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WHAT 'IF'?

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1. Introduction

Conditional sentences, such as (1) and (2), are a heavily worked resource in the activities of planning, communication and inquiry.

(1) If Bob danced, Leland danced. (Indicative)

(2) If Bob had danced, Leland would have danced. (Subjunctive)

Their study has dramatically influenced semantic theory and the role it is understood to play in the explanation of these activities. Frege (1893), Jeffrey (1963), Grice (1989a) and others, use 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 proposition.[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 many adopt a **probabilistic semantics**.[2]

1. To simplify matters, I will initially suppress discussion of Kratzer's (1986; 1991) **restrictor theory**. While it differs in compositional detail from connective theories, the relevant details are the same. It also constructs possible-worlds conditional propositions, but uses instead an (often covert) binary modal connective to relate antecedent and consequent. This relegates *if* to a supporting role: semantic vacuity or restricting the modal. This approach is equally frustrated by (3)–(9). When I turn to examples (6) and (8) in §3.1, the restrictor theory will be discussed in detail.

2. E.g., Adams (1975); Appiah (1985); McGee (1989); Edgington (1995); Bennett (2003). Belnap (1973) hybridizes connective and suppositional accounts by, es-

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

(3) Albert wondered if Mabel loved John.
(4) Mabel asked if John was going to the party.

To these specimens I add (5).

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

In each of these examples 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.

Traditional theorists may respond that this is an uninteresting quirk of English best handled by pleading lexical ambiguity and is, anyway, unimportant to the study of conditionals. This response fails on both fronts. The convergence of interrogatives and conditional antecedents is very common even across *unrelated* languages,[4] a pattern which makes lexical ambiguity both implausible and unexplanatory. In this paper I will show that a semantics for conditionals which captures this **conditional-interrogative link** improves our understanding of conditionals after all. It alone adequately captures conditionals with multiple *if*'s in the antecedent, like (6) and (8). A connective analysis must maintain either that the multiple *if*'s are redundant, or that these structures are analyzable as conjunctions of two separate conditionals. The former option is excluded by the contrasts between the a and b variants of (6) and (8), while I argue against the latter analysis in §3.1. Treating *if* as an indicator of supposition fails to respect the contrast between (6) and (7).

(6) a. If the die comes up 2 and if the die comes up 3, Ben will win.
  b. # If the die comes up 2 and the die comes up 3, Ben will win.
(7) a. # Supposing the die comes up 2 and supposing the die comes up 3, Ben will win.
  b. # Supposing the die comes up 2 and the die comes up 3, Ben will win.
(8) a. If the die comes up 2 or 3, it'll come up 2.
  b. # If the die comes up 2 or if the die comes up 3, it'll come up 2.

The semantics I will propose to explain these data also holds promise for explaining **relevance** ('biscuit') **conditionals**, like (9), within a unified approach to conditionals (§3.2).

(9) If you want to talk to Bob, he's around the corner.

This semantics, and these phenomena, require decomposing conditionals in a way that connective and suppositional approaches cannot. But when one steps back to see the relationship between antecedent and consequent established by this decomposition, one finds a familiar approach: a dynamic strict conditional (e.g., Veltman 1986; Gillies 2004, 2009). This is a welcome conclusion, since such an account has been extensively developed recently and has a plausible claim to being the best overall approach to conditionals. In particular, it offers the best uniform treatment of indicative and subjunctive conditionals (Starr forthcoming),[5] and an approach to indicative conditionals which of-

sentially, using a three-valued logic. Another faction opts for a more tenebrous approach that characterizes only the speech act performed with a conditional (e.g., Barker 1995; DeRose & Grandy 1999; Kearns 2006; Barnett 2006).

3. See Haiman (1978) for an earlier cross-linguistic discussion.

4. As 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, Tagalog (Haiman 1978: 570) and Blackfoot (Louie fortcoming). In ASL and LIS the same non-manual articulation marks the antecedents of conditionals and interrogatives: a raised brow (Pyers & Emmorey 2008, Adriana Belletti p.c.).

5. While Starr (forthcoming) endorses a dynamic strict-conditional semantics

fers an attractive and new combination of the logical, compositional, pragmatic and truth-conditional benefits claimed by restrictor, connective and suppositional theorists (Gillies 2010; Starr 2014).

I want to clarify how the conditional-interrogative link supports a more nuanced decomposition of conditionals. First, this **conditional-interrogative link** should not be construed as an identification of *all* conditional antecedents in all languages with interrogatives, and need not be. Their common 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. Accordingly, languages which do not use the same particle in conditionals and embedded interrogatives do not count as counterexamples to the conditional-interrogative link.[6] Enough unrelated languages use the same particle to make a unified analysis attractive. The goal is not to give an analysis on which an interrogative component is necessary for the formation of a conditional meaning. That analysis is undercut even by English: conditional meanings can be communicated with non-interrogative connectives like *provided that* and *unless*. The goal is a semantic theory which is flexible enough to make an interrogative component *possible*. It is this flexibility which current theories lack, and this flexibility which is exploited to explain data like (9)–(8) in §3. It is also worth noting that there is a more general perspective on conditionals from which this unified theory makes sense.

Striking cross-linguistic parallels between conditionals and topic-comment structures, e.g., *As for the owls in the woods, they have secrets to tell*, have compelled many linguists to view conditionals in parallel. The small difference is that instead of introducing an individual, antecedents introduce a hypothetical proposition as a topic, and the consequent comments on it (e.g., Haiman 1978; Stone 1999; Bittner 2001).[7] An interrogative antecedent fits with this view, because one way of making a proposition a topic is by making it an answer to a question under discussion. This is because becoming a topic of a conversation requires becoming *relevant* to the conversation. Under one prominent approach (Roberts 2012), *relevance* is defined in terms of answering a question under discussion (see §2.2). On the view of conditionals elaborated below, *if*-clauses present a question. A rule of composition is used for interpreting these adjoined interrogatives in conditional structures. It says that the consequent follows from a positive answer to this question, together with the contextual information. After articulating and formalizing this view (§2) I will explain how this decomposition of conditionals sheds light on the phenomena in (9)–(8) (§3). The resulting view, like its predecessors, departs from orthodoxy in formal semantics. Rather than viewing reference as the paradigm concept in the theory of meaning, the semantics looks to the **dynamic meaning** of a symbol (morpheme): the characteristic role it plays in changing the mental states of language users.[8] Since mental states have referential/informational contents, these dynamic meanings determine referential/informational contents for symbols. At the dynamic level it is possible to provide a motivated decomposition of conditional sentences that captures the phenomena mentioned above. But at the level of static content it is, at best, quite difficult to make such an analysis work; or so I argue at the end of §3.1.

2. A New Semantics for Conditionals

A reminder from Austin (1956: 211–212) is a useful starting point:

> 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

for *if... then*, it argues that subjunctive antecedents contain a modal element whose proper semantics renders subjunctives variably strict after all.

6. German *ob* has often been offered to me as such an example. But it is an imperfect one, since *ob* was formerly used in conditionals, as is fossilized in current complex concessives like *obgleich* (Zieglschmid 1929; Di Meola 2001: 134).

7. For a cross-linguistic discussion of topic-comment see Gundel (1988).

8. See Heim (1982); Groenendijk *et al.* (1996).

> 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.

2.1 *First Steps*

Begin with the interrogative side of the link, considering occurrences of *if* like (3) and (4) above. The leading hypothesis about their semantics relies on the leading hypothesis about the semantics of interrogatives due to Hamblin (1958).[9] Hamblin's central idea was that the meaning of an interrogative is given not by its truth-conditions, but rather by its answerhood-conditions. A **polar** (yes/no) interrogative like (10a) has two complete and direct answers: (10b) and (10c).[10] It thus presents two exclusive and exhaustive alternative propositions. An answer to it consists in selecting exactly one of them. Accordingly, (10a)'s answerhood-conditions can be identified with the set containing these two propositions, i.e., Q_b in (11). On analogy with the terminology of *propositions*, this set is often called a *question* (Higginbotham 1996: 362).

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

9. Higginbotham (1993), Groenendijk & Stokhof (1997) and Belnap (1990).
10. This extends to interrogatives like *Who danced?* not discussed here.

(11) $Q_b = \{b, \overline{b}\}$
$b =$ the proposition that Bob danced
$\overline{b} =$ the proposition that Bob didn't dance

Believes in (12a) expresses a relation between Cooper and the proposition denoted by *that Bob danced*. Similarly, *wonder* in (12b) expresses a relation between Cooper and the question denoted by *if Bob danced*.

(12) 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**.

(13) Do you need an efficient car? (Then) Honda has the vehicle for you.
(14) Single? You haven't visited Match.com.
(15) 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 (15) arise from each command being issued against a background where an affirmative answer (*yes*) to its preceding question is *supposed*.[11] Each sequence thereby comes to have a conditional meaning, just as *supposing p, q!* does. With two supplements, this idea provides an account of the 'link' between the consequent and interrogative antecedent of a conditional *sentence*.[12] These two supplements must (i)

11. As Haiman (1978) and Harder (1996: 447) propose for conditionals.
12. This extension to the sentential domain is suggested by German, among other languages, in its use of word-order to identify the antecedent of an indicative conditional and an interrogative.

characterize the relationship between conditional meanings and suppositional reasoning and (ii) explain why it is only the *positive answer* which can be supposed. The latter fact is illustrated nicely by (15), which cannot be interpreted to mean *Seek not to be loosed if you are not bound unto a wife, and seek not a wife if you are not loosed from a wife*. I'll begin with (i).

F.P. Ramsey famously linked 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 1931: 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 Wilson 1926: §102; Ryle 1950: 255; Grice 1989a: 75–78), but makes little of it. Inquiry and communication take place against not only 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 supposing 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.

I wish to sharpen this intuitive characterization. According to the proposal above, evaluating a conditional *q if p* consists in (i) hypothetically adding *p?* to their stock of issues, (ii) focusing on a *p* outcome and (iii) determining whether *q* follows from this outcome. This proposal can be clarified by providing a *rough* paraphrase of a conditional in terms of a suppositional discourse.

(1) If Bob danced, Leland danced.

(1′) a. Suppose that we are wondering if Bob danced...
b. ...and we focus on worlds where he did ....
c. Then we will find that Leland danced.

This method of interpreting conditionals captures their core semantic property, namely **modus ponens**: *if p then q* and *p* entails *q*.[13] Interpreting a conditional is positioning oneself to apply modus ponens. This involves taking the consequent to follow from the antecedent (and background information). 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 to accept. The richer picture construes conditionals as a more complete microcosm of inquiry. They involve entertaining an issue and exploring the consequences of its positive answer. But why the *positive* answer?

Looking at polar interrogatives more generally, there is evidence that root polar interrogatives highlight one of their answers. For example, the two interrogatives (17a) and (18a) have the same two answers. But answering *yes* to (17a) and *yes* to (18a) do not mean the same thing.

(17) a. *X*: Did Bob win?
b. *Y*: Yes.

(16) Hast du was, dann bist du was.
Have you something, then are you something.
'If you have something, then you are something.'
(Bhatt & Pancheva 2006: 644; see also Iatridou & Embick 1994)

13. The theory in §2.5 is compatible with Gillies' (2004: §3) compelling diagnosis of McGee's (1985) alleged counterexamples to modus ponens.

(18) a. *X*: Did Bob lose?
b. *Y*: Yes.

Indeed, some contend that this is a counterexample to Hamblin's (1958) proposal to identify the meaning of an interrogative with the set consisting of its answers (Krifka 2001). A natural hypothesis is that polar interrogatives not only present two propositions, they draw attention to, or **highlight**, one of them in the sense that a subsequent *yes* affirms the highlighted answer and a subsequent *no* denies that answer (Roelofsen & van Gool 2010; Farkas 2011; Farkas & Roelofsen forthcoming).[14] On this model, *yes* and *no* are thought of as anaphoric elements much like pronouns, and 'highlighting' in terms of anaphoric salience. Advertising conditionals containing *then* in the second sentence can be analyzed as anaphorically retrieving the answer highlighted by the interrogative. Perhaps the conditional meaning comes from *then*: it says that its scope follows from hypothetically adding the anaphorically retrieved answer to the contextual information. When *then* is absent, the conditional meaning may be contributed by a discourse-coherence relation — a defeasible inference about the intended relationship between sequences of speech (Hobbs 1985; Asher & Lascarides 2003; Webber *et al.* 2003). As before, I will use advertising conditionals to guide my theorizing about *if*-conditionals. The first step is to justify the assumption that *if*-clauses, like polar interrogatives, highlight their positive answer.

The hypothesis that *if* doesn't just present two alternatives, but also highlights one, has been suggested by linguists trying to distinguish *whether* and *if* in embedded interrogatives (Bolinger 1978; Eckardt 2007). While their data is quite nuanced, the sharpest contrast comes from verbs which intuitively require a balanced consideration of both alternatives. They are marked with *if* but natural with *whether*.[15]

(19) a. Al is agonizing over whether Lily likes him.
b. ?? Al is agonizing over if Lily likes him.

(20) a. Al is weighing whether he should invest.
b. ?? Al is weighing if he should invest.

(21) a. Jack and Jill are disputing whether God exists.
b. ?? Jack and Jill are disputing if God exists.

But is this the same kind of 'highlighting' seen with root polar interrogatives? I believe it is. First, both contrasts are attenuated by adding an *or not*, i.e., by transformation into an *alternative question*.

(22) a. Al is agonizing over whether Lily likes him.
b. Al is agonizing over if Lily likes him or not.

(23) a. *X*: Did Bob win or not?
b. *Y*: ?? Yes.

Second, the difference between *if* and *whether* also impacts the anaphoric availability of the positive answer.

(24) a. I wonder if Bob will dance. Then Leland will dance.
b. I wonder whether Bob will dance. ?? Then Leland will dance.

Adding *or not* in this context also attenuates the contrast.

(25) a. I wonder if Bob will dance or not. ?? Then Leland will dance.
b. I wonder whether Bob will dance or not. ?? Then Leland will dance.

This evidence suggests that *if* highlights its positive answer just like the interrogative operator in root polar interrogatives.

Given that *if* highlights its positive answer, it must be asked whether the meaning of an *if*-conditional is put together in the same

14. The label *highlighting* obscures that this is just propositional anaphora. The fact that some propositions introduced into the conversation can be directly referred to and others cannot is central to Murray's (2011) distinction between at-issue and not-at-issue content, and has been implemented in a variety of dynamic systems (Stone 1999; Kaufmann 2000; Bittner 2009; Murray 2014). I opt for *highlighting* here only because *the at-issue content of an issue* is awkward.

15. Examples (19)–(21) are my own, but are inspired by Bolinger (1978: 93).

way as an advertising conditional. It cannot be. *Then* is optional in *if*-conditionals (except for relevance conditionals), and the two clauses of a conditional do not count as sequences of discourse, so discourse relations cannot provide the essential compositional glue that binds *if*-conditionals together. I propose that natural languages contain a rule of composition for interpreting interrogative clauses (the antecedent) adjoined to matrix clauses (the consequent). The rule says that for each proposition highlighted by the antecedent, the consequent follows from a hypothetical addition of that proposition to the contextual information.[16] Informally, this analysis captures the conditional-interrogative link. But it is unusual: it describes the meaning of a conditional in terms of a *process*, while I am looking for a *semantics*. Models of how language users track an unfolding process are generally agreed to play a key role in explaining how they use language to get things done. My claim is that identifying this *process* with the semantics of conditionals allows a 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 'highlighting answers' and 'hypothetical additions' of them to a body of information. This proposal will be developed in three phases. I will begin by adopting a model of the bodies of information, issues and highlighted propositions (§2.2) and then introduce the basic ideas of a semantics based on transitions between them (§2.3). I will then offer a model of hypothetical additions to these bodies of information and issues (§2.4). These three ideas unite in §2.5 to provide a uniform semantics of *if* in conditional and interrogative constructions.

2.2 *Information, Issues and Highlighted Answers*

What is information? Possible worlds provide a convenient 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, I model an informational content (*proposition*) as 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 also lends precision to Hamblin's picture of interrogative content. His picture was that the content of a polar interrogative $p?$ is identified with the set $\{p, \overline{p}\}$. On the present model, this set amounts to a division of the space of possibilities into two mutually exclusive and exhaustive sets, i.e., a *partition* of the possibilities.

To understand communication and inquiry, it is necessary to consider the body of information that accumulates as the process unfolds. Grice, Lewis, Stalnaker and others view it as what's *mutually* taken for granted.[17] I call this set of worlds c, short for **contextual possibilities**.

To understand communication and inquiry, it is 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.[18] Each issue can be seen as partitioning c into two live propositions the agents are concerned with deciding whether or not to accept. Collectively, these issues divide c into a set of sets of worlds, one division per issue. I refer to this set as the **contextual issues** C. Given their relationship, c can always be constructed from C by merging the members of C in to one set, i.e., $\bigcup C = c$.[19] 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.

16. This would also provide an analysis of what Caponigro (2004) calls prepositional-phrase free-relatives, like *Bob dances where Leland dances*, *Bob dances how Leland dances* and *Bob dances when Leland dances*.

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

18. E.g., Roberts (1996b), Groenendijk (1999), Hulstijn (2002), Schaffer (2004).

19. This model of issues is adopted and developed by Ciardelli *et al.* (2013: §3) but draws on earlier work (Hulstijn 1997; Groenendijk 1999).

So far, my model does not capture the fact that some answers, and not others, are highlighted. Highlighting, in the sense relevant here, involves distinguishing those propositions that are in the foreground of mutual attention, are therefore a topic of the conversation and are thereby available for anaphoric reference. Formally, this can be modeled as pairing C with a set H of highlighted propositions. A body of **highlighted contextual issues** is $\langle C, H\rangle$ and written as C^H.[20]

2.3 *Semantics, Linguistic Meaning and Logic*

On the standard approach to semantics sentences are paired with contents. A declarative sentence P is paired with an informational content $[\![\mathsf{P}]\!]$, and an interrogative sentence $?\mathsf{P}$ is paired with a question $[\![?\mathsf{P}]\!]$. The process by which these contents are incorporated into C^H is held to be a matter of pragmatics, i.e., regulated by general principles of rational coordination, not specifically linguistic competence.

The kind of semantics sketched in §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^H. 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, eventually building up to transitions between bodies of highlighted contextual issues.

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. Read $c[\phi] = c'$ as: c' is the result of updating c with ϕ.[21] This equation identifies a sentence's meaning with its **information change potential** (ICP).[22] 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. 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 changes may come in the wake of speech acts, where ϕ changes a mutual attitude, and thoughts, where ϕ changes less public attitudes. How do **dynamic** approaches relate to truth-conditional ones? This will be discussed below.

Consider a propositional language with the familiar syntax, starting with a set of atomic sentences $\mathcal{A}t = \{\mathsf{p}_0, \mathsf{p}_1, \ldots\}$. 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. Clauses (1)–(4) of Definition 1 assign each kind of formula a special role in modifying c.

Definition 1 (Update Semantics)

(1) $c[\mathsf{P}] = \{w \in c \mid w(\mathsf{P}) = 1\}$ (2) $c[\neg\phi] = c - c[\phi]$

(3) $c[\phi \wedge \psi] = (c[\phi])[\psi]$ (4) $c[\Diamond\phi] = \{w \in c \mid c[\phi] \neq \varnothing\}$

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 ($\varnothing$) results if it is not. Otherwise, c remains as it was. Though I will not discuss *might* here, tests will be used in the analysis of conditionals.

The classical concept of truth is still definable in this framework,

20. This model of highlighting is my own, but simplifies other approaches to propositional anaphora (Bittner 2009; Murray 2014).

21. The general format of this semantics originates with Veltman (1996) but is quite close to Heim (1982). Pratt (1976) is the earliest precursor.

22. Paying homage to Heim's (1982) *context change potentials*. Since I will eventually employ an account of context consisting of more than information, it would be confusing to call these meanings *context change potentials*.

though it is a special case of the more general concept of **support**.[23]

Definition 2 (Support, Truth in w)
(1) Support $c \vDash \phi \Leftrightarrow c[\phi] = c$ (2) Truth $w \vDash \phi \Leftrightarrow \{w\}[\phi] = \{w\}$

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: $\{w\}$.[24] 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 just the set of worlds where it is true and hence determined by and distinct from its linguistic meaning (its ICP).

Definition 3 (Propositional Content) $[\![\phi]\!] = \{w \mid w \vDash \phi\}$

This method for deriving truth-conditions is applied to conditionals in §3. Support is the central theoretical concept in dynamic semantics, because it is the concept used to define entailment.

Definition 4 (Entailment) $\phi_1, \ldots, \phi_n \vDash \psi \Leftrightarrow \forall c : c[\phi_1] \cdots [\phi_n] \vDash \psi$

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.[25] This specifies which linguistic inference moves may be made while preserving even uncertain information. Predictably, classical entailment emerges by focusing on perfect information: $\phi_1, \ldots, \phi_n \vDash_{CL} \psi \Leftrightarrow \forall\{w\} : \{w\}[\phi_1] \cdots [\phi_n] \vDash \psi$.[26]

23. This definition of *support* comes from Veltman (1996), while the treatment of truth and propositional content is my own.
24. This definition is mentioned by Muskens *et al.* (1997: 594). Starr (forthcoming) discusses the advantages of this one over Veltman's (1996: 231).
25. More on this definition: van Benthem (1996: Ch.7) and Veltman (1996: §1.2).
26. Perfect information eliminates order-sensitivity. This is among the reasons I find my definition of truth more perspicuous than Veltman's (1996).

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. One way to argue for a dynamic semantics is to argue that this broader picture is better for capturing particular linguistic phenomena than the static truth-conditional approach (e.g., Veltman 1996; Groenendijk *et al.* 1996). While this kind of argument could be pursued for conditionals, that is not my tack here. It is to use dynamic meanings that specify transitions between states, and thereby formalize the process-oriented decomposition of conditionals sketched in §2.1. As I discuss at the end of §3.1, there are reasons to think this compositional analysis would not be possible within a standard static framework. Since the transitions mentioned above made use of issues and acts of supposition, my next goal will be to formulate meanings that don't just specify transitions between states of information. Nevertheless, the above discussion should be useful for understanding the relationship between the dynamic and static perspectives, and will be used in §3 to briefly state what kind of logic and truth-conditions emerge from the conditional semantics proposed in §2.5.

Ultimately, transitions between bodies of information are not enough. To specify the meaning of declaratives and interrogatives in one theory, the transitions will need to reflect changes in information *and issues*, i.e., $C[\phi] = C'$. 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 B := 'Bob danced' and A := 'Andy cried'. To illustrate the dynamic effects of $?\mathsf{B}$ and $?\mathsf{A}$, one need consider only four kinds of worlds, one for each Boolean combination: $w_{\mathsf{AB}}, w_{\mathsf{Ab}}, w_{\mathsf{aB}}, w_{\mathsf{ab}}$ (uppercase: truth; lowercase: falsity). Starting with no information or issues $C_0 = \{\{w_{\mathsf{AB}}, w_{\mathsf{Ab}}, w_{\mathsf{aB}}, w_{\mathsf{ab}}\}\}$, $?\mathsf{B}$ will return $C_1 = \{\{w_{\mathsf{AB}}, w_{\mathsf{aB}}\}, \{w_{\mathsf{Ab}}, w_{\mathsf{ab}}\}\}$, pictured in Fig.1. Subsequently updating with $?\mathsf{A}$ refines the partition, returning C_2. My proposal to treat *if* as a polar interrogative operator amounts to saying that it does what ? does, which involves partition-

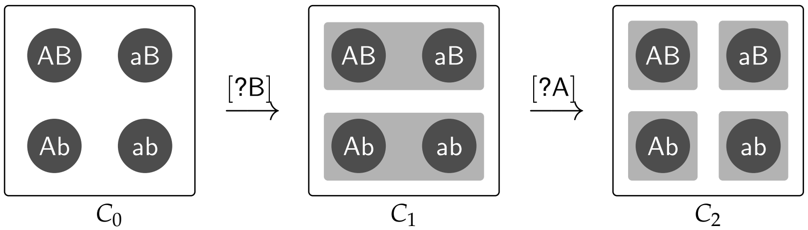

Figure 1: C_0[?B][?A]

ing the contextual possibilities.[27] But as I have discussed above, ? does more: it highlights its positive answer. To model this I proposed a yet richer model of the transitions encoded by sentences: $C^H[\phi] = C'^{H'}$. On this model, ?B will not only divide C into the B-worlds and the $\neg$B-worlds; it will also highlight the B-worlds. So $C_0^{\varnothing}$ will change in two ways when updated with ?B: (i) C_0 will change to C_1, and $\varnothing$ will change to $\{B\}$, where B is the set of B-worlds in $\bigcup C_0$. Fig. 2 depicts this transition — rendering highlighting as outlining a proposition and drawing it nearer. While only the semantics of interrogatives makes

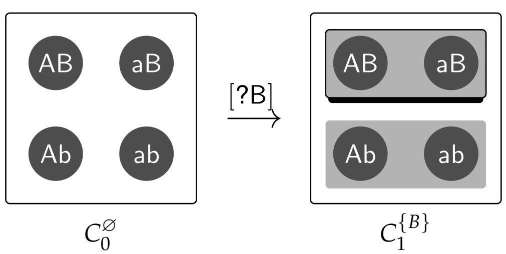

Figure 2: $C_0^{\varnothing}$[?B]

27. Related work: Groenendijk & Roelofsen (2009); Ciardelli *et al.* (2013).

use of these richer transitions, the clauses for connectives and atomics given in Definition 1 can be straightforwardly generalized to this format (Appendix A, Definition 13). The same holds for the definitions of *support*, *truth* and *consequence*, e.g., $C_0^H \vDash \phi$ means $\bigcup C_0 = \bigcup C_1$ where $C_0^H[\phi] = C_1^{H'}$ (Appendix A, Definition 17).

The above has shown how to specify a semantics in terms of transitions between bodies of information and issues. The informal analysis of conditionals proposed in §2.1 involves (i) *hypothetically* adding the question *p?* to the issues under consideration, (ii) focusing on the positive answer and (iii) concluding that q follows from adding this answer to the contextual information. The model of highlighting just presented shows that steps (i) and (ii) are really just one step: introducing a question with a highlighted answer. So, our informal analysis should really read: (i) *hypothetically* adding the question *p?* to the issues under consideration while highlighting the positive answer and (ii) concluding that q follows from adding the highlighted answer to the contextual information. But what is it to *hypothetically* adopt a question or proposition? The next section describes transitions found in suppositional discourse and introduces a formal model for understanding them. These transitions will be compositionally combined in §2.5 to provide an analysis of conditionals that parallels this two-step analysis of conditionals.

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 does not require accepting new information, but merely entertaining it to see the landscape from a more informed vantage point. The result is a kind of inquiry within an inquiry. But the true virtuosity comes in how the results of this experiment in logical tourism are exported back home. To model this phenomenon, 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 information and issues taken for granted separate from information and issues that are merely entertained.[28] Below, I sketch just such a specification and describe how it models two transitions in suppositional discourse that will be part of the semantics for conditionals offered in §2.5.

Begin in a **state** of conversation or inquiry s_0 where there is a lone body of contextual information and issues C with nothing highlighted. I will represent this as the unit sequence containing C_0: $s_0 = \langle C_0 \rangle$. An ordinary update with p, which actually changes what's taken for granted, will affect C_0: $s_0[\mathsf{P}] = \langle C_0[\mathsf{P}] \rangle$. This is depicted in Fig. 3. The

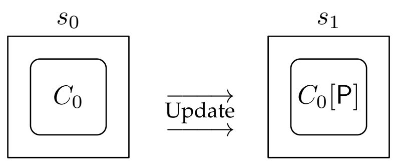

Figure 3: Update $s_0[\mathsf{P}]$

supposition of p, depicted in Fig. 4, is a different kind of update which doesn't change C_0 but involves **entertaining** an update with p; thereby nesting one state within a larger state. This can be modeled as creating a copy of s_0 and updating it with P while leaving C_0 untouched: $s_1 = \langle C_0, \langle C_0[\mathsf{P}] \rangle \rangle$. The left position is reserved for the contextual possibilities, while entertained enrichments of it are nested to the right.[29] I call the transition of creating a hypothetical state and updating it **Subordination**: $s \downarrow \mathsf{P}$. In suppositional discourse, Subordination can be exploited by another transition. **Conclusion** is the virtuosic transition that brings the results of the hypothetical inquiry to bear on what's actually taken for granted. That is, to relate what happened in s_1 back

28. See Appendix A.2. Related model: Kaufmann (2000).
29. Why have nesting states rather than sequences? We will sometimes want to update the hypothetical enrichment of C_0 with a sentence that requires a state, as in the case where a conditional contains a conditional as its consequent.

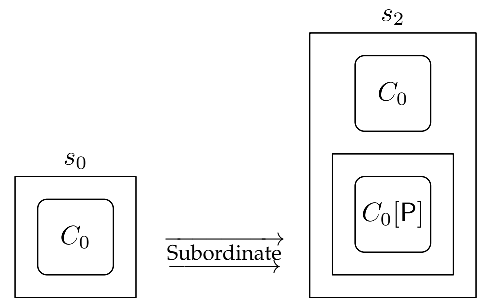

Figure 4: Subordination $s_0 \downarrow \mathsf{P}$

to s_0. An actual suppositional discourse will help show exactly how.

X and *Y* invited Paula and Roger to a potluck without telling them what to bring (each guest brings only one dish). *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.

(26) a. *X*: Suppose Paula brings a side dish to the potluck.
b. *X*: Then Roger will bring a main dish, since Paula and Roger always cook together.
c. *Y*: Ah, so if Paula brings a side dish, 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_0 with the sentence P := 'Paula brings a side dish': $s_0 \downarrow \mathsf{P} = \langle C_0, \langle C_0[\mathsf{P}] \rangle \rangle$. (26b) is the crucial step. There are two observations that must be accounted for. First, whatever (26b) does together with (26a) licenses the indicative conditional in (26c). Second, in a discourse differing only in that *X* admits $\mathsf{P} \wedge \neg \mathsf{R}$-worlds compatible with C_0 (R := 'Roger brings a main dish'), equivalents of (26b) and (26c) are out:

(27) a. *X*: Paula and Roger might both bring side dishes.
b. *X*: Suppose Paula does bring a side dish.
c. *X*: # Then Roger will bring a main dish.
d. *Y*: Ah, so if Paula brings a side dish, Roger will bring a main dish.

This example also shows that (26b)/(27c)'s effects are not quarantined to the suppositional context: the infelicity of (27c) is not purely hypothetical or merely *entertained*. It leads to an actually problematic context. Intuitively, this can be accounted for by saying that (26b)/(27c) is interpreted with respect to what's actually being taken for granted, but *then* refers to the hypothetical information created by the prior supposition. So (26b)/(27c) is saying, from the perspective of our current information, the hypothetical information just introduced entails that Roger will bring a side dish. This leads to an actual conflict since that hypothetical information doesn't actually rule out Roger brining a side dish. Formally, I model (26c) as performing an **entailment test** with R: proceed with what you are accepting if what's supposed — $C_0[\mathsf{P}]$ — entails R, otherwise fail (inconsistency). This can be captured in an equation. Where s_1 is the conversational state *after* (26c):

(28) $$s_1 \uparrow \mathsf{r} = s_2 = \begin{cases} \langle C_0, \langle C_0[\mathsf{P}]\rangle\rangle & \text{if } C_0[\mathsf{P}] \vDash \mathsf{R} \\ \langle \varnothing, \langle C_0[\mathsf{P}]\rangle\rangle & \text{otherwise} \end{cases}$$

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: $(s_0 \downarrow \mathsf{P}) \uparrow \mathsf{r} = s_2$. When this test is passed in (26) it guarantees that all of the P-worlds compatible with C_0 are r-worlds. This is just the condition imposed by a strict-conditional $\Box(\mathsf{P} \supset \mathsf{R})$ ranging over $\bigcup C_0$. I propose that the corresponding indicative conditional (26) is licensed because that is just what an indicative conditional does: performs an entailment test on the antecedent together with contextual information.

2.5 *The Theory*

I've proposed a model of two transitions in suppositional discourse and claimed that they place the same constraint on context as indicative conditionals. I now take this one step further by semantically decomposing conditionals into a sequence of analogous transitions. This

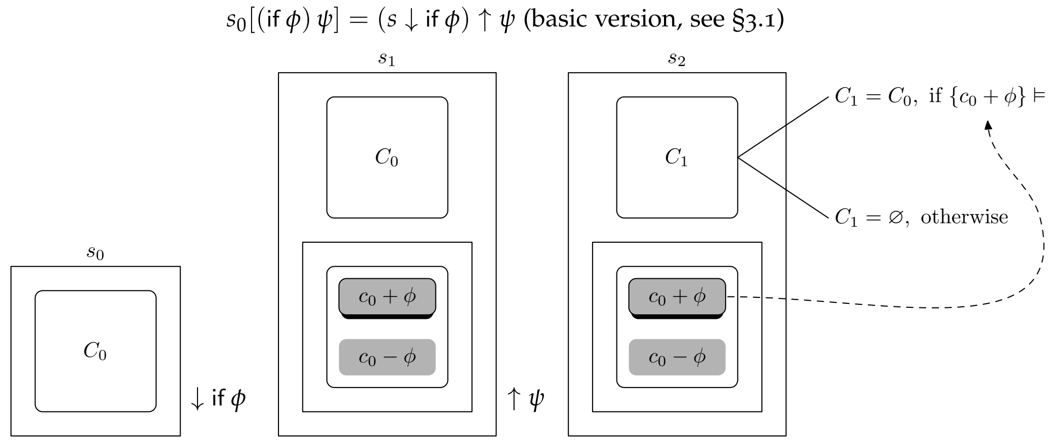

Figure 5: Conditional Update, where $c_0 + \phi = \bigcup(C_0[\phi])$

uses the two suppositional transitions to formalize the two steps of the informal analysis formulated in §2.3: (i) hypothetically taking an interest in the question *p?* while highlighting *p* and (ii) concluding that *q* follows from the highlighted answer.[30] The interpretation of (1) starts in s_0 and triggers the process depicted, left-to-right, in Fig. 5.

First, $\mathsf{if}\ \phi$ adds to a *hypothetical* stock of issues, highlighting the positive answer. Formally, this is achieved by Subordinating the interrogative meaning of the *if*-clause. Next, ψ is drawn as a conclusion of the highlighted answer: it is tested that the hypothetical information — $c_0 + \phi = \bigcup(C_0[\phi])$ — dynamically entails ψ using Conclusion.

30. This requires taking meanings to be transitions between states. Appendix A.3 translates the definitions from §2.3 to this format.

$$(29)\quad s_0 = \begin{cases} \langle C_0, \langle C_0[\mathsf{if}\,\phi]\rangle\rangle & \text{if } \{c_0 + \phi\} \vDash \psi \\ \langle \varnothing, \langle C_0[\mathsf{if}\,\phi]\rangle\rangle & \text{otherwise} \end{cases}$$

In s_1 Conclusion takes ψ and tests that the highlighted proposition of the bottommost sub-state of s_1 entails ψ. This clarifies how central highlighted propositions are to the Conclusion operation. Is it ever the case that multiple propositions are highlighted? If so, what would Conclusion do in that case? Conclusion is defined to cover such a scenario: Conclusion then tests that each highlighted proposition taken alone entails ψ (see Definition 11, Appendix A.2). In §3.1 I use this feature to analyze conditionals with multiple *if*-clauses in the antecedent. In these conditionals the antecedent is not of the form $\mathsf{if}\,\phi$ at all, but rather something like $\mathsf{if}\,\phi_1 \wedge \mathsf{if}\,\phi_2$. In these cases, the result is more nuanced than either Fig. 5 or (29) reflects. But before exploring this in depth, I want to spell out exactly how the above semantics accommodates the conditional-interrogative link.

In the conditional semantics above, *if* contributes a unary polar interrogative operator $(\mathsf{if}\ \cdot\ )$. 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 (§2.1) and certain suppositional discourses, e.g., (26) of §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.[31] 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.

31. This 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*.

One might still wonder how to formulate Hamblin's semantics for embedded interrogatives in the format above. On Hamblin's semantics *A wonders if ϕ* involves a relation between an agent A and a question $[\![\textit{if}\ \phi]\!] = \{[\![\phi]\!], [\![\neg\phi]\!]\}$. Yet, in the present setting $\mathsf{if}\,\phi$ does not refer to a question; it partitions a set of possibilities into the ϕ ones and $\neg\phi$ ones. 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., $\mathsf{B}_\mathsf{A}(\,\cdot\,)$ for *A believes*. For *wonder* I introduce $\mathsf{W}_\mathsf{A}(\,\cdot\,)$. The basic idea is that $\mathsf{W}_\mathsf{A}(\mathsf{if}\,\phi)$ 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. Updating a state s with $\mathsf{W}_\mathsf{A}(\mathsf{if}\,\phi)$ will eliminate any world w where either C_{A_w} entails ϕ or $\neg\phi$, or updating C_{A_w} with $\mathsf{if}\,\phi$ introduces some issues not already present in C_{A_w}, i.e., $\langle C_{A_w}\rangle[\mathsf{if}\,\phi] \neq \langle C_{A_w}, \ldots\rangle$ (see Appendix A.3, Definition 16).

3. A New Look at Conditionals

In the previous section, conditionals were semantically decomposed into two updates in order to capture the conditional-interrogative link. Can this decomposition teach us anything else about conditionals? This section proposes that it can. This is particularly bad news for traditional theorists. Ignoring the conditional-interrogative link not only gives an inaccurate account of *if*; it gives an inaccurate account of how conditionals are put together. Their last resort might be to claim that the semantics of conditionals proposed here comes at too high of a cost. It fails to adequately cover the phenomenon central to previous approaches: the truth-conditions and logic of conditionals. I claim that this is not so. On the present approach, entailment is about information (see §2.3, Definition 4). So to study the logic of inquisitive conditionals, one may attend only to the way they affect the contextual possibilities. Adding the assumption, discussed by many others (e.g., Stalnaker 1975; Veltman 1986; Gillies 2009), that indicative conditionals are felicitous only when their antecedents are compatible with c, the following fact describes the effect of the inquisitive conditional just on a body of information.

Fact 1 (The Inquisitive Conditional is Strict over c)
Let s be a state and c_s the contextual possibilities in s. Then the effect of $(\mathsf{if}\ \phi)\ \psi$ on c_s is identical to the following update just defined on c_s:

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

Proof See Appendix A.3.

So the inquisitive conditional, at this level of remove, turns out to be a kind of strict conditional. If, together with c_s, ϕ entails ψ, then the test imposed by the conditional is accepted. It might be worried that the account will then be plagued by standard objections to the logic of strict accounts. While that was once the prevailing opinion, there has been a renaissance in defending a strict account of indicative conditionals that is equipped with a non-classical definition of entailment and attends to the felicity condition of indicative conditionals (e.g., Warmbrōd 1983; Veltman 1986; Gillies 2004, 2009; Starr 2014). Truth-conditions are not the theoretically central concept in the present approach, but the semantics nonetheless determines truth-conditions for indicative conditionals in the fashion discussed in §2.3. These truth-conditions are familiar in the literature: indicatives are true when both antecedent and consequent are true, false when the antecedent is true and consequent false and undefined otherwise (e.g., Jeffrey 1963; Belnap 1973; McDermott 1996: 6).

Fact 2 (Truth-Conditions for Inquisitive Indicative Conditionals)

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

Proof See Appendix A.3.

While existing versions of this position generate implausible logics, the present one does not (Starr 2014). It does not because the logic is not determined by truth-conditions. Nonetheless, Starr (2014) argues that these truth-conditions are given an explanatory place in the analysis of conditionals and quantifiers (see also Huitink 2008: Ch.5). Finally, one might say that all of this is hopelessly specific to indicative conditionals. Building on Iatridou (2000) and Schulz (2007), Starr (forthcoming) proposes to analyze the antecedents of subjunctive conditionals as modalized, while the basic conditional structure is given the semantics in Fact 1. This modal antecedent is analyzed as expanding c to find antecedent-worlds. So instead of the antecedent worlds being $c_s[\phi]$ they end up being ϕ-worlds selected from a wider space of possibilities. This appropriately weakens the definedness condition to mean that the search must retrieve at least one world. The traditional theorist therefore has little ground to resist the approach developed here, particularly given the facts I am about to discuss.

3.1 *Many* Ifs, *One Antecedent*

Antecedents with multiple *if*s have not been investigated:[32]

(30) If Leland danced and if Sarah smoked, Bob was happy.

On their surface, these are troubling for a connective analysis. How could there be *two* binary conditional connectives both applying to the consequent proposition? A suppositional account fares a bit better. At least (31) is grammatical:

(31) Supposing Leland danced and supposing Sarah smoked, Bob was happy.

How might a restrictor theorist analyze (30)? They analyze *if* as shifting the modal base with its scope (Kratzer 1991: §8, Definition 13):

(32) $[\![\mathsf{if}\ \alpha,\ \mathsf{must}\ \beta]\!]^{f,g} = [\![\mathsf{must}\ \beta]\!]^{f^{\alpha},g}$, where $f^{\alpha}(w) = f(w) \cup \{[\![\alpha]\!]^{f,g}\}$

32. They are observed in descriptive work (Declerck & Reed 2001: 375–376).

With a static treatment of *and*, this does not work for (30), since the antecedent is a conjunction of two *if*-clauses. With a dynamic account of conjunction, I think this problem could be solved.[33] That would lead to a doubly shifted modal base where the propositions that Leland danced and Sarah smoked have been added to $f(w)$ for all w. This is essentially the suppositional analysis. On both analyses two *if*s turn out to be equivalent to one, at least under other plausible assumptions. What's the difference between adding $[\![\alpha]\!]$ and $[\![\gamma]\!]$ to f separately and adding $[\![\alpha \text{ and } \gamma]\!]$? There must not be any difference given the plausibility of:

Import-Export $(\textsf{if } \mathsf{A} \wedge \mathsf{B})\, \mathsf{C} \dashv\vDash (\textsf{if } \mathsf{A})\, ((\textsf{if } \mathsf{B})\, \mathsf{C})$

The problem is that two *if*s are not equivalent to one. Ben and Leland are up to their old habits: gambling on their lunch hour by tossing a die and betting on how it falls. Ben has bet $10 on 2 and $10 on 3. Now contrast (6a) and (6b).

(6) a. If the die comes up 2 and if the die comes up 3, Ben will win.
b. # If the die comes up 2 and the die comes up 3, Ben will win.

This non-equivalence is problematic not only for restrictor theories. It's clear evidence against the suppositional theory. The suppositional construction is just as infelicitous as the conjunctive supposition (6a).

(7) a. # Supposing the die comes up 2 and supposing the die comes up 3, Ben will win.
b. # Supposing the die comes up 2 and the die comes up 3, Ben will win.

This problem is not limited to *and*. Suppose Leland is pressing Ben to be a bit more risky and not distribute his bet. (8a) is fine, but not (8b).

(8) a. If the die comes up 2 or 3, it'll come up 2.
b. # If the die comes up 2 or if the die comes up 3, it'll come up 2.

33. Though it is less clear how to handle a variant of (30) with *or* instead of *and*: *If Leland danced or if Sarah smoked, Bob was happy*.

In both cases, the two *if*s lead to different interpretations.[34] These examples present a sharp challenge for restrictor, connective and suppositional theories of conditionals. But there is a reply on their behalf that should be considered. Perhaps the surface syntax is misleading. These conditionals seem equivalent to a conjunction of two conditionals, so perhaps they really are conjunctions of two conditionals where the first consequent is unpronounced.[35]

(30) If Leland danced and if Sarah smoked, Bob was happy
(33) If Leland danced~~, Bob was happy,~~ and if Sarah smoked, Bob was happy

However, recall (7a) and note that it is not interpretable as (34).

(7) a. # Supposing the die comes up 2 and supposing the die comes up 3, Ben will win.
(34) Supposing the die comes up 2, ~~Ben will win,~~ and supposing the die comes up 3, Ben will win.

But it is quite difficult to see how a grammatical process could silence the first consequent of (33) but not the syntactically parallel first consequent of (7a). The same facts hold for *unless* and *provided that*. Furthermore, there is clear semantic evidence against the assimilation of multiple *if* antecedents to multiple conditionals.

(35) If Laura breaks up with Bobby and if she then runs away with James, she might be more happy.
(36) If Cooper follows every lead and if each of them is a dead end, then the case cannot be solved.
(37) If Duke Taryn has a daughter and if Duke Basilisk has a son, then they will be married.

34. To be precise, (8a) should be *If the die comes up 2 or the die comes up 3, it'll come up 2*. That strikes me, and several informants, as acceptable, though verbose. Since it is clearly different than (8b), I have opted for the less verbose form.
35. Perhaps on analogy with right node raising: *John likes and Peter hates your best friend* (e.g., Hartmann 2000); I thank an anonymous reviewer here.

In (35), it is not claimed that if Laura breaks up with Bobby she might be more happy. It is perfectly consistent with the assumption that merely breaking up with Bobby would make Laura miserable because he would bug her at school. In (36), it is most definitely not claimed that if Cooper follows every lead then the case cannot be solved. Further, (37) does not have this incestuous reading:

(38) If Duke Taryn has a daughter ~~, then they will be married,~~ and if Duke Basilisk has a son, then they will be married.

There is thus both strong grammatical and semantic evidence against the hypothesis that multiple *if* antecedents can be analyzed as simple compounds of conditionals. With this hypothesis eliminated, it becomes clear that connective, restrictor and suppositional theories face a genuine challenge here.

The semantics developed in §2.5 captures the complex antecedents in (6) and (8) with ease. Conditionals like *if p and if q, then r* test that *r* follows from each highlighted answer, namely, it follows from *p* and it follows from *q*. By contrast, *if p and q, then r* will say that *r* follows from *p and q*, which captures the difference between (6a) and (6b) nicely. More formally, the antecedent of (6a) will create a subordinate state and update it thus: $C^{\varnothing}[\mathsf{if\ Two} \wedge \mathsf{if\ Three}]$. Since each if highlights its scope, this update highlights two propositions: the worlds in $\bigcup C$ where Two is true and the worlds in $\bigcup C$ where Three is true. Applying Conclusion will then test that each of these highlights dynamically entails Win. But since the antecedent of (6b) contains only one if, it will highlight only one conjunctive proposition: the worlds in $\bigcup C$ where $\mathsf{Two} \wedge \mathsf{Three}$ is true. Since there are no such worlds, this indicative conditional experiences the kind of presupposition failure mentioned in Fact 1. In (8a) the subordinate state is the result of $C^{H}[\mathsf{if\ Two} \vee \mathsf{Three}]$, which will highlight the single disjunctive proposition. Thus, it will test only that the $\mathsf{Two} \vee \mathsf{Three}$-worlds in $\bigcup C$ entail Two; a test which succeeds as long as there are no Three-worlds around. By contrast, (8b) generates a subordinate state with $C^{\varnothing}[\mathsf{if\ Two} \vee \mathsf{if\ Three}]$. By the semantics of disjunction, this update comes to $C^{\varnothing}[\mathsf{if\ Two}] \vee C^{\varnothing}[\mathsf{if\ Three}]$, where 'unioning' two bodies of highlighted issues and information is defined as unioning both the issues and the highlights: $C_0^{H_0} \cup C_1^{H_1} = (C_0 \cup C_1)^{H_0 \cup H_1}$. Since each *if*-clause on each side of the disjunction highlights its respective proposition, this means that both these propositions will be highlighted in the resulting state. Conclusion will therefore test both that Two entails Two and that Three entails Two, the second of which obviously fails. Examples (35)–(37) fall outside the scope of the semantics given here, for two reasons. First, they require mechanisms of modal anaphora (Groenendijk *et al.* 1996; Roberts 1996a). Second, they also seem to show that if the two highlighted propositions are compatible then they are conjoined together into a single highlighted proposition. These two extensions are related in that a plausible account of modal anaphora would likely capture the first fact. Recall that 'highlighting' is really just making possibilities available for anaphora. It is well known that *might* also does this (Roberts 1989; Stone 1999), and when two successive *might*-sentences raise contextually compatible possibilities, they are assumed by default to describe a single possibility. For example, in (39) it is consistent to assume that some of the worlds in which Taryn has a daughter are worlds in which Basilisk has a son. The *would*-sentence illustrates that these two possibilities have been assumed to describe a single possibility.

(39) Duke Taryn might have a daughter, and Duke Basilisk might have a son. They would certainly be married.

Thus, the present analysis holds promise even for (35)–(37) while connective, restrictor and suppositional analyses do not.

It is helpful at this point to discuss the role of dynamic semantics in the analysis of conditionals developed in this paper. Are dynamic meanings really required to capture the conditional-interrogative link and conditionals with multiple *if*s? Looking at my analysis of the conditional-interrogative link, it seems possible to translate it into a static analysis. *If*-clauses denote highlighted questions (a pair consisting of a set of highlights and a set of answers), and when they are adjoined to matrix declarative clauses, a rule of composition applies which says that the highlighted answer, taken together with contextual information, entails the consequent (or whatever your preferred conditional meaning comes to). This works but must also apply to antecedents with multiple conjoined or disjoined *if*-clauses. To mirror the results of the dynamic analysis, the following denotations for conjoined and disjoined *if*-clauses must be compositionally derived:

$$[\![\text{if A} \wedge \text{if B}]\!] = \langle \{[\![A]\!], [\![B]\!]\}, \{[\![A]\!] \cap [\![B]\!], [\![A]\!] \cap \overline{[\![B]\!]}, \overline{[\![A]\!]} \cap [\![B]\!], \overline{[\![A]\!]} \cap \overline{[\![B]\!]}\}\rangle$$

$$[\![\text{if A} \vee \text{if B}]\!] = \langle \{[\![A]\!], [\![B]\!]\}, \{[\![A]\!], \overline{[\![A]\!]}, [\![B]\!], \overline{[\![B]\!]}\}\rangle$$

- Where $[\![\text{if A}]\!] = \langle \{[\![A]\!]\}, \{[\![A]\!], \overline{[\![A]\!]}\}\rangle$, $[\![\text{if B}]\!] = \langle \{[\![B]\!]\}, \{[\![B]\!], \overline{[\![B]\!]}\}\rangle$

Nothing unexpected is needed for disjunction: just form the union of the answer sets and the highlight sets. But conjunction cannot be just simple intersection. It must apply point-wise intersection to the answer sets and union to the highlight sets. Treating conjunction as point-wise intersection is unusual enough, since it is unclear whether it could be unified with other uses of *and*. But unioning the highlight set is an even more unexpected modification. How could a general account of conjunction amount to unioning anything? By contrast, the dynamic analysis of *and* as sequential conjunction derives this with no surprising stipulations about how highlights are managed. I believe the dynamic analysis also has a more general advantage. The static analysis above draws no parallels between the moves of a discourse and the internal composition of conditionals. Conditionals are not construed as presenting an issue, highlighting an answer and anaphorically concluding something about that answer. They extract the highlighted answer and use it in a way that makes the question a charade: form a conditional proposition. As a purely practical issue, I find it unlikely that we would have been guided to this static analysis without drawing parallels between discourses and conditionals. Further, preserving this parallel between the compositional semantics of conditionals and moves in a discourse also offers more promise for a class of conditionals highlighted at the beginning of this paper. Relevance conditionals are composed in a way that is a slight variant of the two-step dynamic procedure but a complete and puzzling departure from the static rule of composition just outlined above. The next section is dedicated to these conditionals.

3.2 *Relevance Conditionals*

The starting point for my inquisitive-conditional-semantics was Austin's remark about *if* and doubt (Austin 1956: 211–212). Unsurprisingly, we are now led to investigate the enigmatic conditionals that originally animated Austin's discussion.

(40) There are biscuits on the sideboard if you want them.
(9) If you want to talk to Bob, he's around the corner.

The enigma is that the consequent is not presented as logically or causally following from the antecedent. Indeed, the consequent seems to logically follow from a relevance conditional. Following up (9) with *but Bob might not be around the corner* sounds plainly inconsistent. It is quite tempting to assume that relevance conditionals have the same semantics but are simply used in contexts where it is necessary to assume that the consequent is true in order to avoid attributing implausible beliefs to the speaker, i.e., that Bob's being around the corner is epistemically dependent on you wanting to talk to him (Franke 2007, 2009: §5.3). This analysis predicts that relevance readings are available only when conditional readings are not. But this prediction seems to me incorrect. Imagine three friends planning a trip to campus. It is close enough to walk. Sometimes just one or two of them drive, but they sometimes rationalize driving when all three go, on the grounds that it is less of a waste of fuel. *A* then says to *B*:

(41) If you're coming to campus, we're driving

(41) can be given either the relevance or the genuinely conditional in-

terpretation. Are *A* and *C* driving and inviting *B* along? Or is *A* saying that they will drive if *B* decides to join the trip? The availability of both interpretations shows that getting the relevance interpretation does not require excluding the conditional interpretation. Thus, it cannot be that the relevance reading is derived by noting the implausibility of the conditional one. Instead, we are faced with two kinds of conditionals: those that entail their consequent and those that don't. But why would there be *this* variation in conditionals? Why do relevance conditionals contain an *if*-clause at all?

On the analysis developed above, conditionals are semantically composed using a relation between two updates: Conclusion. This relation was found first in similar discourses and then transposed into the compositional semantics of conditionals (§2.4). This dimension of the analysis invites the question whether Conclusion is the only relation conditionals recruit from discourse into compositional semantics. Relevance conditionals sharpen this question: are they the reflex of a different discourse relation being recruited into the semantics of conditionals? Austin observed that (40) is naturally paraphrased as:

(42) Do you want some biscuits? There are some on the sideboard.

How are these two clauses related? The content of the first sentence seems to explain why the second was said. The fact that there's a question about whether you want biscuits explains why one would say — why it's relevant — that there are some on the sideboard. Most discourse relations relate the events described by two clauses, while this one relates the content of one clause (the interrogative) to the utterance of the other (the declarative). Discourse relations of this variety are called *metatalk* (Asher & Lascarides 2003: §7.6.5) or *evaluation* (Hobbs 1990: 89) and are far more common than one might think. Many stories begin with a sequence of this variety.

(43) Something wonderful happened. Ann got a promotion.

In (43), the content of the second clause explains why the first was uttered. I will call this relation, exemplified in (42) and (43), Meta-explanation. In a more fully articulated theory of discourse coherence, Meta-explanation is modeled as a relation between the event described by one clause and the event of uttering the other (Asher & Lascarides 2003; Hobbs 1990). On that analysis, it is no surprise that the temporal/modal anaphor *then* cannot be inserted in the second clause of (42):

(44) Do you want some biscuits? # Then there are some on the sideboard.

Then would require that the state described in the second clause temporally or logically follows from the state described in the first clause. It is more than suggestive that relevance conditionals also cannot tolerate *then* (Davison 1979; Iatridou 1993; Bhatt & Pancheva 2006):

(9) # If you want to talk to Bob, then he's around the corner

In addition to this temporal content of Meta-explanation, it is clear that both clauses are put forward to be accepted. In order for the utterance of the second sentence of (42) to *need* explanation, it must be put forward for acceptance. Further, in order for the content of the first sentence to explain the second, the second sentence must also be put forward. This feature of Meta-explanation can be captured on the model of discourse outlined above: Meta-explanation updates a state with each of the related clauses. The hypothesis that relevance conditionals arise from recruiting Meta-explanation into compositional semantics can be formulated thus:[36]

Relevance Conditionals $(\mathsf{if}\,\phi)\,\psi$ is interpretable as $s[\mathsf{if}\,\phi][\psi]$, with the additional temporal content that the event of uttering ψ is explained by the issue raised by $\mathsf{if}\,\phi$.

This hypothesis explains why an *if*-clause is needed, why the consequent is entailed and how this variation in the interpretation of conditionals fits into a larger pattern. We can interpret two sentences as

36. This composition rule also generates subjunctive relevance conditionals, which have only recently been discussed (Franke 2009; Swanson 2013).

bearing a range of discourse relations, and so too can we interpret the clauses of a conditional. A fuller defense of the hypothesis is needed, but it does have the advantage of not treating conditionals as syntactically ambiguous between two unrelated operations (cf. Siegel 2006; Predelli 2009). This extension of the analysis is possible only on the dynamic version. On the static version, the best one could do is posit a new composition rule that ignores the antecedent completely and just returns the consequent proposition. This captures the fact that the consequent is entailed. But it does not explain why an *if*-clause is used, why *then* cannot be added and how this variation in the meaning of conditionals fits into a larger pattern of linguistic signaling.

4. Conclusion

The conditional-interrogative link calls into question traditional assumptions about the inner workings of conditionals. This inspired me to decompose conditionals into components that parallel moves in a discourse. Once I reassembled them the resultant theory shed light on an undiscussed phenomenon — conditionals with multiple *if*s in the antecedent — and one commonly marginalized phenomenon — relevance conditionals. Together, these three phenomena suggest that the analysis developed here is superior to traditional (connective, restrictor and suppositional) ones.

Viewing conditionals as encapsulated discourses instigated a shift in the format of my semantic theory. Instead of propositions, transitions between bodies of information and issues — or more generally the states of mind that bear these contents — took center stage. Formally articulating this analysis required more and different technical apparatus than traditionally employed. Some might hesitate at this complexity. For this anxiety, Austin has a prescription *cum* rhetorical flourish:[37]

> And is it complicated? Well, it is complicated a bit; but life and truth and things do tend to be complicated. It's not things, it's philosophers that are simple. You will have heard it said, I expect, that over-simplification is the occupational disease of philosophers, and in a way one might agree with that. But for a sneaking suspicion that it *is* their occupation. (Austin 1979: 252)

37. Feedback from audiences at RULing '08, Siena Mind & Culture Workshop, CEU, RuCCS, UChicago, Western Ontario, Toronto, Cornell, Pittsburgh and UCL proved invaluable, as did conversations with Daniel Altshuler, Josh Armstrong, David Beaver, Nuel Belnap, Maria Bittner, Sam Cumming, Veneeta Dayal, Carlos Fasola, Thony Gillies, Jane Grimshaw, Gabe Greenberg, Jeroen Groenendijk, Jim Higginbotham, Harold Hodes, Michael Johnson, Chris Kennedy, Jeff King, Philipp Koralus, Philip Kremer, Ernie Lepore, Karen Lewis, Barry Loewer, Salvador Mascarenhas, Sarah Murray, Floris Roelofsen, Roger Schwarzschild, Chung-chieh Shan, James Shaw, Bob Stalnaker, Jason Stanley, Matthew Stone, Jenn Wang and Brian Weatherson. Three anonymous reviewers for *Philosophers' Imprint* stimulated very significant improvements.

Appendix A. The Logic of Inquisitive Conditionals (LIC)

A.1 Syntax

Remark 1 For simplicity, assume if $\phi := ?\phi$. Strictly speaking, a conditional is written $((?\phi)(\psi))$; I will prefer the more readable (if ϕ) ψ.

Definition 5 (LIC Syntax)

(1)	$A \in \mathcal{W}\!\mathit{ff}_A$	if $a \in \mathcal{A}t = \{\mathsf{A}_0, \mathsf{A}_1, \ldots\}$
(2)	$\neg\phi \in \mathcal{W}\!\mathit{ff}_A$	if $\phi \in \mathcal{W}\!\mathit{ff}_A$
(3)	$\Diamond\phi \in \mathcal{W}\!\mathit{ff}_A$	if $\phi \in \mathcal{W}\!\mathit{ff}_A$
(4)	$(\phi \wedge \psi) \in \mathcal{W}\!\mathit{ff}_A$	if $\phi, \psi \in \mathcal{W}\!\mathit{ff}_A$
(5)	$(\phi \vee \psi) \in \mathcal{W}\!\mathit{ff}_A$	if $\phi, \psi \in \mathcal{W}\!\mathit{ff}_A$
(6)	$(?\phi) \in \mathcal{W}\!\mathit{ff}_Q$	if $\phi \in \mathcal{W}\!\mathit{ff}_A$
(7)	$(\phi \wedge \psi) \in \mathcal{W}\!\mathit{ff}_Q$	if $\phi, \psi \in \mathcal{W}\!\mathit{ff}_Q$
(8)	$(\phi \vee \psi) \in \mathcal{W}\!\mathit{ff}_Q$	if $\phi, \psi \in \mathcal{W}\!\mathit{ff}_Q$
(9)	$((\phi)(\psi)) \in \mathcal{W}\!\mathit{ff}_C$	if $\phi \in \mathcal{W}\!\mathit{ff}_Q, \psi \in \mathcal{W}\!\mathit{ff}_A$
(10)	$((\phi)(\psi)) \in \mathcal{W}\!\mathit{ff}_C$	if $\phi \in \mathcal{W}\!\mathit{ff}_Q, \psi \in \mathcal{W}\!\mathit{ff}_C$
(11)	$\neg\phi \in \mathcal{W}\!\mathit{ff}_C$	if $\phi \in \mathcal{W}\!\mathit{ff}_C$
(12)	$\Diamond\phi \in \mathcal{W}\!\mathit{ff}_C$	if $\phi \in \mathcal{W}\!\mathit{ff}_C$
(13)	$(\phi \wedge \psi) \in \mathcal{W}\!\mathit{ff}_C$	if $\phi, \psi \in \mathcal{W}\!\mathit{ff}_C$
(14)	$(\phi \vee \psi) \in \mathcal{W}\!\mathit{ff}_C$	if $\phi, \psi \in \mathcal{W}\!\mathit{ff}_C$
(15)	$\phi \in \mathcal{W}\!\mathit{ff}$	iff $\phi \in \mathcal{W}\!\mathit{ff}_A \cup \mathcal{W}\!\mathit{ff}_Q \cup \mathcal{W}\!\mathit{ff}_C$

Remark 2 $\mathcal{W}\!\mathit{ff}_A$ is the pure declarative fragment of the language, while $\mathcal{W}\!\mathit{ff}_Q$ is the pure interrogative fragment. While pure interrogatives cannot be negated, they can be conjoined and disjoined. $\mathcal{W}\!\mathit{ff}_C$ is the conditional fragment. The antecedent is required to be a pure interrogative, but can be either a simple one like $?\mathsf{A}_0$ or a complex one such as $?\mathsf{A}_0 \wedge ?\mathsf{A}_3$. Note that interrogative consequents are ruled out for simplicity here, as are antecedents formed from conditionals (which are widely held to be ungrammatical/uninterpretable).

A.2 States and Operations on Them

Definition 6 (Worlds) $W : \mathcal{A}t \mapsto \{1, 0\}$ where $\mathcal{A}t = \{\mathsf{A}_0, \mathsf{A}_1, \ldots\}$

Definition 7 (Contextual Possibilities/Information) $c \subseteq W$

Definition 8 (Contextual Information and Issues)

- C is a non-empty set of subsets of W
  - $\varnothing \neq C \subseteq \mathscr{P}(W)$ and $\bigcup C \in C$
- $\mathcal{C}$ is the set of all such C
- $\bigcup C$ is information embodied by C; sets in C are called *alternatives*
  - Alternatives may overlap, i.e., for $?\phi \vee ?\psi$ though never for $?\phi$

Definition 9 (Issues with Highlighting)

- $C^H = \langle C, H \rangle$, where $C \in \mathcal{C}$ and $H \subseteq \mathscr{P}(W)$
  - H is the (potentially empty) set of answers that are **highlighted**
- $\mathcal{C}^{\mathcal{H}}$ is the set of all such C^H
- Notational conveniences:
  - $C_0^{H_0} \cup C_1^{H_1} = (C_0 \cup C_1)^{H_0 \cup H_1}, \bigcup C^H = \{w \mid \exists c_i \in C \colon w \in c_i\}^H$

Definition 10 (States) S is the set of all states

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

Definition 11 (Subordination, Conclusion)
Where $s = \langle C^H, \cdots \langle C_n^{H_n} \rangle \cdots \rangle$:

1. $s \downarrow \phi = \langle C^H, \cdots \langle C_n^{H_n}, \langle C^H \rangle[\phi] \cdots \rangle \rangle$
2. $$s \uparrow \psi = \begin{cases} s & \text{if } \forall h \in H_n \colon \langle \{c \cap h\}^{\varnothing} \rangle \vDash \psi \\ \langle \varnothing^{\varnothing}, \cdots \langle C_n^{H_n} \rangle \cdots \rangle & \text{otherwise} \end{cases}$$

A.3 Systems of Update Semantics

Remark 3 Below, an update semantics for each fragment of LIC — $\mathcal{W}\!f\!f_A, \mathcal{W}\!f\!f_Q, \mathcal{W}\!f\!f_C$ — is defined. This is only for the purposes of illustration and notational convenience. Ultimately, all $\mathcal{W}\!f\!f$ have only one update semantics, that given in Definitions 14 and 15. Occurrences of $C^H[\phi]$ on the right-hand side in those definitions should be regarded as notational abbreviations for the bodies of highlighted issues specified on the right-hand side of equations in Definition 13.

Definition 12 (Informational Semantics) $[\cdot] : (\mathcal{W}\!f\!f_A \times C) \mapsto C$

(1)	$c[A] = \{w \in c \mid w(A) = 1\}$	(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)	$c[\Diamond\phi] = \{w \in c \mid c[\phi] \neq \varnothing\}$		

Definition 13 (Inquisitive Semantics) $[\cdot] : (\mathcal{W}\!f\!f_A \times \mathcal{C}^{\mathcal{H}}) \mapsto \mathcal{C}^{\mathcal{H}}$

Where $C^H = \{c_0, \ldots, c_n\}^H$, $c + \phi = \bigcup(\{c\}^{\varnothing}[\phi])$, $c - \phi = c - \bigcup(\{c\}^{\varnothing}[\phi])$ and in C^{H^*}, $H^* = \{h \in H \mid h \cap c \neq \varnothing\}$:

(1) $C^H[A] = \{\, \{w \in c_0 \mid w(A) = 1\}, \ldots, \{w \in c_n \mid w(A) = 1\} \,\}^{H^*}$

(2) $C^H[\neg\phi] = \{c_0 - \phi, \ldots, c_n - \phi\}^{H^*}$

(3) $C^H[\phi \wedge \psi] = (C^H[\phi])[\psi]$

(4) $C^H[\phi \vee \psi] = C^{H^*}[\phi] \cup C^{H^*}[\psi]$

(5) $C^H[?\phi] = \{c_0 + \phi, c_0 - \phi, \ldots, c_n + \phi, c_n - \phi\}^{H \cup \{c+\phi\}}$

(6) $C^H[\Diamond\phi] = \{c' \in C \mid C[\phi] \neq \{\varnothing\}\}^H$

Remark 4 $c + \phi$ is just a useful notation for referring to the ϕ worlds in c; similarly for $c - \phi$. H^* ensures that highlighted answers that have been *refuted* are removed. Note that when a proposition is introduced to H it is guaranteed to be a member of C. But subsequent information is not filtered through H. Though it could be, the only use of H is in Definition 11.2 for $s \uparrow \phi$, which first intersects propositions in H with c. Thus there is no need to also have information percolate to H, though a more complex version of Definition 13 could accomplish this.

Remark 5 (Interrogatives) (5) says that an interrogative refines any existing issues, (ii) introduces two new alternatives $c + \phi$, and $c - \psi$, since $c \in C$ (see Definition 9), and (iii) highlights its positive answer $c + \phi$. Step (i) reflects the fact that once ?A is asked, a complete resolution of any of the issues will require taking a stand on A. By contrast, ?A ∨ ?B raises two separate issues, each of which can be resolved without taking a stand on the other.

Definition 14 (Inquisitive-Conditional Semantics)
Where $\phi \in \mathcal{W}\!f\!f_Q$ and $\psi \in \mathcal{W}\!f\!f$

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

Definition 15 (Inquisitive State Semantics) $[\cdot] : (\mathcal{W}\!f\!f \times S) \mapsto S$
Where $s = \langle C^H, \cdots \langle C_n^{H_n}\rangle \cdots\rangle$:

(1) $s[A] = \langle C^H[A], \cdots \langle C_n^{H_n}\rangle \cdots\rangle$

(2) $s[\neg\phi] = \langle C^H[\neg\phi], \cdots \langle C_n^{H_n}\rangle \cdots\rangle$

(3) $s[\phi \wedge \psi] = s[\phi][\psi]$

(4) $s[\phi \vee \psi] = \langle C^H[\phi \vee \psi], \cdots \langle C_n^{H_n}\rangle \cdots\rangle$

(5) $s[?\phi] = \langle C^H[?\phi], \cdots \langle C_n^{H_n}\rangle \cdots\rangle$

(6) $s[\Diamond\phi] = \langle C^H[\Diamond\phi], \cdots \langle C_n^{H_n}\rangle \cdots\rangle$

Remark 6 Definition 16 requires a richer model where there are agents, each of which gets assigned a body of highlighted information and issues in each world, e.g., $C^H_{A_w}$ is A's issues and information in w with highlights H. $\mathsf{W_A}(\text{if } \phi)$ eliminates any w where (i) A has not distinguished between ϕ and $\neg\phi$ alternatives and (ii) A's information in w entails neither ϕ nor $\neg\phi$. Condition (ii) means that updating $C^H_{A_w}$ with if ϕ will return the same highlighted issues. Condition (i) means that $\varnothing$ is not an alternative in $C^H_{A_w}$; if the information entailed ϕ, $\varnothing$ would be the negative answer, and if the information entailed $\neg\phi$, $\varnothing$ would be the positive answer.

Definition 16 (Inquisitive Attitude Semantics)
Where $s = \langle C, \cdots \langle C_m^{H_m} \rangle \cdots \rangle$ and $C = \{c_0, \ldots, c_n\}$:

$$s[\mathsf{W}_{\mathsf{A}}(\mathsf{if}\,\phi)] = \begin{cases} \langle \{ \{ w \in c_0 \mid C^H_{A_w}[\mathsf{if}\,\phi] = C^H_{A_w} \,\&\, \varnothing \notin C^H_{A_w} \}, \\ \quad \ldots, \{ w \in c_n \mid C^H_{n,A_w}[\mathsf{if}\,\phi] = C^H_{n,A_w} \,\&\, \varnothing \notin C^H_{n,A_w} \} \}, \\ \qquad \cdots \langle C_m^{H_m} \rangle \cdots \rangle \end{cases}$$

A.4 Semantic Concepts

Definition 17 (Semantic Concepts)

(1) Support: $s \vDash \phi \Leftrightarrow \bigcup C_s = \bigcup C_{s[\phi]}$
(2) Truth: $w \vDash \phi \Leftrightarrow \langle \{\{w\}\}^H \rangle[\phi] = \langle C_1^H, \ldots \rangle$ and $\bigcup C_1 = \{w\}$
(3) Inconsistency: ϕ is inconsistent with $s \iff s[\phi] = \langle \{\varnothing\}^H, \ldots \rangle$
(4) Informational Content: $[\![\phi]\!] = \{w \mid w \vDash \phi\}$
(6) Entailment: $\phi_1, \ldots, \phi_n \vDash \psi \Leftrightarrow \forall s : s[\phi_1] \cdots [\phi_n] \vDash \psi$

Remark 1 For a plausible logic, the definition of *entailment* should be revised in light of the partial update assigned as the meaning of $(\mathsf{if}\,\phi)\,\psi$ in Definition 16. It should be *Strawsonian* (von Fintel 1999) and consider only states where sequentially updating with the premises and conclusion is defined $\phi_1, \ldots, \phi_n \vDash \psi \Leftrightarrow \forall s$: if $s[\phi_1] \cdots [\phi_n][\psi]$ is defined, $s[\phi_1] \cdots [\phi_n] \vDash \psi$ (see Starr 2014 for discussion).

Fact 3 (The Basic Inquisitive Conditional is Strict over *c*)
Let s be a state and c_s the contextual possibilities in s. Then the effect of $(\mathsf{if}\,\phi)\,\psi$ on c_s is identical to the following update just defined on c:

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

Proof Proceed by induction on the complexity of ψ. First, suppose $\psi \in \mathcal{W}\!f\!f_A$. If $s[\phi] = \langle \varnothing^H, \ldots \rangle$, both $s[(\mathsf{if}\,\phi)\,\psi]$ and $c[(\mathsf{if}\,\phi)\,\psi]$ are undefined. Suppose $s[\phi] \neq \langle \{\varnothing\}^H, \ldots \rangle$. Then $c[\phi] \neq \varnothing$. By Definitions 14 and 11.3 $s[(\mathsf{if}\,\phi)\,\psi] = \langle \{c \in C \mid \langle C^H \rangle[\phi] \vDash \psi\}, \ldots \rangle$. It is clear that $\bigcup(\{c \in C \mid \langle C^H \rangle[\phi] \vDash \psi\}) = \{w \in c \mid c[\phi] \vDash \psi\}$, and thus that $(\mathsf{if}\,\phi)\,\psi$'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 3 holds for them. Suppose $s[\phi] \neq \langle \{\varnothing\}^H, \ldots \rangle$. Then by hypothesis $c[\phi] \neq \varnothing$ and by the same reasoning above, the Fact holds.

Remark 2 Fact 3 applies only to inquisitive conditionals with simple interrogative antecedents, i.e., of the form $?\phi$. A more detailed investigation of how the accounts compare when complex interrogative antecedents, i.e., of the form $?\phi \vee ?\psi$ or $?\phi \wedge ?\psi$, are involved is needed.

Fact 4 (Truth-Conditions for Inquisitive Indicative Conditionals)
1. $(\mathsf{if}\,\phi)\,\psi$ is true in w, if both ϕ and ψ are true in w.
2. $(\mathsf{if}\,\phi)\,\psi$ is false in w, if ϕ is true in w and ψ is false in w.
3. Otherwise, $(\mathsf{if}\,\phi)\,\psi$'s truth-value is undetermined in w.

Proof Suppose ϕ is false in w. What is $(\mathsf{if}\,\phi)\,\psi$'s truth-value in w? This amounts to asking what the result of $\langle \{w\}^H \rangle[(\mathsf{if}\,\phi)\,\psi]$ is. This conditional update must meet the presupposition that $\langle \{w\}^H \rangle[\phi] \neq \langle \{\varnothing\}^H, \ldots \rangle$. But since ϕ is false in w, this presupposition is not met, i.e., $\langle \{w\}^H \rangle[\phi] = \langle \{\varnothing\}^H, \ldots \rangle$. Thus, $(\mathsf{if}\,\phi)\,\psi$'s truth-value is undefined at any world where ϕ is false. Similar reasoning confirms the other truth-conditions stated above.

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