Indicative and Subjunctive Conditionals in Commitment Spaces

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Abstract

The paper argues for a treatment of conditional sentences as conditional speech acts. It provides a formal implementation in the framework of commitment spaces, arguing that this approach has advantages over the conditional proposition account, as it motivates the known restrictions for embedded conditionals. It also introduces an extended model of commitment spaces for subjunctive conditionals, it shows how they affect revisionary updates, and it indicates ways to deal with the problem for the propositional account pointed out by Alonso-Ovalle and Tichý.

1 Conditional Propositions or Conditional Speech Acts?

There are two general approaches to the interpretation of conditional sentences:

(1) *If Fred was at the party, the party was fun.*

One approach analyzes indicative conditionals like (1) as conditional propositions (CP). For example, Stalnaker (1968) interprets *if* φ *then* ψ, where φ, ψ denote propositions φ, ψ (functions from indices i to truth values), as a proposition $\lambda i[\psi(\max(i,\varphi))]$, where $\max(i,\varphi)$ is the index that is maximally similar to i such that φ is true at i. Hence (1) is true at an index i iff for the index i′ that is maximally similar to i except that Fred was at the party at i′, it holds that the party was fun at i′. There are further developments of this view, e.g. Lewis (1973), Kratzer (1981) and much subsequent work, especially in linguistic semantics. This tradition can explain why conditionals occur as embedded clauses in positions like propositional attitude predicates:

(2) *Wilma believes that if Fred was at the party, the party was fun.*

However, there are syntactic slots for propositional expressions were conditionals cannot occur, or are at least very hard to interpret, e.g. in the protasis of another conditional, cf. Gibbard (1981):

(3) *#If Kripke was there if Strawson was (there), then Anscombe was there.*

The other approach takes (1) to be a conditional assertion, and conditionals in general as conditional speech acts (CA): “An affirmation of the form ‘if p, then q’ is commonly felt less

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as an affirmation of a conditional than as a conditional affirmation of the consequent." (Quine 1950). This view is popular in philosophy of language, cf. Barker (1995), Edgington (1995) and subsequent work. One point for the CA analysis is that conditionals are hard to interpret in certain positions where other propositions are fine, cf. (3). Another is that the apodosis of conditionals can be filled by speech acts other than assertions, like questions, exclamatives and directives, cf. (4).

(4) *If Fred was at the party, was it fun? / how fun it must have been! / tell me more about it!*

The CA analysis realizes the insight of Peirce / Ramsey that conditionals involve temporary assumptions allowing for conditional assertions and other argumentative moves. And it appears to have a lot of intuitive appeal, even for proponents of the CP analysis.

> "...[T]he consequent of a conditional proposition asserts what is true, not throughout the whole universe of possibilities considered, but in a subordinate universe marked off by the antecedent." (Peirce in the Grand Logic [1893-4]; Collected Papers 4.435)

> "While there are some complex constructions with indicative conditionals as constituents, the embedding possibilities seem, intuitively, to be highly constrained. For example, simple disjunctions of indicative conditionals with different antecedents, and conditionals with conditional antecedents are difficult to make sense of. The proponent of a non-truth-conditional account needs to explain what embeddings there are, but the proponent of a truth-conditional account must explain why embedded conditionals don't seem to be interpretable in full generality." (Stalnaker 2011).

The current paper proposes a semantic representation for the CA view, and argue that it should be considered a viable option in linguistic semantics. This will be done using Commitment Spaces as developed by Krifka (2015), a format for representing different kinds of speech acts.

2 Commitment Spaces

The current paper will make use of a somewhat simplified version of the framework of Krifka (2015), who introduced as basic notion "commitment states" as sets of propositions; here I will work with context sets c in the sense of Stalnaker (1974), i.e. sets of indices that represent the information considered to be shared by the interlocutors. In addition, the ways how this shared information c can develop at a particular point in conversation to other context sets c′, with c′ ⊂ c, will be represented as well. We will assume sets of context states C, called "commitment spaces" (CS). The context sets c in C with minimal information, those for which there is no c′ ∈ C such that c ⊂ c′, are special insofar as they represent the shared factual information, or "root" of C, written √C, cf. (4.a). Ideally, √C is a singleton set containing the information that is the classical common ground, cf. the illustration in Figure 1. Clauses are interpreted as propositions φ, which are sets of indices like context sets c. Propositions can be turned to assertive updates of context spaces

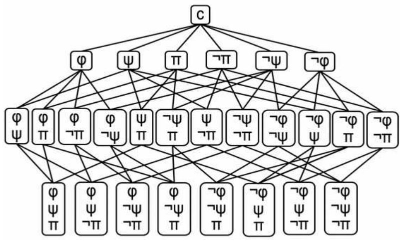


Figure 1. Commitment space C with root √C = {c}, where φ, ψ, π are logically independent propositions; $\boxed{\varphi}$ stands for c⋂φ.

by a function “ · ” as in (4.b), cf. the illustration in Figure 2. Notice that assertive updates of C by · φ restricts C to those context sets c for which the proposition φ holds. Update by functions A will be written as in (4.c).

(4) a. √C := {c∈C | ∃c′∈C[c ⊂ c′]}
  b. · φ := λC{c∈C | c ⊆ φ}
  c. C + A := A(C)

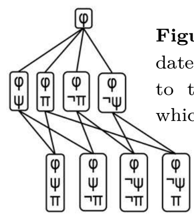


Figure 2. Assertive update C + · φ, reducing C to those context sets for which φ is established.

Update functions in general are closed under the operations of dynamic and Boolean conjunction, of disjunction and of denegation ;, &, V, ~ as defined by functional and set-theoretic operations, cf. (5.a,b,c,d), and illustrated in Figures 3, 4, 5. Notice that a disjunction of assertive updates leads to a context space with a multiple root.

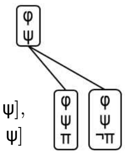


Figure 3. C + [· φ ; · ψ], C + [· φ & · ψ]

(5) a. [A ; B] := λC.B(A(C))
  b. [A & B] := λC[A(C) ∩ B(C)]
  c. [A V B] := λC[A(C) ∪ B(C)]
  d. ~A := λC[C – A(C)]

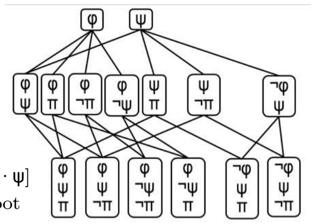


Figure 4. C+[· φ V · ψ] multiple root

Interrogative updates, e.g. the question if φ is true, are defined as in (6.a). In contrast to assertive updates, they do not change the root of the input CS but reduce the continuations. The alternative question whether φ or ψ is true can be rendered as in (b), and the question whether φ or not φ is true as in (c), cf. Figure 6.

(6) a. ?φ := √C ∪ C+ · φ
  b. [?φ V ?ψ] = √C ∪ C+ · φ ∪ C+ · ψ
  c. [?φ V ?¬φ] = √C ∪ C+ · φ ∪ C+ · ¬φ

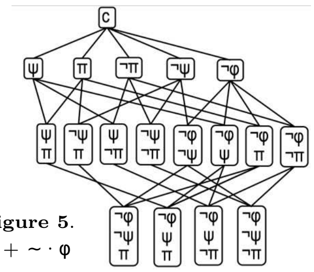


Figure 5. C + ~ · φ

The disjunction of two interrogative updates does not result in a multiply-rooted CS; rather, the root of the input CS does not change at all, reflecting the fact that questions do not add information but restrict the possible continuations of the conversation. Krifka (2015) assumes in addition that in assertions the speaker s declares commitment for a proposition φ, resulting in an update with a proposition · s⊢φ, whereas in a question the speaker requests the addressee a to declare commitment for a proposition, resulting in updates like ?a⊢φ for monopolar questions or [?a⊢φ V ?a⊢¬φ] for bipolar questions. The expected move is that the addressee performs one of these commitments, or rejects the proposal with some other move.

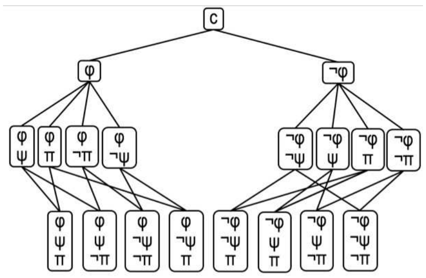


Figure 6. C + [? · φ V ? · ¬φ]

3 Conditionals in Commitment Spaces

Under the CA analysis of conditionals, the apodosis is an update. We define the notion of a conditional update C + [A ⇒ B] as an update by B that involves only the part C+A. This can be expressed as in (7.a) or, disregarding anaphoric bindings from A to B, (7.b); cf. Figure 7.

(7) a. [A ⇒ B] := [∼A V A;B]
b. [A ⇒ B] := [∼A V B]

Conditional update uses the denegation operator ∼ to deal with the protasis of the conditional. However, the protasis of natural-language conditionals is not a speech act but a proposition. Notice that the protasis cannot accommodate speechact-related adverbs, cf. *If Fred (*presumably) was at the party, the party was fun.* Also, in German the protasis has the verb-final word order characteristic for embedded propositions, cf. *Wenn Fred da war, dann …hat die Party Spaß gemacht* 'If Fred was there, the party was fun'. Hence we assume that the protasis is a proposition, and the apodosis is a speech act. This calls for the a definition for update as in (9).

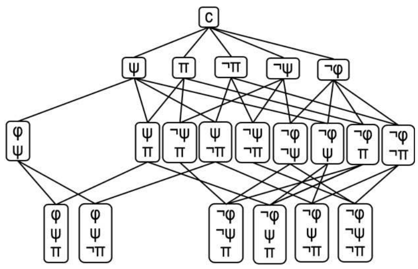


Figure 7. C + [· φ ⇒ · ψ].
C + [if φ, · ψ]

(8) [if φ, A] := λC [{c∈C | c ⊈ φ} ∪ C+A],
= [∼ · φ V A]

The conditional assertion like *if Fred was at the party, it was fun* restricts the commitment space C in such a way that whenever the proposition 'Fred was at the party' is established, the speaker is committed to the proposition 'the party was fun', cf. Figure 7. The conditional question *if Fred was at the party, was it fun or not?* restricts C in such a way that whenever 'Fred as at the party' is established, the only continuations are that the addressee commits to 'the party was fun' or to its negation, cf. Figure 8.

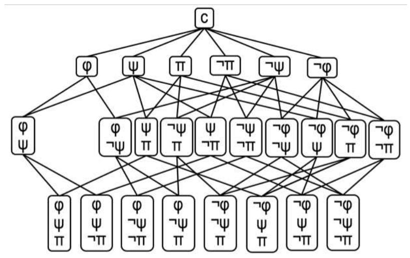


Figure 8. C + [· φ ⇒ [?ψ V ?¬φ]]

4 Embedding of conditional assertions

In this section we will discuss the embedding of conditional sentences in larger constructions, which is sometimes possible, and restricted at other times (cf. Stalnaker 2011). We will compare how the analysis as conditional assertions fares in comparison with conditional propositions.

4.1 Conjunction and Disjunction

Conjunction of conditionals is straightforward and can be modelled by dynamic or Boolean conjunction on updates. This predicts transitivity for conditional assertions, cf. (9). Let C be updated to C′ by the Boolean conjunction of [if φ, · ψ] and [if ψ, · π], then it also holds that [if φ, · π] is established in C′, that is, C′ + [if φ, · π] = C′. For the CP analysis we need a stipulation for transitivity: We have [φ > ψ] ∧ [ψ > π] = λi[ψ(max(i,φ)) ∧ π(max(i,ψ))] and [φ > π] = λi[π(max(i,φ)]; transitivity [[φ > ψ] ∧ [ψ > π]] ⊆ [φ > π] is guaranteed only if max(i,φ) = max(i,ψ).

(9) C + [[if φ, · ψ] & [if ψ, · π]] ⊆ C + [if φ, · π]

Disjunction of conditionals is known to be problematic, as the results are often hard to make sense of (cf. Barker 1995, Abbott 2004, Stalnaker 2011). Take the example by Edgington (1995):

(10) *If you open Box A you will get ten pounds, or if you open Box B you will get a button.*

Under the CA analysis as developed here we find that $[[\text{if } \varphi,\ \cdot\psi]\ \mathrm{V}\ [\text{if } \varphi',\ \cdot\psi']]$ is equivalent to $[[\text{if } \varphi,\ \cdot\psi']\ \mathrm{V}\ [\text{if } \varphi',\ \cdot\psi]]$[2], that is, the protases can be swapped. This is confusing, as the particular grouping of clauses should be informative. The CP analysis should not have a problem with (10), $[\varphi > \psi] \vee [\varphi' > \psi']$ is straightforwardly interpreted as $\lambda i[\psi(\max(i,\varphi)) \vee \psi'(\max(i,\varphi'))]$.

However, under certain conditions disjunctive conditionals are interpretable easily, as in (11), cf. Barker (1995). Notice that this sentence states unconditionally that the check will arrive today or tomorrow. It then gives the additional information that if George has put it into the mail, it will arrive today, and that if he hasn't, it will derive tomorrow. Hence (11) is not a disjunction of conditionals, but rather has the structure $\cdot[\psi \vee \psi']\ \&\ [\text{if } \varphi;\ \cdot\psi]\ \&\ [\text{if } \neg\varphi;\ \cdot\psi']$. The prosodic realization, with deaccented conditional clauses, helps to create this interpretation.

(11) *The check will arrive today, if George has put it into the mail, or it will come with him tomorrow, if he hasn't.*

The problem of (10) should also not arise when the apodosis is the same for both protases; this predicts that (12.a) should be fine. However, (12.a) turns out to be equivalent to the shorter (12.b), cf. (13.a), which appears to disfavour (12.a).

(12) a. *If you open Box A you get ten pounds or if you open Box B you get ten pounds.*
b. *If you open Box A and you open Box B you get ten pounds.*
c. *If you open Box A or if you open Box B, you get ten pounds.*
c. *If you open Box A or you open Box B, you get ten pounds.*
d. *If you open Box A you get ten pounds and if you open Box B you get ten pounds.*

Due to $[\cdot\varphi\ \&\ \cdot\psi] = \cdot[\varphi \wedge \psi]$ and $[\cdot\varphi\ \mathrm{V}\ \cdot\psi] \subseteq \cdot[\varphi \vee \psi]$[3], we have the logical relationships in (13). Due to (13.a), (12.a) is equivalent to (12.b) and (12.c). Due to (13.b), (12.c) has (12.d) as a close paraphrase under a propositional interpretation of the disjunction, though not as an equivalence (here, $A \subseteq B$ holds iff for all C, for $A(C) \subseteq B(C)$).

We have true equivalence if (12.c) is interpreted following the scheme $[\sim[\cdot\varphi \mathrm{V} \cdot\psi]\mathrm{V} \cdot\pi]$.

(13) a. $[\text{if } [\varphi \wedge \psi],\ \cdot\pi] = [[\text{if } \varphi,\ \cdot\pi]\ \mathrm{V}\ [\text{if } \psi,\ \cdot\pi]] = [[\sim\cdot\varphi]\ \mathrm{V}\ [\sim\cdot\psi]]\ \mathrm{V}\ \cdot\pi]$[4]
b. $[\text{if } [\varphi \vee \psi],\ \cdot\pi] \subseteq [[\text{if } \varphi,\ \cdot\pi]\ \&\ [\text{if } \psi,\ \cdot\pi]] = [\sim[\cdot\varphi\ \mathrm{V}\ \cdot\psi]\ \mathrm{V}\ \cdot\pi]$[5]

DP coordination like *you open Box A or/and Box B* might express narrow-scope propositional or wider-scope speech-act coordination. e.g. *If you open Box A and Box B…* may be interpreted as $[[\text{if } \varphi,\ \cdot\pi]\ \&\ [\text{if } \psi,\ \cdot\pi]]$. Several issues remain to be investigated that will not be pursued in this paper, e.g. the role of scalar implicature, but cf. (30.a,b) for subjunctive conditionals.

[2]Due to commutativity and associativity of disjunction, $[[\sim\cdot\varphi\ \mathrm{V}\ \cdot\psi]\ \mathrm{V}\ [\sim\cdot\varphi'\ \mathrm{V}\ \psi']] = [[\sim\cdot\varphi'\ \mathrm{V}\ \cdot\psi]\ \mathrm{V}\ [\sim\cdot\varphi\ \mathrm{V}\ \psi']]$

[3]Note that $[\cdot\varphi\ \mathrm{V}\ \cdot\psi]$ may have a multiple root, cf. Figure 4, whereas $\cdot[\varphi \vee \psi]$ includes nodes above this root.

[4]Due to $[[\sim\cdot\varphi\ \mathrm{V}\ \cdot\pi]\ \mathrm{V}\ [\sim\cdot\psi\ \mathrm{V}\ \cdot\pi]] = [[\sim\cdot\varphi\ \mathrm{V} \sim\cdot\psi]\ \mathrm{V}\ \cdot\pi] = [\sim[\cdot\varphi\ \&\ \cdot\psi]\ \mathrm{V}\ \cdot\pi] = [\sim\cdot[\varphi \wedge \psi]\ \mathrm{V}\ \cdot\pi]$.

[5]Due to $[\sim\cdot[\varphi \vee \psi]\ \mathrm{V}\ \cdot\pi] \subseteq [\sim[\cdot\varphi\ \mathrm{V}\ \cdot\psi]\ \mathrm{V}\ \cdot\pi] = [[\sim\cdot\varphi\ \& \sim\cdot\psi]\ \mathrm{V}\ \cdot\pi] = [[\sim\cdot\varphi\ \mathrm{V}\ \cdot\pi]\ \&\ [\sim\cdot\varphi\ \mathrm{V}\ \cdot\pi]]$.

4.2 Negation

Another semantic operation on conditionals that is notoriously difficult to grasp is negation (cf. Barker 1995, Edgington 1995). In (14.a), negation does not scope over the whole sentence in contrast to (b), which shows that in principle negation can take wide scope over a dependent clause.

(14) a. *The party was not fun if Fred was there.*
b. *The party was not fun because Fred was there (but because there was no beer.)*

This begs for explanation in the CP view, as $[\varphi > \psi]$ can be negated, resulting in $\lambda i\neg[\psi(\mathrm{ms}(i,\varphi))]$. The CA view predicts lack of propositional negation, as this negation could not take scope over an update. However, cases with wide-scope negation have been discussed by Barker (1995):

(15) a. *It is not the case that if God is dead, then everything is permitted.*
b. *If God is dead, then everything is NOT permitted.*

Barker suggests an analysis in terms of a metalinguistic negation that rejects the claim made by the non-negated assertion. This negation cannot be expressed by denegation, as $\sim$[if φ, $\cdot\,\psi$] is equivalent to $[\cdot\,\varphi\ \&\ \sim\cdot\,\psi]$, hence (15) would mean that God is dead and it is ruled out that everything is permitted. Rather, we assume the weak negation that Punčochář (2015) has proposed for inquisitive semantics. It can be expressed by a combination of dynamic possibility and denegation, cf. (17), where $C+\Diamond A$ returns C iff $C+A$ is defined, cf. (16). Independent evidence for this type of negation comes from interactions like S1: *The number 37753 is certainly prime.* S2: *No, it might just have very high prime factors*, where *no* expresses possible falsehood of the antecedent.

(16) $\Diamond A := \lambda C.C+A \neq \emptyset\ [C]$
(17) $C + \Diamond\sim[\text{if } \varphi,\ \cdot\,\psi] = C$ if $\exists c{\in}C[\varphi \subseteq c \wedge \psi \nsubseteq c]$, else undefined

Egré & Politzer (2013), in an experimental study of conditionals that are rejected by *No*, distinguish between three kinds of negation within the CP framework. However, we can work with just one negation, $\Diamond\sim$, with different kinds of explanation why the negation holds.

(18) S1:	*If it is a square chip, it will be black.*	[if s(c), $\cdot$ b(c)], = A
S2: *No.*	(i) *There are square chips that are not black.*	$\Diamond\sim A\ ;\ \cdot\,\exists x[s(x) \wedge \neg b(x)]$
	(ii) *all square chips are not black.*	$\Diamond\sim A\ ;\ \cdot\,\forall x[s(x) \rightarrow \neg b(x)]$
	(iii) *square chips are not necessarily black.*	$\Diamond\sim A\ ;\ \cdot\,\neg\Box\forall x[s(x) \rightarrow b(x)]$

4.3 Conditional apodosis and conditional protasis

Conditional apodosis clauses are unremarkable, cf. (19), and can be easily modelled within the CA approach, as [if φ, [if ψ, $\cdot\,\pi$]].

(19) *If Fred was at the party, then if there was beer at the party, the party was fun.*

We have [if φ, [if ψ, $\cdot\,\pi$]] = [if $[\varphi \wedge \psi]$; $\cdot\,\pi$][6], as it should be. For the CP account, observe that $[\varphi > [\psi > \pi]] = \lambda i[\pi(\max(\max(i, \varphi), \psi))]$ and $[[\varphi \wedge \psi] > \pi] = \lambda i[\pi(\max(i, [\varphi \wedge \psi]))]$, so to get equality of the two terms we have to stipulate $\max(\max(i, \varphi), \psi) = \max(i, [\varphi \wedge \psi])$. There are apparent counterexamples of this rule like (20) by Barker (1995). However, here *even* scopes over the embedded conditional sentence, preventing a conjunction with the first protasis.

(20) *If Fred is a millionaire, then even if he fails the entry requirement,*

[6] Due to $[\sim\cdot\varphi \vee [\sim\cdot\psi \vee \pi]] = [[\sim\cdot\varphi \vee \sim\cdot\psi] \vee \pi] = [\sim[\cdot\varphi\ \&\ \cdot\psi] \vee \pi] = [\sim[\varphi \wedge \cdot\psi] \vee \pi]$

he would still get the job.

In contrast, conditional sentences cannot occur in the protasis of another conditional, cf. (3). This is because *if* in the protasis selects proposition, hence conditionals are of the wrong semantic type. However, there are cases in which conditionals in protasis position are fine, as in (21). But notice that this example is naturally read with accent on *broke* and deaccented *if it was dropped*, making this *if*-clause the topic of the whole clause, leading to the interpretation spelled out in (b).

(21) a. *If the glass broke if it was dropped, it was fragile.*
b. 'If the glass was dropped, then if it broke, it was fragile.'

4.4 Conditionals in propositional attitude contexts

We have seen in (2) that conditional clauses occur in propositional attitude contexts, cf. also (22) for a different set of predicates. This constitutes a strong argument for the CP approach.

(22) *Fred knows / thinks / assumes / hopes / doubts that if Wilma applies, she will get the job.*

However, there is a line of defense for the CA approach here. Similar to other lexical predicates that come with sortal requirements, propositional attitude contexts can lead to a coercion of an update to a proposition. This is similar to *drink the whole bottle*, which is understood as drink the whole content of the bottle. The coercion of an update A would be to the proposition that A is assertable, where a simple assertion $\cdot\varphi$ is assertable at an index i iff φ is true at i. This means that $\cdot\varphi$, short for $\lambda C\{c\in C \mid c \subseteq \varphi\}$, is coerced to φ, the function $\lambda i[\varphi(i)]$. For conditional updates like [if φ, ψ] the assertability condition would result in a proposition that is close to one of the CP accounts of propositions, like Stalnaker's $\lambda i[\psi(\max(i,\varphi)]$. This coercion approach would have to be worked out in greater detail, which is not the focus of this paper.

5 Subjunctive Conditionals and Generalized CSs

5.1 The interpretation of subjunctive conditionals

Indicative conditionals have a pragmatic requirement that their protasis can be asserted at the current CS, as otherwise the update would be uninformative (cf. Veltman 1985: p.181): If $C + \cdot\varphi = \emptyset$, then $C +$ [if φ, A] $= [C \cup C+A] = C$. Subjunctive conditionals like (23) violate this requirement, as they are uttered felicitously under the assumption that Fred was not at the party.

(23) *If Fred had been at the party, it would have been fun.*

Classical approaches to subjunctive conditionals assume that they denote propositions that have a truth value, which is defined via a relation of closeness of worlds (cf. Lewis 1973). But just as indicative conditionals, subjunctive conditionals can have other speech acts as their apodosis, and resist certain kinds of embeddings.

(24) *If Fred had been at the party, would it had been fun? / how fun it would have been!*

(25) *#If Kripke would have been there if Strawson had been, then Anscombe was there.*[7]

How can we extend the current representation framework to accommodate subjunctive conditionals? A subjunctive conditional [if φ, A] should be interpretable at an input commitment space C even if C+ · φ = Ø. The idea that will be pursued here is that this can be done by relaxing C to a C′, C ⊂ C′, such that C′ + · φ ≠ Ø. Relaxing should be minimal, that is, C′ should be as similar to C as possible. This C′ is a hypothetical commitment space that is entertained in case φ were true, after which we return to C. Nevertheless, the hypothetical commitment space might actually become relevant in case φ turns out to be true, necessitating a revisionary update.

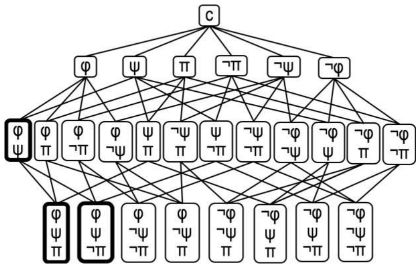


Figure 9. C + [· φ ; · ψ] = ⟨Ca,Cb⟩ **actual** and background CS

To work out this idea, we introduce the notion of a “generalized CS” as a pair of an actual CS and a background CS, $\langle C_a, C_b\rangle$, where C_a is a sub-CS of C_b as defined in (26).

(26) $C' \leq_{CS} C'' :\Leftrightarrow C' \subseteq C''$ and $\forall c \in C''[\exists c'[c' \in \surd C' \wedge c \subseteq c'] \rightarrow c \in C']$

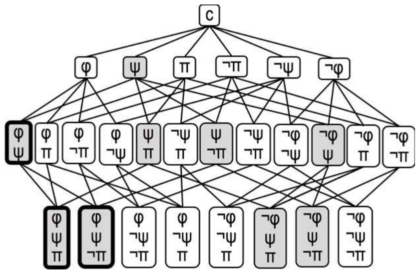


Figure 10. Smallest hypothetical Ca′ such that Ca ⊆ Ca′ ⊆ C and Ca′ + [if ¬φ, · π] ≠ Ca′

For example, updating the CS C of Figure 1 by [· φ; · ψ] leads to the generalized CS Figure 9, with the actual CS C_a rendered in bold, and the background CS C_b, identical to the original C.

When we want to update $\langle C_a, C_b\rangle$ by [if ¬φ, · π], we fail, as updating C_a with · ¬φ would result in the empty actual CS. Hence we assume an hypothetical CS $C_a{'}$ that differs from C_a minimally such · ¬φ can be interpreted. This $C_a{'}$ is defined as min(C_a, · ¬φ, C_b) by (27). In our example, this is the gray CS in Figure 10.

(27) min(C_a, A, C_b) = the smallest C such that $C_a \leq_{CS} C \leq_{CS} C_b$ and C+A ≠ Ø

Updating $C_a{'}$ by [if ¬φ, · π] leads to the removal of all context sets in which ¬φ but not π are established. This does not affect the actual CS C_a but only the background CS C_b. After the update with the subjunctive conditional, the resulting generalized CS is as in Figure 11.

In general, we can assume that regular indicative update affects primarily the actual CS and only secondarily the background CS, as it must be guaranteed that the actual CS is a sub-CS of the background CS. This is achieved by (28).

(28) $\langle C_a, C_b\rangle + A = \langle C_a{+}A, [C_b - C_a] \cup C_a{+}A\rangle$

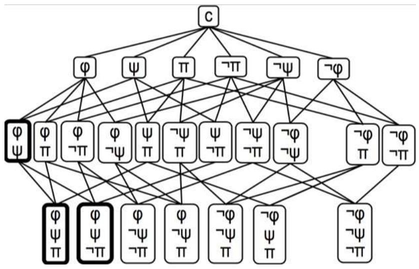


Figure 11. Generalized CS after update with [if ¬φ, · π]

Subjunctive update, on the other hand, affects primarily the background CS, which can be expressed as in (29). The output background CS C for a conditional update is defined via the CS C* that is the smallest CS between C_a and C_b such that the protasis φ can be asserted:

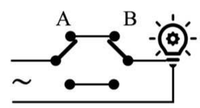
[7] Gibbard (1981) considers this better than with the indicative case, “Delphic but not incomprehensible”.

(29) $\langle C_a, C_b\rangle$ + [if φ, A] = $\langle C_a \cap C, C\rangle$
where $C = [C_b - C^*] \cup C^*$+[if φ, A], and $C^* = \min(C_a,\ \cdot\varphi, C_b)$

Notice that (29) can be taken as the general rule for conditional updates. In case $C_a + \ \cdot\varphi \neq \emptyset$, it holds that $C^* = C_a$, and we get the same result as under rule (28), as only the actual input CS C_a is affected. The use of indicative vs. subjunctive mood indicates whether $C^* = C_a$ or $C_a <_{CS} C^*$. Hence indicative is a morphological index that expresses coreference with the actual CS, whereas subjunctive expresses disjointness with the actual CS.

The current account can explain the experimental findings by Ciardelli et al. (2018) that (30.a) is often judged true whereas (b) is often judged false in the given scenario.

(30) a. *If Switch A or Switch B was down, the light would be off.*
b. *If Switch A and Switch B were not both up, the light would be off.*



Assume that (30.a) is interpreted following the scheme $[\sim[\cdot\varphi\ \mathrm{V}\ \ \cdot\psi]\ \mathrm{V}\ \ \cdot\pi]$, it has an interpretation in which it is equivalent to a conjunction of two conditionals, $[\sim\cdot\varphi\ \mathrm{V}\ \ \cdot\pi]$ & $[\sim\cdot\psi\ \mathrm{V}\ \ \cdot\pi]$, cf. (13.b). Interpreted independently of each other (cf. Alonso-Ovalle 2009), the first conjunct would require a minimal hypothetical CS in which 'A down' can be assumed, for which case the light would be off (and simlarly for the second conjunct). Hence the judgement that (30.a) is true. On the other hand, (30.b) is interpreted as $[\sim\cdot\neg[\varphi \wedge \psi]\ \mathrm{V}\ \ \cdot\pi]$, equivalent to $[\sim\cdot[\varphi \vee \psi]\ \mathrm{V}\ \ \cdot\pi]$, and requires a minimal hypothetical CS in which the negation of 'A and B up' can be assumed, with one prominent option a CS in which 'A and B down', for which the light would be on. Hence the judgement that (30.b) is false. Note that one crucial step was the difference in the understanding of the protasis, as $\sim[\cdot\varphi\ \mathrm{V}\ \ \cdot\psi]$ or as $[\sim\cdot[\varphi \vee \psi]$; this is structurally similar to inquisitive lifting in Ciardelli et al. (2018).

The indicative / subjunctive distinction is reminiscent of temporal reference: Just as present tense refers to the actual time of utterance and past tense shifts to some prior time, indicative refers to the actual assumptions of the common ground C_a and subjunctive shifts to a stage of the common ground development in which certain assumptions are not made. This motivates the observation that subjunctive is often expressed with past-like morphology (cf. Iatridou 2000, Karawani 2014):

(31) *If Fred was at the party right now, the party would be fun.*

The current proposal leads to a straightforward explanation of the relation between subjunctive and past tense than theories based on closeness of possible worlds: If tense morphology expresses temporal or modal distance from the actual point of reference, then it is not clear why it is past tense and not, for example, future tense is used to express counterfactuality.

5.2 Revisionary Updates

In the current setup, subjunctive conditionals only affect the background CS. As communication typically develops in the actual CS, the question arises what subjunctive conditionals contribute to the communication. Intuitively, they express general rules that, due to the subjunctive that requires $C_a \neq C^*$, do not have an effect on the part of the common ground that describes the way how the world is. For example, (31) implicates that Fred is not at the party, and nothing follows concerning whether the party was fun. However, if it turns out that Fred is, in fact, at the party, we can conclude that the it is fun. Subjunctive conditionals unfold their inferential power after a revisionary update.

Revisionary update can be seen as a rescue strategy if C+A results in the empty set. In this case, the input CS C may be changed minimally to a C′ for which C′+A is defined. In a generalized CS framework, revisionary update can be specified as in (32). For example, revisionary update of $\langle C_a, C_b\rangle$ by $\cdot\varphi$ in Figure 9 results in the generalized CS of Figure 12.

(32) $\langle C_a, C_b\rangle +_{rev} A = \langle \min(C_a, A, C_b) + A, C_b\rangle$

Revisionary update after the subjunctive conditional [if $\neg\varphi$, $\cdot\pi$] of Figure 11 leads to the generalized CS in Figure 13, showing that the subjunctive conditional affects the new actual CS.

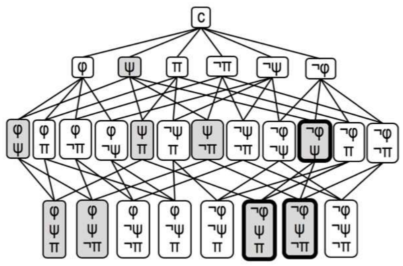


Figure 12. Revisionary update of generalized CS in Fig. 9 with $\cdot\neg\varphi$,max(Ca, $\cdot\neg\varphi$, Cb) grayed out

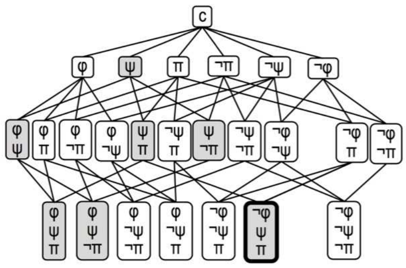


Figure 13. Revisionary update of generalized CS in Fig. 11 with $\cdot\neg\varphi$

5.3 A Solution to Tichý's problem

The current proposal suggests that conditionals do not express propositions about the world but rather statements concerning the assumptions made in a conversation. In this, it is an example of the premise semantics approach to conditionals, cf. Kratzer 1989, Veltman 2005, and Starr 2019 for an overview. According to this approach, subjunctive assertive conditionals adjust a body of premises with the protasis, and assert that the apodosis is a consequence of this revised premise set.

Tichý (1976) pointed out a problem for the modal similarity analysis. Assume that Jones wears a hat if it is raining, and otherwise wears a hat or not at random. Assume furthermore that it is in fact raining (hence Jones wears a hat). Now, is the subjunctive conditional *If it were not raining, Jones would wear a hat* true? Intuitively, it is not true, but the modal similarity analysis asks us to consider a world that is maximally close to the current one except that it is not raining; as wearing a hat is compatible with there being no rain, in this world Jones would wear a hat (see Starr 2019 for discussion).

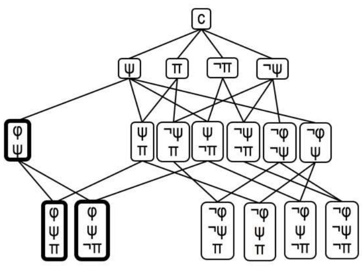


Figure 14.
$\langle C, C\rangle$+[[if φ, $\cdot\psi$] & [if $\neg\varphi$, [$\cdot\psi$V$\cdot\neg\psi$]]]+$\cdot\varphi$

As it stands, the current model of generalized CSs would run into the same problem. This is because it does not record the way how the actual CS developed. As an example, take the generalized CS $\langle C, C\rangle$, where C is the CS of Figure 1. Update with [[if φ, $\cdot\psi$] & [if $\neg\varphi$, [$\cdot\psi$ V $\cdot\neg\psi$]]] and further update with $\cdot\varphi$ leads to the generalized CS in Figure 14. Notice that this entails the subjunctive update [if $\neg\varphi$, $\cdot\psi$], as the conditional will be interpreted at the CS with root ψ, as this is the closest CS for which $\neg\varphi$ can be interpreted, and in this CS the conditional [if $\neg\varphi$, $\cdot\psi$] holds.

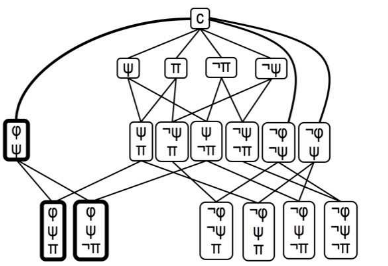


Figure 15.
$\langle C, C\rangle$+[[if φ, $\cdot\psi$] & [if $\neg\varphi$, [$\cdot\psi$ V $\cdot\neg\psi$]]]+$\cdot\varphi$
with constructive predecessor rules

What is necessary is that by asserting [if φ, $\cdot\psi$] at $\langle C, C\rangle$, the root of the resulting CS, C+[if φ, $\cdot\psi$], i.e. the node $\boxed{\varphi\psi}$, gets as immediate predecessor the node $\boxed{c}$ itself, the root of the input CS C. This results in the generalized CS of Figure 15. Notice that the subjunctive update [if $\neg\varphi$, $\cdot\psi$] is not already established here, as the root of the minimal CS at which $\neg\varphi$ can be assumed is the node $\boxed{c}$. In this account, the relation between the context sets of a CS do not just follow from the inclusion relation, but in addition by an accessibility relation that is determined by how the conversation actually moves forward.

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