2021

Chasing Hook: Quantified Indicative Conditionals

Angelika Kratzer

Chasing Hook: Quantified Indicative Conditionals

Angelika Kratzer

University of Massachusetts at Amherst

May 2015

Abstract

This chapter looks at indicative conditionals embedded under quantifiers, with a special emphasis on 'one-case' conditionals as in *No query was answered if it came from a doubtful address*. It agrees with earlier assessments that a complete conditional (with antecedent and consequent) is embedded under a quantifier in those constructions, but then proceeds to create a dilemma by showing that we can't always find the right interpretation for that conditional. Contrary to earlier assessments, Stalnaker's conditional won't always do. The paper concludes that the embedded conditional in the sentence above is a material implication, but the *if*-clause also plays a pragmatic role in restricting the domain of the embedding quantifier. That an appeal to pragmatics should be necessary at all goes with Edgington's verdict that "we do not have a satisfactory general account of sentences with conditional constituents."

0. Introduction

I should say this upfront. The Hook from Edgington's *Conditionals* is a man with opinions. He thinks that *if* is a truth-functional connective and corresponds to material implication. My Hook is not a 'he' or a 'she', but an 'it'. It is material implication itself. It is ⊃. Hook is elusive. We know it has a connection with *if*, but we don't quite know what the connection is. My project is to hunt Hook down in the back alleys of English. It's not that I think Hook is that special. I am interested in Hook because it makes a good probe for exploring the properties of embedded conditionals.

Embedded conditionals are a potential problem for theories of conditionals that don't give them truth-conditions. Lewis (1976) voiced an admittedly inconclusive objection: "We think we know how the truth conditions of compound sentences of various kinds are determined by the truth conditions of constituent subsentences, but [if conditionals had no truth conditions A. K.] this knowledge would be useless when it comes to conditional subsentences." Edgington (1995) accepts the first part of Lewis' statement, but then goes on: "But this knowledge *is* useless when it comes to conditional subsentences. We do not have a satisfactory general account of sentences with conditional constituents" (p. 281). What's on the docket, then, are the prospects for a satisfactory general account of sentences with embedded conditionals.

1. Higginbotham's Puzzle

The embarrassment had been known for a long time, but nobody dared talk about it. Then Higginbotham (1986) dragged it into the open. Then many tried their hand at it (von Fintel (1998); Dekker (2001); von Fintel & Iatridou (2002); Higginbotham (2003); Abbott (2004); Egré & Cozic (2008); Leslie (2009); Huitink (2009); Klinedinst (2011)). The embarrassment was for those who believe in compositionality. Examples 1(a) and (b) are (almost) Higginbotham's.

(1) a. Everyone will fail if they goof off.

b. No one will pass if they goof off.

If failing is not passing, 1(a) and (b) are equivalent. They express the same proposition. 1(a) and (b) are also syntactic isomorphs; they are put together in the same way. And their semantic type trees are the same. The meanings of 1(a) and (b) should be put together in the same way, too, then. But that can't be so if *if* means Hook. Hook does well with 1(a), but fails badly with (b). 2(b) comes out true iff everyone goofs off and no one succeeds. But 1(b) does not require that everyone goof off, and so 2(b) cannot be the correct formalization of 1(b).

(2) a. $\forall x$ (goof-off(x) $\supset$ fail(x)) Correct formalization of 1(a).

b. $\neg\exists x$ (goof-off(x) $\supset$ pass(x)) Incorrect formalization of 1(b).

Some say there is a silent *always* that comes with *if* in cases like 1(a) or (b), or a silent necessity modal. That's no help. 3(a) and (b) still aren't equivalent, nor are 4(a) and (b).

(3) a. $\forall x \forall t$ (goof-off(x)(t) $\supset$ fail(x)(t))

b. $\neg \exists x \forall t$ (goof-off(x)(t) $\supset$ pass(x)(t))

(4) a. $\forall x \forall w$ (goof-off(x)(w) $\supset$ pass(x)(w))

b. $\neg \exists x \forall w$ (goof-off(x)(w) $\supset$ succeed(x)(w))

Some say that *if*-clauses restrict quantificational operators. If they can restrict adverbial or modal quantifiers, why not determiner quantifiers, too? The *if*-clauses in 1(a) and (b) should then restrict the domains of *every* and *no* in the same way a restrictive relative clause would. 1(a) should mean the same as 5(a), and 5(b) should be a paraphrase of 1(b).

(5) a. Everyone who goofs off will fail.

b. No one who goofs off will pass.

That proposal faces problems, too. Higginbotham (2003), Leslie (2009), and von Fintel & Iatridou (2002) have counterexamples. Leslie imagines a student, Meadow, whose teacher would never fail her, regardless of how well she did. Meadow happens to work very hard for that teacher's class, however, and is thus not among

those who goof off. The relative clause *who goofs off* in 5(a) and (b) can be readily understood as restricting the domain of *everyone* and *no one* to those students who are actually in the habit of goofing off or will actually goof off in the course of the class. Since Meadow is not among them, she is no obstacle to the truth of 5(a) or (b). In contrast, the *if*-clause in 1(a) and (b) creates a strong pull towards an interpretation where we look at all students in turn and consider situations where they goof off, moving on to merely possible situations if there aren't any actual ones. On that interpretation, the fact that Meadow would pass if she goofed off makes her a falsifying instance for 1(a) and (b).

von Fintel and Iatridou (2002) observe that the construction exemplified by 1(a) and (b) is constrained in a way that would be unexpected if *if*-clauses restricted determiner quantifiers in the way relative clauses do. We would have no obvious explanation for the contrast between 6(a) and 6(b) (modeled after Goodman (1955)), for example.

(6) a. Every coin that is in my pocket is silver.

b. # Every coin is silver if it is in my pocket.

Unlike 6(a), 6(b) is odd. It suggests a non-accidental link between coins that are silver and coins in my pocket. The suggestion of a non-accidental link between antecedent and consequent is a well-known property of conditionals. It points to a complete conditional construction embedded under *every coin*.

Another striking contrast discovered by von Fintel & Iatridou is illustrated by the minimal pair 7(a) and (b) (their examples 27(a) and (b)).

(7) a. Nine of the students will succeed if they work hard.

b. Nine of the students who work hard will succeed.

7(b) presupposes that there are more than nine students who work hard. 7(a) has no such presupposition. 7(a) says that there are nine students who 'have it in them' to succeed if they work hard. Nothing is implied about the number of students who actually work hard. This interpretation points again to a complete conditional construction in 7(a).

To sum up, we have seen evidence suggesting that sentences like 1(a) and (b) embed complete conditional constructions. They are genuine cases of embedded conditionals, then. In light of Edgington's (2001) verdict that "… no general algorithmic approach to complex statements with conditional components has yet met with success", the prospects for an insightful analysis of such constructions look daunting. The following two sections will feed Edgington's skepticism: The discussion will get to a point where the prospects for a general account of conditionals embedded under quantifier phrases look outright hopeless. The rest of the paper will then begin to gather support for a more positive outlook.

2. Abbott's Puzzle

Assuming that passing is not failing, the logical make-up of 1(a) and (b) can be displayed as in 8(a) and (b):

(8) a. ∀x (if goof-off(x), fail(x))

b. ∀x ¬ (if goof-off(x), ¬fail(x))

We can now see clearly that, to derive the equivalence of 1(a) and (b), we need a conditional that makes 9(a) and (b) equivalent.

(9) a. (if goof-off(x), fail(x))

b. ¬ (if goof-off(x), ¬fail(x))

Assuming a bivalent background logic, 9(a) and (b) are equivalent just in case 10(b) is the negation of 10(a).

(10) a. (if goof-off(x), fail(x))

b. (if goof-off(x), ¬fail(x))

The conditional we are looking for, then, needs to be one that is negated by negating its consequent. Like material implication, it doesn't allow opposite conditionals (like 10(a) and (b)) to be both false. It has to obey Conditional Excluded Middle (CEM).

But unlike material implication, our conditional also doesn't allow opposite conditionals to be both true. It has to obey Weak Boethius' Thesis (WBT).[1]

(11) (if A, B) ∨ (if A, ¬B) CEM

(12) (if A, ¬B) ⊃ ¬(if A, B) WBT

On a material implication interpretation, the opposite conditionals 10(a) and (b) are both true if x doesn't actually goof off. Leslie's example shows that we are looking for a conditional that cares about what would happen if x were to goof off. As Higginbotham (2003) and Klinedinst (2011) point out, there is a conditional in the literature that almost fits the bill – Stalnaker's (Stalnaker 1968).

Stalnaker's conditional is true in a world w just in case its consequent is true in the closest world to w where its antecedent is true. If the antecedent is impossible, the closest world to w is stipulated to be the absurd world, where everything is true. On Stalnaker's analysis, conditionals with impossible antecedents are true, hence opposite conditionals with impossible antecedents are both true, violating WBT. The violation seems minor, though, and comes from a stipulation that feels a little arbitrary. We might set aside the impossible case. Stalnaker's conditional would then explain the intuitive equivalence of 1(a) and (b). Leslie's student Meadow is no longer a counterexample. Since she isn't actually goofing off we have to consider the

---

[1] . I am using the terminology of Pizzi & Williamson (2005).

closest world where she is. In that world she will still pass, hence 1(a) and (b) both wind up false. Stalnaker's analysis does well with conditionals like 1(a) and (b). But there are other kinds of conditionals that insist that we stick to actuality. The point was made in Abbott (2004). My example is a variation on one of hers, but is also different in important respects. It was constructed so as to not merely challenge the semantic side of Stalnaker's account of indicative conditionals. It also tries to block the possibility of invoking the pragmatic side of his account.[2]

Email Handling

You have two employees who, between them, are required to jointly answer all of your email queries, as long as they come from a respectable address. Your clients come from India or the US. One of the employees, Good Employee, handles all mail from India. She reliably answers all queries that come from respectable addresses. The other employee, Bad Employee, handles all mail from the US. She never answers any queries at all. There have been complaints recently about unanswered queries. You pick a particular time window for investigation: last month. Here is what you found. Good Employee handled 100 queries during that time. By sheer accident, they were all sent from respectable addresses, and she answered all of them. Bad Employee also handled 100 queries last month. By sheer accident, not a single one was sent from a respectable address, and she didn't answer any of them.

In the situation described, (13) is intuitively true.

---

2. See Stalnaker (2014), chapter 6.

(13) Every query was answered if it was sent from a respectable address.

Assume that your clients all have both respectable and dubious e-mail addresses that they can access with equal ease, and that they don't send messages from any other country but their own. Assume whatever else it may take to make it so that every query that actually came from a dubious (not respectable) address would still have landed in Bad Employee's mailbox if it had come from a respectable address. (13) would then seem to wind up false on Stalnaker's account. We would seem to have to consider for every query that actually came from a dubious address the closest world where it didn't. The query would still land in Bad Employee's mailbox in that world, and thus remain unanswered.

But Stalnaker's account of indicative conditionals also has a pragmatic side to it. Interestingly, embedding a conditional under a quantifier phrase affects its pragmatic properties in crucial ways. For example, (13) can be completely acceptable and natural in contexts, where for each of the 200 queries under investigation, it is common knowledge whether or not it came from a respectable address. Here is an illustration. Suppose you assembled a list of the 200 queries, each paired with information about whether or not it came from a respectable address, and whether or not it was answered. You met with your two employees and put the list on the table. You could then use (13) as a way of summarizing the data you are looking at together. In this situation, the content of the list has become

Common Ground among the three of you. There is no world in the Common Ground where a query that came from a dubious address in the actual world came from a respectable address. With respect to the assumed Common Ground, then, it was impossible for any of those dubious queries to come from a respectable address.

According to Stalnaker (1968), the truth of a conditional depends on a selection function *f*, which maps a proposition and a world to a selected world. A conditional of the form *(if A, B)* is true in a world *w* with respect to a selection function *f* just in case *B* is true in *f*(*A*, *w*). Not just any selection function is permitted. There are constraints. One says that *A* must be true in *f*(*A*, *w*). Another one lets the selection function pick the absurd world only if *A* is impossible. This condition is met on our scenario. In the context described above, the antecedent of 'if x was sent from a respectable address, x was answered' is impossible for any x that was actually sent from a dubious address. Once the pragmatic part of Stalnaker's analysis is taken into account, then, (13) comes out true in contexts like the one we imagined. That's right for our example, but it is not the end of the story.

In the assumed context, the embedded conditional of (13) is precisely the marginal case of a Stalnaker conditional that we had to set aside in our search for a conditional that makes 1(a) and (b) equivalent. Stalnaker's conditional only delivers the equivalence of 1(a) and (b) as long as we don't have to worry about impossible antecedents. Otherwise, WBT fails. The problem that we are now facing is that sentences like 14(a) and (b) below feel no less equivalent than 1(a) and (b), but we

can no longer afford to neglect cases with impossible antecedents. The scenario we have been considering confronts us with just such a case.

(14) a. Every query was answered if it was sent from a respectable address.

b. No query was not answered if it was sent from a respectable address.

If material implication is ruled out as a possible interpretation for the embedded conditional in 14(a) and (b), so is the Stalnaker conditional. We are back to square one. We have no general analysis of conditionals embedded under quantifier phrases. Stalnaker's conditional delivers the equivalence of 1(a) and (b) under plausible assumptions, but those assumptions are no longer plausible for 14(a) and (b): the cases that can be neglected for 1(a) and (b) can no longer be neglected for 14(a) and (b).

3. Pizzi & Williamson's bombshell

Let us take stock of where things stand. We convinced ourselves that for 14(a) and (b) to come out equivalent, the embedded conditional must obey both CEM and WBT.

(14) a. Every query was answered if it was sent from a respectable address.

b. No query was not answered if it was sent from a respectable address.

We have also seen that the embedded conditional in 14(a) and (b) has different properties from that in 1(a) and (b). The *if*-clause in 1(a) and (b), but not that in 14(a) and (b), allows us to consider mere potentials. Tracking the behavior of the kind of conditional exemplified in 14(a) and (b) in other syntactic environments reveals moreover that, as a type, it validates both Modus Ponens (MP) and Contraposition (CP).

(15) (If A, B), A $\vdash$ B MP

(16) (If A, B) $\vdash$ (if $\neg$B, $\neg$A) CP

Modus Ponens used to be considered a solid principle for reasoning with conditionals, but then there was McGee (1985), who came with a series of counterexamples. Here is the best-known one (McGee (1985), 462).

<u>McGee</u>

Opinion polls taken just before the 1980 election showed the Republican Ronald Reagan decisively ahead of the Democrat Jimmy Carter, with the other Republican in the race, John Anderson, a distant third. Those apprised of the poll results believed, with good reason:

> If a Republican wins the election, then if it's not Reagan who wins it will be Anderson. A Republican will win the election.

Yet they did not have reason to believe that if it's not Reagan who wins, it will be Anderson.

The conditionals discussed in McGee (1985) either contain the modal *will* or have the feel of lawlike generalizations. They very readily comply with Modus Ponens as soon as we change them into the bare past tense conditionals exemplified in (14).

Transposed McGee

Opinion polls taken just before the 1980 election showed the Republican Ronald Reagan decisively ahead of the Democrat Jimmy Carter, with the other Republican in the race, John Anderson, a distant third. Imagine that the polls just closed and those apprised of the poll results believe, with good reason:

> If a Republican won the election, then if it wasn't Reagan who won, it was Anderson. A Republican won the election.

They had every reason to believe that if it wasn't Reagan who won, it was Anderson.

Contraposition is usually rejected for counterfactuals, but seems to hold for the kind of indicative conditional we have in (14). If any breed of conditionals obeys Contraposition, that particular breed does.

(17) a. If this query was sent from a respectable address, it was answered.

b. If this query was not answered, it was not sent from a respectable address.

Yet sometimes, bare past conditionals like 18(a) and (b) are offered as potential counterexamples to Contraposition.

(18) a. If Mary read the paper, she didn't read it this morning.

b. If Mary read the paper this morning, she didn't read it.

Both 18(a) and (b) convey that Mary didn't read the paper this morning. 18(a) is acceptable, 18(b) is not. The difference doesn't seem to be a difference in truth-conditions, though. 18(a) is only appropriate in contexts where Mary might have read the paper (Stalnaker (1975)). Likewise, 18(b) should only be appropriate in contexts where Mary might have read the paper this morning. However, no cooperative speaker uttering 18(b) can possibly believe that Mary might have read the paper this morning, since 18(b) implies that she didn't read the paper this morning. 18(a) and (b) are an odd pair of contraposed conditionals, but they are no counterexample to Contraposition. I conclude that both Modus Ponens and Contraposition are valid for the type of indicative conditional exemplified in (14).

There is a bombshell hidden in the conclusion I just drew: it turns out that any conditional that satisfies MP, CP, CEM, and WBT is equivalent to the material biconditional. In other words, if the conditional embedded in 14(a) and (b) is a type of conditional that validates MP, CP, CEM, and WBT, we can prove that it has to be equivalent to the material biconditional. The proof is in Pizzi & Williamson (2005). It is easy to see that the material biconditional satisfies MP, CP, CEM, and WBT. The

other direction requires a little more work. Following the strategy in Pizzi & Williamson, it can be shown that, assuming a bivalent background logic, 19(a) to (d) are valid for any conditional satisfying MP, CP, CEM, and WBT.

(19) a. $(A \& B) \supset (\text{if } A, B)$

b. $(A \& \neg B) \supset \neg(\text{if } A, B)$

c. $(\neg A \& B) \supset \neg(\text{if } A, B)$

d. $(\neg A \& \neg B) \supset (\text{if } A, B)$

If 19(a) to (d) are valid for a conditional, it is true just in case its antecedent and consequent are both true or both false. Those are the truth-conditions for the material biconditional.

What is upsetting about the result we have just derived is that the conditional embedded in 14(a) or (b) doesn't look or feel like a biconditional.[3] Intuitively, 14(a) and (b) could be true in cases where some queries from dubious, not respectable, addresses were also answered. But that can't seem to be so if the embedded

---

[3] . Conditionals can sometimes be strengthened to biconditionals via a pragmatic process called 'Conditional Perfection' in the linguistic literature (Geis & Zwicky (1971), see also the discussion of examples (25) to (27) below). Conditional Perfection might affect 14(a): the effect can be contextually manipulated, though, and doesn't affect 14(b) in the same way.

conditional is a material biconditional. I have slipped into what looks like a paradoxical situation. Where did I go wrong? I stand by every single step in the reasoning I went through. 14(a) and (b) do feel equivalent. The embedded conditionals should therefore satisfy CEM and WBT. Those particular kinds of indicative conditionals also satisfy MP and CP. Pizzi & Williamson's proof is correct. The embedded conditional in 14(a) and (b) has to be equivalent to the material biconditional, then. How can this be?

4. Solving Abbott's Puzzle: Hook in hiding

Let us take stock again. We have zoomed-in on a breed of conditional that is different from *will*-conditionals. It validates Modus Ponens and Contraposition. When it is embedded under a quantifier phrase, it doesn't allow us to consider individuals' mere potentials for satisfying the antecedent. It looks just like Hook. The problem is that we also judge sentences like 14(a) and (b) as equivalent.

(14) a. Every query was answered if it was sent from a respectable address.

b. No query was not answered if it was sent from a respectable address.

Pizzi & Williamson's proof seems to establish that for 14(a) and (b) to be equivalent, the embedded conditional has to be the material biconditional. Our dilemma is that we do not perceive a material biconditional in 14(a) or (b).

There must be some element in the syntactic environment of the embedded conditionals in 14(a) and (b) that obscures their compositional meaning contribution. The meaning of 14(a) and (b) can't just be composed from a conditional and a quantifier phrase with a fixed, context independent, denotation. There has to be another player. I want to suggest that that other player is no stranger: it is whatever device is responsible for covert domain restrictions for nominal quantifiers. Many authors, including von Fintel (1994), Stanley & Szabó (2000), Stanley (2000), and Martí (2003), have posited domain variables to account for covert quantifier domain restrictions. Martí and von Fintel have argued moreover that nominal domain restriction variables are attached to determiners.

(20) No$_D$ query was not answered if it came from a respectable address.

The domain restriction variable in (20) needs a value, and the embedded *if*-clause is a natural provider. In out-of-the-blue contexts, it is the only possible provider. On this proposal, the *if*-clause in 14(a) and (b) plays a double role. It is the antecedent of an embedded conditional, while simultaneously restricting the domain of the nominal quantifier. Logical forms for 14(a) and (b) would amount to 21(a) and (b).

(21) a. (∀x: query(x) & from-respectable-address (x)) (from-respectable-address (x) ⊃ answered (x))

b. (∀x: query(x) & from-respectable-address (x)) ¬ (from-respectable-address (x) ⊃ ¬answered (x))

21(a) and (b) have the right interpretation. They do not imply that no queries from dubious, not respectable, addresses were answered. They are equivalent, and boil down to (22).

(22) (∀x: query(x) & from-respectable-address (x)) answered (x)

The proposal preserves von Fintel & Iatridou's insight that a complete conditional is embedded under the quantifier phrase in constructions like 14(a) and (b). In this particular case, the embedded conditional seems to be Hook.

If *if*-clauses can only restrict nominal domains indirectly through the mediation of a domain variable that comes with DPs (determiner phrases), we might expect nominal domain restriction via *if*-clauses to be sensitive to the nature of those DPs. Probing into this question, we find that different types of DPs do indeed differ in their ability to be restricted by *if*-clauses. (23) and (24) illustrate.

(23) a. Every query was answered if it came from a respectable address.

b. No query remained unanswered if it came from a respectable address.

c. Most queries were answered if they came from a respectable address.

(24) a. # Exactly fifty queries were answered if they came from a respectable address.

b. # At least fifty queries were answered if they came from a respectable address.

c. # At most fifty queries were answered if they came from a respectable address.

In 23(a) to (c), the *if*-clauses can restrict the domains of the quantifiers with relative ease. In contrast, readings where the *if*-clauses restrict the domains of the quantifiers are hard to get, if not unavailable, for 24(a) to (c). As a result, we can't seem to figure out what those sentences say. We are confused about how to count the queries. Clear cases of verifying instances are those queries that came from respectable addresses and were answered. But what are we supposed to do with queries that came from dubious addresses? My mind wants to side with Nicod (1924) and veto them as confirming instances of 24(a) to (c). But it also seems to want to interpret the embedded conditional as Hook. It is caught in a conundrum, then, that it can't seem to resolve.

(23) and (24) sort DPs in familiar ways. According to Landman (2004), those in (24) are born with property interpretations ("denotations at the type of sets") that may be type-shifted into other denotations in particular syntactic environments. The property interpretation emerges in constructions like *the exactly fifty queries*, *the at most fifty queries*, or *the at least fifty queries*, for example. In contrast, the DPs in (23) begin life with contentful determiners that map properties to generalized quantifiers. If nominal domain variables require contentful determiners to attach to,

we have an explanation for the pattern in (23) and (24). More work is needed, of course, to put the assumption that nominal domain variables have to attach to contentful determiners on a more solid footing. I will have to leave that project for another occasion.[4]

A potential argument supporting the assumption that *if*-clauses restrict determiner quantifiers pragmatically, rather than semantically or syntactically, can be constructed by showing that discourse properties can be manipulated to create configurations where the consequents, rather than the antecedents, of conditionals act as restrictors for quantifier domains. (25) illustrates.

(25) You: Did you see kids using calculators when you volunteered in your son's school yesterday? What did they use the calculators for?

Me: <u>Most kids asked for calculators if they had to do long divisions</u>. But I am pleased to report that most kids in my son's school do long divisions by hand.

---

[4] . An equally plausible story can be told if nominal quantifier domain restrictions are accounted for by routine situation arguments, rather than by special domain restriction variables. Here, there are already arguments that strong, but not weak, quantificational determiners introduce situation arguments. See Keshet (2008), Schwarz (2009, 2012), and Elbourne (2013) for discussion of this issue.

The targeted sentence in (25) is (26):

(26) Most kids asked for calculators if they had to do long divisions.

The context for (26) in (25) is set up so that the consequent of the embedded conditional is old information and the antecedent is new information. This manipulation has the effect of restricting the domain of *most* in (26) within (25) to kids who asked for calculators. The claim is that most kids who asked for calculators had to do long divisions. Only this interpretation of (26) is consistent with the sentence following it in (25), which adds the information that most kids in my son's school who do long divisions do not use calculators. Since my reply in (25) has an interpretation that feels entirely consistent, there must be an interpretation of (26) where the consequent, rather than the antecedent, of the embedded conditional restricts the domain of the embedding quantifier phrase.

The context manipulation that allows the consequent of the embedded conditional in (26) to be a restrictor has a second, well-known, effect. The emphasis placed on the antecedent creates an *only*-implicature, *de facto* turning the embedded conditional into a biconditional. The effect can be tracked more clearly with the unembedded conditional in (27):

(27) You: Does your son use a calculator in math classes? And if so, what does he use the calculator for?

Me: My son uses a calculator if he has to do long divisions.

In the context of (27), my reply is most readily understood as saying that my son uses a calculator if he has to do long divisions, but not otherwise. The suggestion is that if he doesn't have to do long divisions, he doesn't use a calculator. The pragmatic process that turns a conditional into a biconditional (Conditional Perfection (Geis & Zwicky (1971)) has generated a huge literature and cannot be done justice here. For our current argument, it is important that there is such a process, that it is facilitated by placing emphasis on the antecedent, and that it can apply to embedded conditionals. A logical form that displays the intended interpretation of (26) is (28), which is equivalent to (28'):

(28) (Most x: kid(x) & asked-for-calculator(x)) (has-to-do-long-divisions(x) ≡ asked-for-calculator(x))

(28') (Most x: kid(x) & asked-for-calculator(x)) has-to-do-long-divisions(x)

The idea that *if*-clauses may play both a semantic and a pragmatic role is neither new nor outlandish. von Fintel (2001) uses an example from Edgington ((1995), 252f) to illustrate the pragmatic, dynamic, effect of *if*-clauses.

<u>The Missing Hard Hat</u>

For example, a piece of masonry falls from the cornice of a building, narrowly missing a worker. The foreman says: "If you had been standing a foot to the left, you

would have been killed; but if you had (also) been wearing your hard hat, you would have been alright. ”

As Edgington notes (for a related example, p. 253; see also Frank (1997)), the order of presentation of the counterfactuals matters in such discourses. The first counterfactual in the previous passage feels true, but that very same counterfactual in the following passage comes across as false.

Transposed Missing Hard Hat

For example, a piece of masonry falls from the cornice of a building, narrowly missing a worker. The foreman says: “If you had been wearing your hard hat, you would have been alright; but if you had been standing a foot to the left, you would have been killed.”

In both versions of the Missing Hard Hat, the antecedent of the first counterfactual remains active in the discourse and has a continued pragmatic effect beyond its semantic contribution to the truth-conditions of the first counterfactual. In the original Missing Hard Hat example, that effect can be channeled back into the semantics via the anaphoric particle *also*. In the transposed Missing Hard Hat example, the impact of the first antecedent is more indirect. It might update the set of worlds that are relevant for the interpretation of the second counterfactual, as on the accounts of von Fintel (1999, 2001) and Gillies (2007). Alternatively, it could make salient the possibility that the worker might have been wearing a hard hat if

he had been standing a foot to the left, as suggested by the account of Moss (2012). If the foreman can't rule out that salient possibility, Moss would say, it would be irresponsible of him to claim that the worker would have been killed if he had been standing a foot to the left.

If *if*-clauses can 'live on' in discourse beyond their local domain, there should be nothing preventing them from pragmatically restricting non-local nominal domains. There is a solution for Abbott's Puzzle, then. The solution says that when we interpret 14(a) or (b), the domains of the embedding quantifier phrases are pragmatically restricted by the embedded *if*-clause. The embedded conditional itself might very well be Hook.

5. The family of Hook

Hook is just one among many kinds of conditionals that can be embedded under quantifiers. All of the following pairs of conditionals feel equivalent.

(29) a. Everyone failed if they goofed off.

b. Nobody passed if they goofed off.

(30) a. Everyone will fail if they goof off.

b. Nobody will pass if they goof off.

(31) a. Everyone would fail if they goofed off.

b. Nobody would pass if they goofed off.

(32) a. Everyone should fail if they goof off.

b. Nobody should pass if they goof off.

(33) a. Everyone has to fail if they goof off.

b. Nobody can pass if they goof off.

By the end of the day, we would want to account for all the equivalences in (29) to (33). We would also want to explain what is going on with 34(a) and (b).

(34) a. Everyone is likely to fail if they goof off.

b. Nobody is likely to pass if they goof off.

34(b) seems to have two interpretations. One, but not the other, makes 34(a) and (b) equivalent. Suppose everyone who goofs off has a 50% chance of passing. Then 34(a) is false. On its first interpretation, 34(b) says that everyone is unlikely to pass if they goof off. That's also false if everyone who goofs off still has a 50% chance of passing. On its second interpretation, 34(b) is true on our scenario. Students who have a mere 50% chance of passing if they goof off cannot be said to be likely to pass. None of those who goof off are among those who are likely to pass, then. 34(a) an (b) are equivalent on the first interpretation, but not on the second.

We need to steer a course that allows the whole family of conditionals to stand united. The conditionals embedded in (29) to (34) are all different, but they don't differ in capricious ways. The main difference is the modal in their consequent: *likely*, *can*, *have to*, *should*, *would*, and *will*. If we want a unified analysis of all *if*-clauses in (30) to (34), we need to let the *if*-clauses restrict the domains of their modals. This is the Restrictor View of *if*-clauses. There is also the apparently modal-less (29). For full generality, we should posit a silent modal in (29). I will use the symbol $\boxdot$ for that particular modal in what follows. An immediate consequence of the Restrictor View is that the negation of a conditional should amount to the negation of its (restricted) modalized consequent. This is a particular interesting prediction to check, since different types of modals are known to interact with negation in different ways:

(35) a. Nobody will fail.

b. Nobody would fail.

c. Nobody should fail.

d. Nobody has to fail.

e. Nobody can fail.

f. Nobody is likely to fail.

The interaction between negation and conditionals has recently been investigated experimentally by Paul Egré and Guy Politzer (reported in Egré & Politzer (2013)).

Preliminary findings suggest that conditionals might interact with negation in the way expected on the Restrictor View.

If the *if*-clauses in (29) to (34) restrict their modal, they simultaneously restrict two domains: that of the modal and that of the quantifier. The restriction of the quantifier is a pragmatic effect, as we saw earlier. The restriction of the modal seems to be more tightly engineered by grammar. To see the difference, we need to move to a slightly more technical level of discussion. For illustration, I will adopt von Fintel's (1994) implementation of the Restrictor View.

Suppose every occurrence of conditional *if* carries a domain variable that ranges over accessibility functions (functions from worlds to sets of worlds) and is coindexed with a domain variable on a local modal.

(36) If$_{C_1}$she goofed off, she has to$_{C_1}$fail.

The interpretations of *if*, *has to*, and *can* could be as in (37).

(37) For any sentences α and β:

a. $[[(If_{C_1}\ \beta)\ \alpha]]^{w,g} = [[\alpha]]^{w,g'}$, where g' is like g, except that $g'(C_1) = \lambda w.\ g(C_1)(w) \cap [[\beta]]^g$.

b. $[[has\ to_{C_1}\alpha]]^{w,g} = 1$ iff $g(C_1)(w) \subseteq [[\alpha]]^g$.

c. $[[can_{C_1}\alpha]]^{w,g} = 1$ iff $g(C_1)(w) \cap [[\alpha]]^g \neq \varnothing$.

d. $[[\alpha]]^{g} =_{def} \{w: [[\alpha]]^{w, g} = 1\}$.

If-clauses do not identify the values of the domain variables they are coindexed with on von Fintel's account. They merely constrain their values. We might assume that initial variable assignments assign the trivial accessibility function (the function that assigns the set of all possible worlds to every world) to each modal domain variable. Context and *if*-clauses can then successively update the values of those variables. The account assumes that *if*-clauses are coindexed with a local modal contained in the sentence they are adjoined to. The coindexation has the effect that the domain of the *if*-clause and the domain of the modal are identified. Relying on related observations in Iatridou (1991), von Fintel points out that the locality requirement for the association of an *if*-clause with its modal is the one familiar from overt movement. The relation between *if*-clause and its modal can be long-distance, but it cannot be across known barriers for movement. This suggests that by the time we see an *if*-clause, it may have moved away from its original position adjacent to its modal. Alternatively, it may not be the *if*-clause itself that enters a relation with a modal, but its 'correlate' pronoun *then*. It would then not be the *if*-clause, but its correlate that moves away from an adjacent modal (see Bhatt & Pancheva (2006) for discussion of such a possibility within a different analysis of conditionals).

von Fintel's implementation of the Restrictor View predicts that multiple *if*-clauses should be able to restrict one and the same modal, and a single *if*-clause should be

able to restrict multiple modals. Both predictions are borne out, as illustrated in (38) and (39).

(38) a. If he left at five, he must be home, if he didn't stop for a beer.

b. (If$_{C_1}$ he left at five (if$_{C_1}$ he didn't stop for a beer (he has to$_{C_1}$ be home)))

(39) If$_{C_1}$ a wolf entered the house, he must$_{C_1}$ have eaten grandma, since she was bedridden. He might$_{C_1}$ have eaten the girl with the red cap, too.

If *if*-clauses are grammatically required to relate to a modal, but modals are not grammatically required to relate to an *if*-clause, there is a grammatically enforced relation between *if* and *must* in (39), but there is no grammatically enforced relation between *if* and *might*, nor between *might* and *must*. There is nothing in the grammar that requires coindexation of the domain variables of the two modals. The domain variables of modals can be restricted by context alone, as in (40):

(40) There might$_{C_1}$ be a storm. We might$_{C_2}$ be without electricity.

One way of understanding the second sentence of (40) is as conveying that we might be without electricity if there is a storm. The first sentence in (40) raises the possibility that there might be a storm. As a result, the possible worlds considered for the second sentence can be pragmatically restricted to those where there is a storm. Mauri & van der Auwera (forthcoming) report that there are languages

where conditionals are generally expressed via a pragmatic strategy along the lines of (40).

On the Restrictor View, the modals in (29) to (34) are the crucial players. They should be responsible for the distinctive properties of all conditionals. I will not be able to demonstrate this in full detail. I would have to dig deeply into the semantics of each individual modal. To illustrate the agenda, I will derive the interpretations of (41) and (42) by positing particular denotations for *will* and the unpronounced modal $\boxdot$.

(41) No_D one λx (if_{C_1} x goofs off (will_{C_1} x pass))

(42) No_D one λx (if_{C_1} x goofed off ($\boxdot_{C_1}$ x passed))

I am aiming for interpretations where (41), but not (42), cares about what would happen if a student goofed off. On the intended readings, (41) is a generic conditional, and (42) is a 'one-case' conditional that makes a hypothesis about a particular exam.[5] I am aware that those interpretations do not only depend on the

---

[5] . The term 'one-case-conditional' is due to Kadmon (1992). Not all conditionals with silent modals are 'one-case' conditionals. Not all silent modals are $\boxdot$. Some seem to be genuine necessity operators. The kind of experiments designed by Egré & Politzer (2013) should help with identifying the nature of silent modals in conditionals.

modals. The contributions of tense-mood-aspect marking in the participating sentences are very important, too (see Iatridou's contribution in this volume). I will not be able to separate out those contributions from those of the modals themselves in this paper. That's a project for another time. Here are the proposed denotations of the two modals:

(43) a. $[[will_C \alpha]]^{w,g} = 1$ iff $[[\alpha]]^{w',g} = 1$, where w' is the world in $g(C)(w)$ that is closest to w. Pick the absurd world if there is none.

b. $[[\boxdot_C \alpha]]^{w,g} = 1$ iff $g(C)(w) \cap \{w\} \subseteq [[\alpha]]^g$.

In interaction with a coindexed *if*-clause, 43(a) produces the Stalnaker conditional, 43(b) delivers the material conditional. Under the assumption that the antecedent is possible, the Stalnaker conditional accounts for the intended interpretation and the equivalence of 30(a) and (b), the pair we started out with.

(30) a. Everyone will fail if they goof off.

b. No one will pass if they goof off.

To account for the equivalence and the intended interpretation of 29(a) and (b), the embedded conditional has to be material implication, and the *if*-clause has to pragmatically restrict the domain of the embedding quantifier.

(29) a. Everyone failed if they goofed off.

b. No one passed if they goofed off.

If the restriction of nominal domain variables by *if*-clauses is pragmatic, it should be optional in the absence of non-grammatical pressures. Why is it nevertheless obligatory, at least in 29(b)? I already suggested a possible answer for deviant examples like (44):

(44) # Exactly five queries were answered if they came from a respectable address.

If the presence of the modal $\boxdot$ makes the embedded conditional a material conditional in (44), we are forced to count queries that came from dubious addresses as confirming instances. I suggested that Nicod's Criterion militates against this. If numeral quantifiers like *exactly five* have no domain variables, the sentence should feel odd. In (29), the violation of Nicod's Criterion can be avoided by letting the *if*-clause restrict the domain variables introduced by the quantifiers. This has an effect on the interpretation of 29(b), but results in an equivalent interpretation for 29(a).

In 30(b), the modal *will* tells us that the embedded conditional is a Stalnaker conditional. It forces us to move on to merely possible worlds and check whether students who don't actually goof off would fail if they did. There is no violation of Nicod's Criterion, then, and no need for the *if*-clause to restrict the nominal domain variable introduced by the quantifier. It should nevertheless be able to. It seems it is:

there seems to be a reading of 29(b) that doesn't make Leslie's Meadow (who doesn't goof off, but would pass no matter what) a counterexample.[6] Here is a slightly different example that brings out that kind of reading more clearly. Suppose that, as a matter of policy, students don't pass a course in Meadow's school if they have skipped more than three classes. Meadow doesn't ever skip classes, but, being the teacher's favorite, she would pass even if she did. There is an interpretation of (45) that feels true on this scenario.

(45) No one will pass if they skipped more than three classes.

If *will* tells us that the embedded conditional in (45) is a Stalnaker conditional, then Meadow would be a counterexample for (45) if the *if*-clause couldn't restrict the domain variable of *no*. We would have to consider the closest world where she did skip classes. She would still pass, and as a consequence, (45) would wind up false. Since (45) has an interpretation where it is true on our scenario, I conclude that the *if*-clause in (45) can optionally restrict the nominal quantifier.

6. Outlook

I have scrutinized one particular species of embedded conditionals: those embedded under nominal quantifiers. The display in (29) to (34) gave a snapshot of representative specimens. If we care about a unified treatment of the species, we can't semantically compose the meanings of the sentences in (29) to (34) from just

---

[6] . Thanks to Daniel Rothschild for pointing this out.

two pieces: the quantifier phrase and, say, a Stalnaker conditional. But we also can't seem to semantically compose their meanings from just three pieces: the quantifier phrase, the *if*-clause, and a modal. There is another force to reckon with. The *if*-clause can pragmatically restrict the domain of the nominal quantifier. Do we have an account of those constructions, then? If so, is it a "general algorithmic" account? What if not? Is that a reason to just give up?

Acknowledgements

I am very indebted to Daniel Rothschild and Lee Walters for extensive comments on an earlier version of this paper. The research leading to the paper has benefitted from funding and intellectual stimulation provided by the University of Massachusetts at Amherst, the Radcliffe Institute for Advanced Study at Harvard University, and (via François Recanati) by the European Research Council under the European Community's Seventh Framework Program (FP7/2007-2013) / ERC grant agreement n° 229 441 -CCC. I am also grateful to audiences at EHESS and the Institut Jean Nicod in Paris (2009), Rutgers University (Ernie Fest, 2010), LACSI (NCSU, 2011), the Chicago Linguistics Society (2011), the Central APA (Chicago, 2012), and the University of Konstanz (*What if* collaborative research group, 2013).

References

Abbott, Barbara. 2004. Some Remarks on Indicative Conditionals. Paper presented at Semantics and Linguistic Theory XIV, 2004.

Bhatt, Rajesh & Roumyana Pancheva. 2006. Conditionals. The Blackwell Companion

to Syntax, ed. by M. Everaert & H. v. Riemsdijk, 638-87.

Dekker, Paul. 2001. On 'If' and 'Only'. Paper presented at Semantics and Linguistic Theory XI, 2001.

Egré, Paul & Mikael Cozic. 2008. Introduction to the Logic of Conditionals. ESLLI, University of Hamburg. http://paulegre.free.fr/Teaching/ESSLLI_2008/cond_esslli08.pdf

Egré, Paul & Guy Politzer. 2013. Proceedings of the 19th Amsterdam Colloquium, ed. by M. Aloni, M. Franke, and F. Roelofsen, 10-18. http://www.illc.uva.nl/AC/AC2013/uploaded_files/inlineitem/02_Egre_Politzer.pdf

Edgington, Dorothy. 1995. On Conditionals. *Mind*, New Series, Vol. 104, No. 414. 235-329.

—. 2001. Conditionals. In *Stanford Encyclopedia* (ed.) E.N. Zalta. Stanford: CSLI.

Elbourne, Paul. 2013. *Definite Descriptions*. Oxford University Press.

Fintel, Kai von. 1994. Restrictions on Quantifier Domains: University of Massachusetts Ph.D.

—. 1998. Quantifiers and 'If'-Clauses. *Philosophical Quarterly* 48. 209-14.

—. 1999. NPI Licensing, Strawson Entailment, and Context Dependency. *Journal of Semantics* 16. 97-148.

—. 2001. Counterfactuals in a Dynamic Context. In *Ken Hale*: A Life in Language, ed. by M. Kenstowicz, 123-52. Cambridge/Mass.: MIT Press.

Fintel, Kai von & Sabine Iatridou. 2002. If and When 'If'-Clauses Can Restrict Quantifiers. Manuscript, MIT.

Frank, Anette. 1996. Context Dependence in Modal Constructions: University of Stuttgart PhD dissertation.

Geis, Michael & Arnold Zwicky. (1971). On Invited Inferences. *Linguistic Inquiry*. 561-566.

Gillies, Thony. 2007. Counterfactual Scorekeeping. *Linguistics and Philosophy* 30. 329-360.

Goodman, Nelson. 1955. *Fact, Fiction, and Forecast*. Cambridge/Mass: Harvard University Press.

Higginbotham, James. 1986. Linguistic Theory and Davidson's Program in Semantics. In *Truth and Interpretation*: Perspectives on the Philosophy of Donald Davidson, ed. by E. Lepore, 29-48. Oxford: Basil Blackwell.

—. 2003. Conditionals and Compositionality. *Philosophical Perspectives* 17. 181-94.

Huitink, Janneke. 2009. Quantified Conditionals and Compositionality. *Language and Linguistics Compass* 4. 42-53.

Iatridou, Sabine. 1991. *Topics in Conditionals*. Cambridge/Mass.: MIT Ph.D. dissertation.

Iatridou, Sabine. 2014. Grammar Matters. This volume.

Kadmon, Nirit. 1992. Unique and Non-Unique Reference. *Outstanding Dissertations in Linguistics*. Garland.

Keshet, Ezra. 2008. *Good intensions: Paving two roads to a theory of the de re/de dicto distinction*. MIT PhD dissertation.

Klinedinst, Nathan. 2011. Quantified Conditionals and Conditional Excluded Middle. *Journal of Semantics* 28. 149 - 70.

Landman, Fred. 2004. *Indefinites and the Type of Sets*. Wiley-Blackwell.

Leslie, Sarah-Jane. 2009. 'If ', 'Unless', and Quantification. In *Compositionality, Context and Semantic Values*: *Essays in Honor of Ernie Lepore*, ed. by R.J. Stainton & C. Viger, 3-30. Dordrecht: Springer.

Lewis, David K. 1976. Probabilities of Conditionals and Conditional Probabilities. *Philosophical Review* 85. 297-315.

Martí, Luisa. 2003. *Contextual Variables*. University of Connecticut PhD dissertation.

McGee, Vann. 1985. A Counterexample to Modus Ponens. *Journal of Philosophy* 9. 462-71.

Moss, Sarah. 2012. On the Pragmatics of Counterfactuals. *Nous* 46. 561-586.

Mauri, Caterina & Johan van der Auwera. (Forthcoming). Chapter 19: Connectives. In *Cambridge Handbook of Pragmatics*, ed. by K. M. Jaszczolt and Keith Allan. Cambridge: Cambridge University Press.

Nicod, Jean. 1924. *Le Problème Logique de l'Induction*. Paris: Félix Alcan.

Pizzi, Claudio & Timothy Williamson. 2005. Conditional Excluded Middle in Systems of Consequential Implication. *Journal of Philosophical Logic* 34. 333-62.

Schwarz, Florian. 2009. *Two Types of Definites in Natural Languages*. University of Massachusetts at Amherst PhD dissertation.

—. 2012. Situation Pronouns in Determiner Phrases. *Natural Language Semantics* 20. 431-75.

Stalnaker, Robert. 1968. A Theory of Conditionals. In *Studies in Logical Theory*, Volume 2: American Philosophical Quarterly Monograph Series, ed. by N. Rescher, 98-112. Oxford: Basil Blackwell.

—. 1975. Indicative Conditionals. *Philosophia* 5. 269-86.

—. 2014. *Context*. Oxford University Press.

Stanley, Jason. 2000. Context and Logical Form. *Linguistics and Philosophy* 23. 391-434.

Stanley, Jason & Zoltán Gendler Szabó. 2000. On Quantifier Domain Restriction. *Mind & Language* 15. 219-61.