \mid a \in C_R - \{\emptyset\} \text{ or } a = c_R\}$$

Definition 47 (Connective Semantics)

1. $R[\phi \wedge \psi] = (R[\phi])[\psi]$
2. $R[\phi \vee \psi] = R[\phi] \cup R[\psi]$
3. $R[(\text{if } \phi) \psi] = \{r \in (R \cup (R[\phi])[\psi]) \mid c_{R[\phi]} = c_{(R[\phi])[\psi]}\}$

Definition 48 (Declarative Entailment) For declaratives $\phi_1, \dots, \phi_n, \psi$

$$\phi_1, \dots, \phi_n \models \iff \forall R : c_{R'} = c_{R'[\psi]} \text{ if } R[\phi_1] \cdots [\phi_n] = R'$$

Definition 49 (Imperative Entailment) For imperatives $\phi_1, \dots, \phi_n, \psi$

1. $\phi_1, \dots, \phi_n \models! \psi \iff \forall R : \succ_{R'} = \succ_{R'[\psi]} \text{ if } R[\phi_1] \cdots [\phi_n] = R'$
2. $\forall w, w' \in c_R : w \succ_R w' \iff \exists \langle a, a' \rangle \in R : w \in a \ \& \ w' \in a'$

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