To appear in 2011 in *Tense across Languages*, R. Musan & M. Rathert, eds., Niemeyer, Tübingen.

Maria Bittner

Time and modality without tenses or modals[1]

1. Introduction

In English, reference to time in discourse involves a grammatical system of tense markers interpreted as temporal anaphors (Reichenbach 1947, Partee 1973, Webber 1988, a.o.). Recently, it has been argued that reference to hypothetical worlds in conditionals involves a parallel grammatical system of modal axiliaries interpreted as modal anaphors (Stone 1997, Stone and Hardt 1999, Brasoveanu 2007, a.o.). Based on evidence from Kalaallisut (Eskaleut: Greenland), this paper argues that temporal and modal discourse anaphora can be just as precise in a language that does not have either anaphoric tenses or anaphoric modals.

Bittner (2005) shows that future uses of the English modals *will* and *would* have many translation equivalents in Kalaallisut. Most of these are derivational suffixes for prospect-oriented attitudinal states, e.g., expectation (*-ssa*, *-jumaar*), desire (*-ssa*, *-rusuk*, *-juma*), intent (*-niar*, *-jumaar*), need (*-tariaqar*), anxiety (*-qina*), considering the prospect possible (*-sinnaa*), impossible (*-navianngit*), etc. Instead of grammatical tense, the language has a grammatical system of mood inflections that distinguish currently verifiable facts (in the declarative, interrogative, or factual mood) from current prospects (in the imperative, optative, or hypothetical mood). In this system futurity is a species of a fact. For example, the English future *Ole will win* translates into (1)[2], which asserts (*-pu* '$\text{DEC}_{\top}$') that there is a real and current state of expectation (*-ssa* '$\text{exp}^{>}$') that Ann (topic, ⊤) will win. The Kalaallisut attitudinal predicate *-ssa* '-$\text{exp}^{>}$' is impersonal, so the attitude holder is unspecified.

(1) *Aani ajugaassaaq*.
*Aani ajugaa-**ssa**-**pu**-q*
Ann win-$\text{exp}^{>}$-$\text{DEC}_{\top}$-3S
Ann will win. (*lit.* is expected to)

Both fact-oriented moods and prospect-oriented attitudes also occur in Kalaallisut conditionals. Both are required even in conditionals about the past, such as the Kalaallisut translations (2)–(3) of the classic examples of Adams (1970).

---

1 I thank Hans Kamp, Sarah Murray, Poul Portner, Monika Rathert, Craige Roberts, Katrin Schulz, Judith Tonhauser, two reviewers, and the participants in my seminars and talks at Rutgers (2006–9), OSU (2009), IMS Stuttgart (2008), and the 2008 DGfS workshop on *Tense across Languages*.

2 In the Kalaallisut examples, line 1 is in the standard Kalaallisut orthography, line 2 gives the phonemic form of each morpheme, line 3 provides the glosses, and line 4, an English translation equivalent. The glosses are in small caps for inflections (e.g. '-DEC'), lower case for derivational suffixes (e.g. '-not'). Abbreviations: ⊤ = topic, ⊥ = background, bel = believe, exp = expect(ed), des = desire(d), int = intend(ed), obl = obliged.to, att_{se} = attitude *de se*, $\text{att}_{\perp}$ = attitude *de* ⊥, $\text{att}^{>}$ = attitude to prospect, rem = remote from expected or desired ideal, pssv = passive.

(2) *Oswaldip Kennedy toqusimanngippagu*
Oswald-p Kennedy tuqut-sima-nngit-pp-a-gu
Oswald-ERG Kennedy kill-prf-not-HYP$_{\perp}$-3S$_{\perp}$-3S
inupiloqataata toqusimassavaa.
*inuk-piluk-qat-a-ata tuqut-sima-**ssa**-**pa**-a*
man-bad-other-3S$_{\perp}$-ERG kill-prf-exp$^{>}$-DEC$_{\top\perp}$-3S.3S
If Oswald didn't kill Kennedy, then someone else did.

(3) *Oswaldip Kennedy toqusimanngikkaluarpagu*
Oswald-p Kennedy tuqut-sima-nngit-galuar-pp-a-gu
Oswald-ERG Kennedy kill-prf-not-rem-HYP$_{\perp}$-3S$_{\perp}$-3S
inupiloqataata toqusimassagaluarpaa.
*inuk-piluk-qat-a-ata tuqut-sima-**ssa**-galuar-**pa**-a.*
man-bad-other-3S$_{\perp}$.ERG kill-prf-exp$^{>}$+rem-DEC$_{\top\perp}$-3S.3S
If Oswald hadn't killed Kennedy, then someone else would've.

I propose that conditionals, too, introduce real and current attitude states into discourse. In conditionals about the past these are real states of expectation. These real mental states are based on real past events, e.g. the real assassination in (2), or real hate-mongering in (3). The modal object of the attitude are the projected consequences of these events in hypothetical antecedent worlds.

More precisely, I propose that fact-oriented moods in Kalaallisut (e.g. 'DEC' in (1)–(3)) constrain the last eventuality of the verb (here, the state of expectation of 'exp$^{>}$') to be a *currently verifiable fact*. That is, they constrain this eventuality to be already realized, or have at least begun, in the same world as the speech act. The assertion that this eventuality is a fact can therefore be verified here and now, i.e. in the speech world at the speech time.

Next, I build on the aforementioned finding that the English modal *will* translates into Kalaallisut predicates that introduce prospect-oriented attitude states (Bittner 2005). For example, the predicate *-ssa* 'exp$^{>}$' introduces a state of expectation. By discourse-initial default, exemplified in (1), this expectation concerns the immediate future (consequent state) of the speech act (default perspective point), in the common ground (default topical modality and hence the default modal base). The attitude holder's expectations rank the modal base worlds from the most to the least expected. Within the modal base (i.e., the common ground), in the worlds that best fit the attitude holder's expectations, Ann wins within the consequent state of this speech act. The unspecified attitude holder of this real attitudinal state is likely to be the topic (Ann), or the speaker who is making this prediction.

In conditionals, the antecedent clause defeats discourse-initial defaults. Modally, it updates the input modal base to a topical sub-domain (see Lewis 1973, Kratzer 1981, Bittner 2001, a.o.). Temporally, it may update the perspective point. For instance, on the salient reading of the conditional (2), the real state of expectation concerns the consequent state of the real assassination event, in the topical antecedent sub-domain of the common ground where the assassin is not Oswald. Within this topical sub-domain, in the worlds that best fit the attitude holder's expectations, the real assassination time is followed by the consequent state (*-sima* 'prf') of an assassination by another agent.

To extend this approach to counterfactuals, I propose that the suffix *-galuar* 'rem(ote)' is implicitly attitudinal: it indicates that the world of evaluation is not amongst (*remote* from) the ideal worlds, given the ranking of the modal base worlds by contextually salient attitudes (e.g., the beliefs or desires of the speaker or topic). For instance, the counterfactual (3) introduces a real state of expectation concerning the consequent state of a real event—for example, JFK's enemies reaching critical mass—in the modal domain where this event is realized. In the topical sub-domain, which *-galuar* marks as remote from the sub-domain that best fits the speaker's beliefs, JFK is not assassinated by Oswald. Within this remote sub-domain, the expected worlds are those where, as a consequence of his enemies reaching critical mass, JFK is assassinated by some other agent.

In what follows I first introduce an update system that can represent centering-based discourse anaphora (Section 2). The above proposal is then empirically supported and formally implemented as explicit updates for sample discourses (Sections 3–6) and a CCG fragment (Section 7). Finally, I outline an analysis of English tenses and modals in this framework and suggest that they too grammaticalize centering-based anaphora (Section 8).

2 Update with centering

2.1 Centering-based anaphora

Grosz *et al* (1995) observed that in English anaphora resolution depends on the relative prominence of potential antecedents. They also introduced the term *center* for the discourse referent in the current center of attention and hence the top-ranked antecedent. Subsequent research has shown that centering is a semantic universal and revealed a great variety of grammatical centering systems (see e.g. Walker 1998, Chen and Yeh 2007).

Kalaallisut explicitly marks current centering status for nominal and modal referents. Nominal centering is marked by obviation (e.g. '$3_{\top}$' vs. '$3_{\bot}$', 'FCT$_{\top}$' vs. 'FCT$_{\bot}$'), whereas modal centering is indicated by grammatical mood (e.g. 'DEC' vs. 'FCT') and grammatical category (e.g. inflection 'DEC' vs. derivation '-not'). Ambiguous English pronouns (e.g. in *Ann's friend has won so* ***she's*** *happy*) are typically disambiguated in Kalaallisut. For example, the factual dependent introduces Ann's friend as the topic in (4a) and Ann herself as the topic in (4b). In (4a) Ann is in the background, whereas her friend is in the background in (4b). The subject pronoun in the matrix clause always refers to the topic ('DEC$_{\top}$-3S'). Thus, it unambiguously refers to Ann's friend in (4a), and to Ann, in (4b).

(4)	a.	*Aanip*	*ikinngutaa*	*ajugaagami*	*nuannaarpoq.*
		Aani-p	*ikinngut-**a***	*ajugaa-ga-**mi***	*nuannaar-pu-**q***
		Ann-ERG	friend-3S$_{\bot}$	win-FCT$_{\top}$-3S$_{\top}$	happy-DEC$_{\top}$-3S
		Ann$^{\bot}$'s friend$^{\top}$ has won so she$_{\top}$'s happy.			
	b.	*Aanip*	*ikinngunni*	*ajugaammat*	*nuannaarpoq.*
		Aani-p	*ikinngut-**ni***	*ajugaa-mm-**at***	*nuannaar-pu-**q***
		Ann-ERG	friend-3S$_{\top}$	win-FCT$_{\bot}$-3S$_{\bot}$	happy-DEC$_{\top}$-3S
		Ann$^{\top}$'s friend$^{\bot}$ has won so she$_{\top}$'s happy.			

In general, centering systems contrast the center (⊤) vs. periphery (⊥) of attention. Accordingly, *Update with Centering* (UC) models recentering as update from the input set of *top-bottom lists* (⊤⊥-lists) to the output set. That is, a state of information is a set of ⊤⊥-lists (adapting Veltman 1996, Dekker 1994). Since discourse initially nominal anaphora is infelicitous, I propose that by default both lists start out empty, as in (5) (ignoring other types of referents). Kalaallisut (4a) and (4b) update this default state of information as in (6a) and (6b). The output state (i.e. output set of ⊤⊥-lists) is spelled out underneath each update. I assume a model where Ann (a) has two friends (f_1 and f_2). One friend has won and is happy (f_1), while Ann herself is not happy, perhaps because she wanted to win. In this model, (4a) is intuitively true, whereas (4b) is false. Formally, the UC representation (6a) yields a non-empty final output state (c_4), whereas (6b) yields the *absurd state* ($c'_4 = \varnothing$).

(5) $\{\langle\langle\rangle, \langle\rangle\rangle\}$

(6a)	$[x \mid x =_i ann]$;	$^{\top}[x \mid friend\langle x, \bot\delta\rangle]$;	$[win\langle\top\delta\rangle]$;	$[happy\langle\top\delta\rangle]$
	c_1	c_2	c_3	c_4
	$\{\langle\langle\rangle, \langle a\rangle\rangle\}$	$\{\langle\langle f_1\rangle, \langle a\rangle\rangle$ $\langle\langle f_2\rangle, \langle a\rangle\rangle\}$	$\{\langle\langle f_1\rangle, \langle a\rangle\rangle\}$	$\{\langle\langle f_1\rangle, \langle a\rangle\rangle\}$

(6b)	$^{\top}[x \mid x =_i ann]$;	$[x \mid friend\langle x, \top\delta\rangle]$;	$[win\langle\bot\delta\rangle]$;	$[happy\langle\top\delta\rangle]$
	c'_1	c'_2	c'_3	c'_4
	$\{\langle\langle a\rangle, \langle\rangle\rangle\}$	$\{\langle\langle a\rangle, \langle f_1\rangle\rangle$ $\langle\langle a\rangle, \langle f_2\rangle\rangle\}$	$\{\langle\langle a\rangle, \langle f_1\rangle\rangle\}$	$\varnothing$

Stone and Hardt (1999) analyze so-called 'sloppy identity' as anaphora to a center-dependent antecedent plus center-shift. They argue that centering guides all types of anaphora, be it nominal (7a), modal (7b), or temporal (7c). Bittner (2001) adduces crosslinguistic evidence, including ambiguous topic-comment structures like Warlpiri (8), where the topic anaphor (*ngula-ju*) can refer to an individual (A), modality (B), or time (C). Building on these findings, I propose that illocutionary contrasts, e.g. assertion (9a) vs. question (9b), instantiate the centering top-bottom dichotomy in the modal domain.

(7)
a. Smith$^{\top}$ spent *his*$_{\top}$ paycheck. Jones$^{\top}$ saved ***it*** (= *his*$_{\top}$ paycheck).
b. Al$^{\top}$ would use slides if *he*$_{\top}$ gave this talk. Bill$^{\top}$ ***would***=n't (if *he*$_{\top}$ gave this talk).
c. Back then$^{\top}$ you thought I *was*$_{\top}$ crazy. You still$^{\top}$ ***do*** (= think I *am*$_{\top}$ crazy).

(8) Warlpiri (Hale 1976, p.c.)
*Maliki-rli kaji-ngki yarlki-rni nyuntu ngula-**ju** kapi-rna luwa-rni.*
[dog-ERG CMP-3S.2S bite-NPST you] that-TOP FUT-1S.3S shoot-NPST
A. That$^{\top}$ dog that bites you, I'll shoot *it*$_{\top}$.
B. If$^{\top}$ a dog bites you, I'*ll*$_{\top}$ shoot it.
C. When$^{\top}$ the dog bites you, I'*ll*$_{\top}$ shoot it.

(9)
a. *Aani ajugaa-**pu**-q.*
Ann win-DEC$_{\top}$-3S
Ann won.

b. *Aani ajugaa-**pi**-a*? (*Aap.*)
Ann win-QUE$_{\top}$-3S (yes.)
Did Ann win? (Yes.)

More precisely, I extend the default state (5) with modal referents. If the initial common ground is $p_0 = \{w_0, w_1\}$, the default state is (10). This state is induced by the very act of speaking up ('commonplace effect' of Stalnaker 1978). Suppose Ann won in w_1 and w_2 but not in w_0. Then both the assertion (9a) and the question (9b) are felicitous in this context.

(10) $\langle\langle w_0, p_0\rangle, \langle\rangle\rangle$
$\langle\langle w_1, p_0\rangle, \langle\rangle\rangle$

I propose to analyze both as modal updates. Assertion (11a) reduces the common ground, i.e. the set of topic worlds, from $\{w_0, w_1\}$ in (10) to $\{w_1\}$ in c_2. It also introduces the set of surviving topic worlds as the new primary topic (top referent, $p_1 := \{w_1\}$, in c_3). In contrast, a question is a pure attention update (11b). That is, it does not reduce the common ground ($\{w_0, w_1\}$ in c'_1 through c'_3). Instead, the scope of the question (the proposition that Ann won, $p_1^+ := \{w_1, w_2\}$) is added to the $\perp$-list. This induces a partition of the common ground into a *yes*-cell and a *no*-cell ($p_1 = \{w_1\}$ vs. $\{w_0\}$, adapting Hamblin 1973, and Groenendijk and Stokhof 1994). If the addressee answers *Yes*, then this assertion reduces the common ground to the *yes*-cell (c'_4) and introduces this modality as the new primary topic ($p_1 := \{w_1\}$ in c'_5). Thus, a question+*yes* answer updates information and the primary topic like a plain assertion, but questions introduce additional modal referents (e.g. p_1^+ in c'_3).

(11a)

$^{\top}[x \mid x =_i ann]$;	$[win_{\top\omega}\langle\top\delta\rangle]$;	$^{\top}[p \mid p = \top\omega \|\|]$
c_1	c_2	c_3
$\langle\langle a, w_0, p_0\rangle, \langle\rangle\rangle$		
$\langle\langle a, w_1, p_0\rangle, \langle\rangle\rangle$	$\langle\langle a, w_1, p_0\rangle, \langle\rangle\rangle$	$\langle\langle p_1, a, w_1, p_0\rangle, \langle\rangle\rangle$

(11b)

$^{\top}[x \mid x =_i ann]$;	$[w \mid win_w\langle\top\delta\rangle]$;	$[p \mid p = \perp\omega \|\|]$
c'_1	c'_2	c'_3
$\langle\langle a, w_0, p_0\rangle, \langle\rangle\rangle$	$\langle\langle a, w_0, p_0\rangle, \langle w_1\rangle\rangle$	$\langle\langle a, w_0, p_0\rangle, \langle p_1^+, w_1\rangle\rangle$
	$\langle\langle a, w_0, p_0\rangle, \langle w_2\rangle\rangle$	$\langle\langle a, w_0, p_0\rangle, \langle p_1^+, w_2\rangle\rangle$
$\langle\langle a, w_1, p_0\rangle, \langle\rangle\rangle$	$\langle\langle a, w_1, p_0\rangle, \langle w_1\rangle\rangle$	$\langle\langle a, w_1, p_0\rangle, \langle p_1^+, w_1\rangle\rangle$
	$\langle\langle a, w_1, p_0\rangle, \langle w_2\rangle\rangle$	$\langle\langle a, w_1, p_0\rangle, \langle p_1^+, w_2\rangle\rangle$

(c'_4	c'_5)
$[\top\omega \in_i \perp\Omega]$	$^{\top}[p \mid p = \top\omega \|\|]$
$\langle\langle a, w_1, p_0\rangle, \langle p_1^+, w_1\rangle\rangle$	$\langle\langle p_1, a, w_1, p_0\rangle, \langle p_1^+, w_1\rangle\rangle$
$\langle\langle a, w_1, p_0\rangle, \langle p_1^+, w_2\rangle\rangle$	$\langle\langle p_1, a, w_1, p_0\rangle, \langle p_1^+, w_2\rangle\rangle$

This has implications for modal anaphora. For example, assuming that a conditional gets its modal base by anaphora (Kratzer 1981, Stone 1997), we correctly predict that the antecedent can be a question (12a), or another source of a propositional referent (e.g. (12b, c)).

(12) a. (*Did* Oswald shoot Kennedy?) Well, *if* he had, someone would've seen him. So I don't believe *it*.
b. Oswald did=*n't* shoot Kennedy. *If* he had, someone would've seen him.
c. Kennedy was shot *because* he had enemies. *If* Oswald hadn't shot him, someone else would have.

In what follows I formally define *Update with Modal Centering* (UC_ω, Section 2.2) and DRT-style abbreviations used above (Section 2.3). I then extend UC_ω with temporal referents so that we can represent centering-based anaphora across domains (Section 2.4).

2.2 *Update with Modal Centering* (UC_ω)

Update with Centering (UC) is an update system designed to represent centering-based discourse anaphora and to allow direct type-driven composition. To accomplish these goals, UC combines type logic (adapting Muskens 1995, 1996) with update semantics (adapting Veltman 1996). That is, the meaning of a sentence updates an input state of information to the output state. Centering is analyzed as list-based anaphora (adapting Dekker 1994). More precisely, a state of information is a set of $\top\bot$-*lists* of ranked semantic objects that are available for anaphoric reference (*discourse referents*). Each $\top\bot$-list is a pair of two sequences of objects: a $\top$-*list*, representing ranked referents for top-anaphors (e.g. '$3s_\top$'), and a $\bot$-*list*, representing ranked referents for bottom anaphors (e.g. '$3s_\bot$').

DEFINITION 1 (lists and info-states) Given a non-empty set D of objects:

- $D^{n,m} = D^n \times D^m$ is the set of $\top\bot$-*lists* of n $\top$-*objects* and m $\bot$-*objects*.
- For any $\top\bot$-list $\mathrm{i} \in D^{n,m}$, $\top\mathrm{i} := \mathrm{i}_1$ and $\bot\mathrm{i} := \mathrm{i}_2$. Thus, $\mathrm{i} = \langle\top\mathrm{i}, \bot\mathrm{i}\rangle$.
- An (n, m)-*info-state* is any subset of $D^{n,m}$. The empty set, $\varnothing$, is the *absurd state.*

UC_ω represents discourse reference to *individuals* (δ), *worlds* (ω), and *propositions* ($\Omega := \omega t$). That is, a non-empty $\top\bot$-list consists of semantic objects of these types. A $\top\bot$-list is itself a semantic object (of type s), but not a discourse referent ($s \notin \mathrm{DR}(\Theta)$).

DEFINITION 2_ω (UC_ω types). The set of UC_ω *types* Θ is the smallest set such that (i) $\delta, \omega, t, s \in \Theta$, and (ii) $(ab) \in \Theta$ if $a, b \in \Theta$. The subset $\mathrm{DR}(\Theta) = \{\delta, \omega, \omega t\}$ is the set of *discourse referent types* within Θ.

In UC_ω-frames, D_s is the domain of $\top\bot$-lists. It consists of all the pairs of sequences of objects of referent types ($\mathrm{DR}(\Theta) = \{\delta, \omega, \omega t\}$), including the empty $\top\bot$-list, $\langle\langle\rangle,\langle\rangle\rangle$. A model for UC_ω consists of a UC_ω-frame and an interpretation of non-logical constants.

DEFINITION 3 (UC_ω frames). A UC_ω frame is a set $\{D_a | a \in \Theta\}$ of non-empty pairwise disjoint sets D_a such that (i) $D_t = \{1, 0\}$, (ii) $D_{ab} = \{f | \varnothing \subset \mathrm{Dom}\, f \subseteq D_a \,\&\, \mathrm{Ran}\, f \subseteq D_b\}$, and (iii) $D_s = \cup\{D^{n,m} | 0 \le n \,\&\, 0 \le m\}$, where $D = \cup\{D_a | a \in \mathrm{DR}(\Theta)\}$

DEFINITION 4_ω (UC_ω models). A UC_ω model is a pair $M = \langle\{D_a | a \in \Theta\}, [\![\cdot]\!]\rangle$ such that $\{D_a | a \in \Theta\}$ is a UC_ω frame and for all $A \in Con_a$, $[\![A]\!] \in D_a$.

The basic terms of UC_ω are variables and non-logical constants. The syntactic definition ($D5_\omega$) builds complex terms by means of six standard rules of type logic (i–vi) and three centering rules (vii–ix). The centering rule (vii) combines a referent-valued variable and a $\top\bot$-list into an extended $\top\bot$-list. Rule (viii) builds local anaphors (e.g. $\top a_n$ for the nth object of type a on the $\top$-list of the input $\top\bot$-list). Finally, rule (ix) builds global anaphors (e.g. $\top a_n\{I_{st}\}$ for the entire set of $\top a_n$-objects on all the $\top\bot$-lists of the input state I). For any assignment g, UC$_\omega$ semantics (D6$_\omega$) extends the interpretation of constants, $[\![\cdot]\!]$, to all terms, $[\![\cdot]\!]^g$. Rules (i-vi) are standard. (We write '$X \doteq Y$' for 'X is Y, if Y is defined, else X is undefined'. We also use the von Neumann definition of truth values, so $1 := \{\emptyset\}$ and $0 := \emptyset$.) In the centering rule (vii), $(\mathsf{d} \oplus \mathsf{z}) := \langle \mathsf{d}, \mathsf{z}_1, \ldots, \mathsf{z}_n\rangle$ for any object d and sequence z. That is, the object $g(u_a)$ is added to the specified sublist of the input $\top\bot$-list $[\![B]\!]^g$. In (viii), $(\mathsf{z})_n$ denotes the nth coordinate of z, and $(\mathsf{z})_a$, the sub-sequence of type a coordinates of z. That is, $\top a_n$ (or $\bot a_n$) denotes the nth a-object on the $\top$-list (or $\bot$-list), if there is such an object, and fails to denote otherwise. Finally, rule (ix) says that $A\{B\}$ denotes the *global value* of the anaphor A_{sa} in state B_{st}, i.e. (the characteristic function of, $^{\chi}(\cdot)$) the set of all the A-objects on all the $\top\bot$-lists in (the set characterized by, $^{\{\}}(\cdot)$) B (adapting van den Berg 1996).

DEFINITION 5$_\omega$ (UC$_\omega$-syntax). For any type $a \in \Theta$, define the set of a-terms, $Term_a$:

i. $Con_a \cup Var_a \subseteq Term_a$
ii. $\lambda u_a(B) \in Term_{ab}$, if $u_a \in Var_a$ and $B \in Term_b$
iii. $BA \in Term_b$, if $B \in Term_{ab}$ and $A \in Term_a$
iv. $(A = B) \in Term_t$, if $A, B \in Term_a$
v. $\neg\varphi, (\varphi \rightarrow \psi), (\varphi \wedge \psi), (\varphi \vee \psi) \in Term_t$, if $\varphi, \psi \in Term_t$
vi. $\forall u_a\varphi, \exists u_a\varphi \in Term_t$, if $u_a \in Var_a$ and $\varphi \in Term_t$
vii. $(u_a {}^{\top}\!\oplus B), (u_a {}^{\bot}\!\oplus B) \in Term_s$, if $a \in \mathrm{DR}(\Theta)$, $u_a \in Var_a$, and $B \in Term_s$
viii. $\top a_n, \bot a_n \in Term_{sa}$, if $a \in \mathrm{DR}(\Theta)$ and $n \geq 1$.
ix. $A\{B\} \in Term_{at}$, if $a \in \mathrm{DR}(\Theta)$, $A \in Term_{sa}$, and $B \in Term_{st}$

DEFINITION 6$_\omega$ (UC$_\omega$ semantics). For any $M = \langle \{D_a | a \in \Theta\}, [\![\cdot]\!]\rangle$ and g:

i. $[\![A]\!]^g = [\![A]\!]$ if $A \in Con_a$
$= g(A)$ if $A \in Var_a$
ii. $[\![\lambda u_a(B)]\!]^g(\mathsf{d}) \doteq [\![B]\!]^{g[u/\mathsf{d}]}$ if $\mathsf{d} \in D_a$
iii. $[\![BA]\!]^g \doteq [\![B]\!]^g([\![A]\!]^g)$
iv. $[\![A = B]\!]^g = 1$ iff $[\![A]\!]^g, [\![B]\!]^g \in D_a$ & $[\![A]\!]^g = [\![B]\!]^g$
v. $[\![\neg\varphi]\!]^g \doteq 1\backslash[\![\varphi]\!]^g$
$[\![\varphi \rightarrow \psi]\!]^g \doteq 1\backslash([\![\varphi]\!]^g\backslash[\![\psi]\!]^g)$
$[\![\varphi \wedge \psi]\!]^g \doteq [\![\varphi]\!]^g \cap [\![\psi]\!]^g$
$[\![\varphi \vee \psi]\!]^g \doteq [\![\varphi]\!]^g \cup [\![\psi]\!]^g$
vi. $[\![\forall u_a\varphi]\!]^g \doteq \cap\{[\![\varphi]\!]^{g[u/\mathsf{d}]}: \mathsf{d} \in D_a\}$
$[\![\exists u_a\varphi]\!]^g \doteq \cup\{[\![\varphi]\!]^{g[u/\mathsf{d}]}: \mathsf{d} \in D_a\}$
vii. $[\![u_a{}^{\top}\!\oplus B]\!]^g \doteq \langle (g(u_a) \oplus \top[\![B]\!]^g), \bot[\![B]\!]^g\rangle$
$[\![u_a{}^{\bot}\!\oplus B]\!]^g \doteq \langle \top[\![B]\!]^g, (g(u_a) \oplus \bot[\![B]\!]^g)\rangle$
viii. $[\![\top a_n]\!]^g(\mathsf{i}) \doteq ((\top\mathsf{i})_a)_n$ if $\mathsf{i} \in D_s$
$[\![\bot a_n]\!]^g(\mathsf{i}) \doteq ((\bot\mathsf{i})_a)_n$ if $\mathsf{i} \in D_s$
ix. $[\![A\{B\}]\!]^g \doteq {}^{\chi}\{[\![A]\!]^g(\mathsf{j}) | \mathsf{j} \in {}^{\{\}}[\![B]\!]^g\}$

A *context* of utterance is a pair of a non-empty set of worlds (p_0, initial *common ground*) and an individual who is known to be speaking (the *speaker*, denoted by the δ-constant $\textsc{i}$ and constrained by the $\omega\delta t$-predicate *speak*). The common ground determines the *default state*, ${}^{st}\mathsf{p}_0$. By default, the common ground p_0 is the topical proposition, i.e. the $\top\Omega_1$-object. Moreover, for each common ground world (candidate for the speech world), there is some $\top\bot$-list in the default state where that world is the local topic world, i.e. the $\top\omega_1$-object.

DEFINITION 7_ω (contexts and defaults). For a model $M = \langle\{D_a |\ a \in \Theta\}, [\![\cdot]\!]\rangle$,

i. An *M-context* is a pair $\langle \mathsf{p}_0, [\![\textsc{i}]\!]\rangle \in D_{\omega t} \times D_\delta$ such that (a) ${}^{\{\}}\mathsf{p}_0 \neq \varnothing$ and (b) $\forall \mathsf{w} \in {}^{\{\}}\mathsf{p}_0$: $[\![\textsc{i}]\!] \in {}^{\{\}}[\![\mathit{speak}]\!](\mathsf{w})$

ii. ${}^{st}\mathsf{p}_0 = {}^{\chi}\{\langle\langle \mathsf{w}, \mathsf{p}_0\rangle, \langle\ \rangle\rangle |\ \mathsf{w} \in {}^{\{\}}\mathsf{p}_0\}$ is the p_0-*default* (*info-*)*state*.

The content of what is said updates the default state. For any input state of information c (set of $\top\bot$-lists), a term φ of type $(st)st$ (representation of a sentence) is assigned a truth value just in case it updates the primary topic to a proposition ($\textsc{top}_{M,\mathsf{c}}\ \varphi = \{\mathsf{p}\}$). In that case, the topical proposition is the set of worlds where φ is true; in all other worlds, φ is false.

DEFINITION 8 (topic-set, truth). For a model M, info-state c, and $(st)st$ term φ:

i. $\textsc{top}_{M,\mathsf{c}}\ \varphi = \{(\top\mathsf{j})_1 |\ \mathsf{j} \in D_s \backslash {}^{\{\}}\mathsf{c}\ \&\ \forall g\text{: } \mathsf{j} \in {}^{\{\}}[\![\varphi]\!]^g(\mathsf{c})\}$

ii. φ is *true* relative to M and c at world w iff $\exists \mathsf{p} \in D_{\omega t}$: $\textsc{top}_{M,\mathsf{c}}\ \varphi = \{\mathsf{p}\}\ \&\ \mathsf{w} \in {}^{\{\}}\mathsf{p}$

iii. φ is *false* relative to M and c at world w iff $\exists \mathsf{p} \in D_{\omega t}$: $\textsc{top}_{M,\mathsf{c}}\ \varphi = \{\mathsf{p}\}\ \&\ \mathsf{w} \notin {}^{\{\}}\mathsf{p}$

2.3 DRT-style abbreviations

For the sake of readability, we follow the usual practice (Muskens 1996, Stone 1997, a.o.) and introduce a system of DRT-style abbreviations. For example, in section 2.1 we used some abbrevations defined in Table 1. Further abbreviations will be introduced as needed.

Table 1. Drt-notation for $\mathrm{UC}_{(\omega)}$-terms

• static relations ($a \in \textsc{dr}(\Theta)$)		
$A_a \in B_{at}$	for	BA
$A_a \notin B_{at}$	for	$\neg BA$
$A_{at} \subseteq B_{at}$	for	$\forall u_a(u \in A \rightarrow u \in B)$
$B(A_1, \ldots, A_n)$	for	$BA_1 \ldots A_n$
• local projections, conditions, and updates ($a \in \textsc{dr}(\Theta)$, $\mathbf{R} \in \{=, \in, \notin, \subseteq\}$)		
$\top a$, $\bot a$	for	$\top a_1$, $\bot a_1$
$A_a{}^{\circ}$, $A_{sa}{}^{\circ}$	for	$\lambda i_s.\ A$, $\lambda i_s.\ Ai$
$B\, \mathbf{R}_{\boldsymbol{i}}\, A$	for	$\lambda i_s.\ B^{\circ}i\ \mathbf{R}\ A^{\circ}i$
$B_W\langle A_1, \ldots A_n\rangle$	for	$\lambda i_s.\ B(W^{\circ}i, A_1{}^{\circ}i, \ldots A_n{}^{\circ}i)$
$[C]$	for	$\lambda I_{st}\lambda j_s.\ Ij \wedge Cj$
${}^{\top}[u_1 \ldots u_n|\ C]$	for	$\lambda I_{st}\lambda j_s. \exists u_1 \ldots u_n \exists i_s(j = (u_1 {}^{\top}\!\oplus \ldots (u_n {}^{\top}\!\oplus i)) \wedge Ii \wedge Ci)$
$[u_1 \ldots u_n|\ C]$	for	$\lambda I_{st}\lambda j_s. \exists u_1 \ldots u_n \exists i_s(j = (u_1 {}^{\bot}\!\oplus \ldots (u_n {}^{\bot}\!\oplus i)) \wedge Ii \wedge Ci)$

• global updates ($a \in \mathrm{DR}(\Theta)$, $\mathbf{R} \in \{=, \in, \notin, \subseteq\}$)

$[A\ \mathbf{R}\ B\|\|]$	for	$\lambda I_{st}\lambda j_s.\ Ij \wedge Aj\ \mathbf{R}\ B\{I\})$
$[A\|\|\ \mathbf{R}\ B\|\|]$	for	$\lambda I_{st}\lambda j_s.\ Ij \wedge A\{I\}\ \mathbf{R}\ B\{I\})$
$^{\top}[u_a\|\ u\ \mathbf{R}\ A\|\|]$	for	$\lambda I_{st}\lambda j_s.\ \exists u_a \exists i_s(j = (u\ {}^{\top}\!\oplus\ i) \wedge Ii \wedge u\ \mathbf{R}\ A\{I\})$
$[u_a\|\ u\ \mathbf{R}\ A\|\|]$	for	$\lambda I_{st}\lambda j_s.\ \exists u_a \exists i_s(j = (u\ {}^{\perp}\!\oplus\ i) \wedge Ii \wedge u\ \mathbf{R}\ A\{I\})$
$(J_{(st)st}\ ;\ K_{(st)st})$	for	$\lambda I_{st}\lambda j_s.\ (K(JI))j$

By way of illustration, consider again the representations of assertions and question-answer pairs proposed in (11a, b). The proposed UC_{ω} representations, in the above drt-notation, are repeated in (13) and (14) together with the glosses of the respective examples:

(13) Ann win-DEC$_{\top}$-3S
$^{\top}[x|\ x =_i ann];\ [win_{\top\omega}\langle\top\delta\rangle];\ ^{\top}[p|\ p = \top\omega||]$

(14) Ann win-QUE$_{\top}$-3S? Yes.
$^{\top}[x|\ x =_i ann];\ [w|\ win_w\langle\top\delta\rangle];\ [p|\ p = \bot\omega||];\ \ [\top\omega \in_i \bot\Omega];\ ^{\top}[p|\ p = \top\omega||]$

In the case of assertion (13), the first box adds Ann to the $\top$-list (15). The second box tests that this topical individual ($\top\delta$) won in the local topic world ($\top\omega$), reducing the common ground ($\top\omega||$) to the worlds that pass this test (16). The last box introduces the updated common ground as the new primary topic (17). The truth definition (D8) then correctly predicts that assertions have truth values and assigns the correct truth condition.

(15) $({}^{st}\mathrm{p}_0)[\![{}^{\top}[x|\ x =_i a]]\!]^g$ $=: \mathrm{c}_1$
$:=\ [\![\lambda I_{st}\lambda j_s.\ \exists x \exists i_s(j = (x\ {}^{\top}\!\oplus\ i) \wedge Ii \wedge x = a)]\!]^g({}^{st}\mathrm{p}_0)$
$=\ {}^{\chi}\{\langle\langle \mathrm{a}, \mathrm{w}, \mathrm{p}_0\rangle, \langle\,\rangle\rangle|\ \mathrm{w} \in {}^{\{\}}\mathrm{p}_0\ \&\ \mathrm{a} = [\![a]\!]\}$

(16) $\mathrm{c}_1[\![[win_{\top\omega}\langle\top\delta\rangle]]\!]^g$ $=: \mathrm{c}_2$
$:=\ [\![\lambda I_{st}\lambda j_s.\ Ij \wedge win(\top\omega_1 j,\ \top\delta_1 j)]\!]^g(\mathrm{c}_1)$
$=\ {}^{\chi}\{\langle\langle \mathrm{a}, \mathrm{w}, \mathrm{p}_0\rangle, \langle\,\rangle\rangle|\ \mathrm{w} \in {}^{\{\}}\mathrm{p}_0\ \&\ \mathrm{a} = [\![a]\!]\ \&\ \mathrm{a} \in {}^{\{\}}[\![win]\!](\mathrm{w})\}$

(17) $\mathrm{c}_2[\![{}^{\top}[p|\ p = \top\omega||]]\!]^g$ $=: \mathrm{c}_3$
$:=\ [\![\lambda I_{st}\lambda j_s.\ \exists p \exists i_s(j = (p\ {}^{\top}\!\oplus\ i) \wedge Ii \wedge p = \top\omega_1\{I\})]\!]^g(\mathrm{c}_2)$
$=\ {}^{\chi}\{\langle\langle \mathrm{p}_1, \mathrm{a}, \mathrm{w}, \mathrm{p}_0\rangle, \langle\,\rangle\rangle|\ \mathrm{w} \in {}^{\{\}}\mathrm{p}_0\ \&\ \mathrm{a} = [\![a]\!]\ \&\ \mathrm{a} \in {}^{\{\}}[\![win]\!](\mathrm{w})$
$\&\ \mathrm{p}_1 = {}^{\chi}\{\mathrm{w}' \in {}^{\{\}}\mathrm{p}_0|\ \mathrm{a} \in {}^{\{\}}[\![win]\!](\mathrm{w}')\}\}$

In the related question (14), the first update is again (15) (hence $\mathrm{c}'_1 = \mathrm{c}_1$). However, the other two boxes are pure attention updates. Both add modal referents to the $\bot$-list: first, all of the possible worlds where Ann wins (18), and then, the entire set of these worlds, i.e. the proposition that Ann won (19).

(18) $\mathrm{c}'_1[\![[w|\ win_w\langle\top\delta\rangle]]\!]^g$ $=: \mathrm{c}'_2$
$:=\ [\![\lambda I_{st}\lambda j_s.\ \exists w \exists i_s(j = (w\ {}^{\perp}\!\oplus\ i) \wedge Ii \wedge win(w,\ \top\delta_1 i))]\!]^g(\mathrm{c}'_1)$
$=\ {}^{\chi}\{\langle\langle \mathrm{a}, \mathrm{w}, \mathrm{p}_0\rangle, \langle \mathrm{v}\rangle\rangle|\ \mathrm{w} \in {}^{\{\}}\mathrm{p}_0\ \&\ \mathrm{a} = [\![a]\!]\ \&\ \mathrm{v} \in D_{\omega}\ \&\ \mathrm{a} \in {}^{\{\}}[\![win]\!](\mathrm{v})\}$

(19) $c'_2[\![[p|\, p = \bot\omega|\!|]]\!]^g$ $=: c'_3$

$:= [\![\lambda I_{st}\lambda j_s.\ \exists p\exists i_s(j = (p\ {}^{\bot}\!\oplus i) \wedge Ii \wedge p = \bot\omega_1\{I\})]\!]^g(c'_2)$

$= {}^{\chi}\{\langle\langle a, w, p_0\rangle, \langle p_1{}^{+}, v\rangle\rangle |\ w \in {}^{\{\}}p_0\ \&\ a = [\![a]\!]\ \&\ v \in D_\omega\ \&\ a \in {}^{\{\}}[\![win]\!](v)$
$\&\ p_1{}^{+} = {}^{\chi}\{v' \in D_\omega|\ a \in {}^{\{\}}[\![win]\!](v')\}\}$

This analysis captures the intuition that a question adds no information (i.e. does not reduce the common ground), and that the issue of truth value does not arise (given the truth definition D8). In contrast, the answer to a question is informative and does have a truth value. In the present theory, this is because the answer reduces the common ground (20) and introduces the updated common ground as the new primary topic (21). The relation of an elliptic answer to the question is analyzed as centering-based modal anaphora.

(20) $c'_3[\![[\top\omega \in_i \bot\Omega]]\!]^g$ $=: c'_4$

$:= [\![\lambda I_{st}\lambda j_s.\ Ij \wedge \top\omega_1 j \in \bot\Omega_1 j)]\!]^g(c'_3)$

$= {}^{\chi}\{\langle\langle a, w, p_0\rangle, \langle p_1{}^{+}, v\rangle\rangle |\ w \in {}^{\{\}}p_0\ \&\ a = [\![a]\!]\ \&\ v \in D_\omega\ \&\ a \in {}^{\{\}}[\![win]\!](v)$
$\&\ p_1{}^{+} = {}^{\chi}\{v' \in D_\omega|\ a \in {}^{\{\}}[\![win]\!](v')\}\ \&\ w \in {}^{\{\}}p_1\}$

(21) $c'_4[\![{}^{\top}[p|\, p = \bot\omega|\!|]]\!]^g$ $=: c'_5$

$:= [\![\lambda I_{st}\lambda j_s.\ \exists p\exists i_s(j = (p\ {}^{\top}\!\oplus i) \wedge Ii \wedge p = \top\omega_1\{I\})]\!]^g(c'_4)$

$= {}^{\chi}\{\langle\langle p_1, a, w, p_0\rangle, \langle p_1{}^{+}, v\rangle\rangle |\ w \in {}^{\{\}}p_0\ \&\ a = [\![a]\!]\ \&\ v \in D_\omega\ \&\ a \in {}^{\{\}}[\![win]\!](v)$
$\&\ p_1{}^{+} = {}^{\chi}\{v' \in D_\omega|\ a \in {}^{\{\}}[\![win]\!](v')\}\ \&\ a \in {}^{\{\}}[\![win]\!](w)$
$\&\ p_1 = {}^{\chi}\{v' \in {}^{\{\}}p_0|\ a \in {}^{\{\}}[\![win]\!](v')\}\}$

In what follows UC_ω serves to represent nominal and modal reference in discourse. To factor in temporal reference we define an extension of this update system.

2.4 General *Update with Centering* (UC)

General *Update with Centering*, UC, extends UC_ω with three types of discourse referents: events (ε), states (σ), and times (τ).

DEFINITION 2 (UC types). The set of UC types Θ is the smallest set such that (i) $\delta, \varepsilon, \sigma, \tau, \omega, t, s \in \Theta$, and (ii) $(ab) \in \Theta$ if $a, b \in \Theta$. The subset $\mathrm{DR}(\Theta) = \{\delta, \varepsilon, \sigma, \tau, \omega, \omega t\}$ is the set of *discourse referent types* within Θ.

UC-terms are interpreted on the same frames as UC_ω (D3 in Section 2.2), but in richer models. In natural language discourse time behaves like a chain of discrete instants (see Kamp 1979, Bittner 2008, a.o.). For simplicity, I model discourse time using integers (as in D4.ii). A *discourse instant* is a set of one integer (e.g. {3}), whereas a *discourse period* is a set of successive integers (e.g. {4, 5}). A discourse time t *precedes* t′, written $t <_\tau t'$, iff every integer in t precedes every integer in t′. In addition, UC has a set of time-related logical operators (see D4.iii). First of all, for any world w, the *run time* operator ϑ maps any eventuality in w to its run time in w. If the eventuality is an event, then its run time in any world is a discourse instant, $\{n\}$, and its *consequent state* (CON) begins at the next instant, $\{(n+1)\}$. If the eventuality is a state, then its run time in any world is a discourse period, and its *beginning* (BEG) and *end* (END) are events that begin and end that period. Some eventualities have a *central individual* (CTR). In particular, verbal predicates (i.e. constants of type $\omega a\delta...t$, where $a \in \{\varepsilon, \sigma\}$) center their eventuality argument on their first individual argument. Eventuality-valued operators (CON, BEG, END) preserve this nominal centering. In addition, some eventualities may have a contrasting *background individual* (BCK).

DEFINITION 4 (UC models) A UC model is a triple $M = \langle\{D_a | a \in \Theta\}, <_\tau, [\![\cdot]\!]\rangle$ such that: (i) $\{D_a | a \in \Theta\}$ is a UC frame, (ii) D_τ is the set of non-empty convex sets of integers and $\forall \mathsf{t}, \mathsf{t}' \in D_\tau$: $\mathsf{t} <_\tau \mathsf{t}'$ iff $\forall n \in \mathsf{t} \forall n' \in \mathsf{t}'(n < n')$, and (iii) $[\![\cdot]\!]$ assigns to each $A \in Con_a$ a value $[\![A]\!] \in D_a$ and to each $B \in \{\text{CON, BEG, END, CTR, BCK}, \vartheta\}$, a value $[\![B]\!]$ such that:

a. $[\![\text{CON}]\!] \in D_{\varepsilon\sigma}$ $\qquad$ $[\![\vartheta]\!] \in \{f_\varepsilon \cup f_\sigma | f_\varepsilon \in D_{\omega\varepsilon\tau} \,\&\, f_\sigma \in D_{\omega\sigma\tau}\}$
$[\![\text{BEG}]\!], [\![\text{END}]\!] \in D_{\sigma\varepsilon}$ $\qquad$ $[\![\text{CTR}]\!], [\![\text{BCK}]\!] \in \{f_\varepsilon \cup f_\sigma | f_\varepsilon \in D_{\varepsilon\delta} \,\&\, f_\sigma \in D_{\sigma\delta}\}$

b. $\forall \mathsf{t} \in D_\tau, \mathsf{w} \in D_\omega, \mathsf{d} \in D_\delta, \mathsf{e} \in D_\varepsilon, \mathsf{s} \in D_\sigma, \mathsf{ev} \in D_\varepsilon \cup D_\sigma$:
$[\![\vartheta]\!](\mathsf{w}, \mathsf{e}) = \mathsf{t} \rightarrow \exists n(\mathsf{t} = \{n\} \,\&\, [\![\vartheta]\!](\mathsf{w}, [\![\text{BEG}]\!]([\![\text{CON}]\!](\mathsf{e}))) = \{(n+1)\})$
$[\![\vartheta]\!](\mathsf{w}, \mathsf{s}) = \mathsf{t} \rightarrow \{\text{MIN}\ \mathsf{t}\} = [\![\vartheta]\!](\mathsf{w}, [\![\text{BEG}]\!](\mathsf{s})) <_\tau \{\text{MAX}\ \mathsf{t}\} = [\![\vartheta]\!](\mathsf{w}, [\![\text{END}]\!](\mathsf{s}))$
$\langle \mathsf{ev}, \mathsf{d}, \ldots\rangle \in {}^{\{\}}[\![A]\!](\mathsf{w}) \rightarrow \mathsf{d} = [\![\text{CTR}]\!](\mathsf{ev})$ $\qquad$ if $A \in Con_{\omega a\delta\ldots t}, a \in \{\varepsilon, \sigma\}$
$\mathsf{d} = [\![\text{CTR}]\!](\mathsf{ev}) \leftrightarrow \mathsf{d} = [\![\text{CTR}]\!]([\![B]\!](\mathsf{ev}))$ $\qquad$ if $B \in \{\text{CON, BEG, END}\}$
$\mathsf{d} = [\![\text{BCK}]\!](\mathsf{ev}) \rightarrow [\![\text{CTR}]\!](\mathsf{ev}) \in D_\delta \backslash \{\mathsf{d}\}$

The syntactic and semantic definitions of UC include three extra rules (x–xii), which introduce and interpret time-related logical constants.

DEFINITION 5 (UC syntax). Rules (i–ix) as in DEFINITION 5_ω

x. $(A \subset B), (A < B) \in Term_t$, if $A, B \in Term_\tau$

xi. $\text{CON}\, A \in Term_\sigma$, if $A \in Term_\varepsilon$
$\text{BEG}\, A, \text{END}\, A \in Term_\varepsilon$, if $A \in Term_\sigma$
$\text{CTR}\, A, \text{BCK}\, A \in Term_\delta$, if $A \in Term_\varepsilon \cup Term_\sigma$

xii. $\vartheta_W A \in Term_\tau$, if $W \in Term_\omega$ and $A \in Term_\varepsilon \cup Term_\sigma$

DEFINITION 6 (UC semantics). Rules (i–ix) as in DEFINITION 6_ω

x. $[\![A \subset B]\!]^g = 1$ $\qquad$ iff $[\![A]\!]^g, [\![B]\!]^g \in D_\tau \,\&\, [\![A]\!]^g \subset [\![B]\!]^g$
$[\![A < B]\!]^g = 1$ $\qquad$ iff $[\![A]\!]^g, [\![B]\!]^g \in D_\tau \,\&\, [\![A]\!]^g <_\tau [\![B]\!]^g$

xi. $[\![BA]\!]^g \doteq [\![B]\!]([\![A]\!]^g)$ $\qquad$ if $B \in \{\text{CON, BEG, END, CTR, BCK}\}$

xii. $[\![\vartheta_W A]\!]^g \doteq [\![\vartheta]\!]([\![W]\!]^g)([\![A]\!]^g)$

In UC an (*utterance*) *context* is a pair of a non-empty common ground, p_0, and a speech event, e_0, realized throughout p_0 at a particular instant. A context induces a *default state* ('commonplace effect' of Stalnaker 1978): the common ground p_0 determines the default modal topics, whereas the speech event e_0 determines the default temporal topics. The modal defaults are the same as in UC_ω. In the temporal domain, the speech instant is the default topic time, and the speech event itself, the default perspective point (e.g. for indexicals, adapting Kaplan 1978). The truth definition for UC is the same as for UC_ω (i.e. D8).

DEFINITION 7 (utterance context, default state). For a model $M = \langle \{D_a |\ a \in \Theta\}, <_\tau, [\![\cdot]\!]\rangle$,

i. an *M*-(*utterance*) *context* is a pair $\langle p_0, e_0\rangle \in D_{\omega t} \times D_\varepsilon$ such that (a) ${}^{\{\}}p_0 \neq \varnothing$, and (b) $\exists t_0 \forall w \in {}^{\{\}}p_0$: $t_0 = [\![\vartheta]\!](w, e_0)$ & $\langle e_0, [\![\text{CTR}]\!](e_0)\rangle \in {}^{\{\}}[\![speak]\!](w)$

ii. ${}^{st}\langle p_0, e_0\rangle = {}^{\chi}\{\langle\langle t_0, w, p_0, e_0\rangle, \langle\,\rangle\rangle |\ w \in {}^{\{\}}p_0$ & $t_0 = [\![\vartheta]\!](w, e_0)\}$

In the following analysis of Kalaallisut discourse, we systematically first use UC_ω to analyze modal reference and then the full UC, to factor in temporal reference. We begin with fact-oriented moods (Section 3) and successively add attitudes (Section 4), hypothetical mood (Section 5), modal remoteness (Section 6), and direct composition (Section 7).

3 Fact-oriented moods

3.1 Observations

Kalaallisut verbs inflect for *matrix mood* (22) or *dependent mood* (23). Matrix moods are illocutionary. A matrix 'verb' is a complete sentence, classified by the mood inflection as an assertion about the topic (declarative, DEC), question about the topic (interrogative, QUE), wish concerning the topic (optative, OPT), or directive to the addressee (imperative, IMP). Dependent moods classify the dependent verb, in relation to the matrix, as a background *fact* (FCT), *hypothesis* (HYP), *elaboration* (ELA), or *habit* (HAB). They also mark the centering status of the dependent subject as either *topical* (e.g. -FCT$_\top$) or *backgrounded* (e.g. -FCT$_\perp$), i.e., anaphoric or in contrast to the matrix subject, which is always topical.

(22) Matrix moods

a. (**Aqagu*) *uterpoq*.
(**aqagu*) *utir-**pu**-q*
(*tomorrow) return-DEC$_\top$-3S
He$_\top$ has returned (*tomorrow).

b. (**Aqagu*) *uterpa*?
(**aqagu*) *utir-**pi**-a*
(*tomorrow) return-QUE-3S
Has he$_\top$ returned (*tomorrow)?

c. (*Aqagu*) *uterli*!
(*aqagu*) *utir-**li***
(tomorrow) return-OPT.3S
May he$_\top$ return (tomorrow)!

d. (*Aqagu*) *uterina*!
(*aqagu*) *utir-**gi**-na*
(tomorrow) return-IMP-2S
Return (tomorrow)!

(23) Dependent moods (sample)

a. (**Aqagu*) {*uterami* | *utermat*} *nuannaarpuq.*
(**aqagu*) {*utir-**ga**-ni* | *utir-**mm**-at*} *nuannaar-pu-q*
(*tomorrow) {return-FCT$_\top$-3S$_\top$| return-FCT$_\perp$-3S$_\perp$} happy-DEC$_\top$-3S
Because/when {he$_\top$ | he$_\perp$} returned (*tomorrow), he$_\top$ was happy.

b. *Aqagu* {*uteruni* | *uterpat*} *nuannaassaaq.*
aqagu {*utir-**gu**-ni* | *utir-**pp**-at*} *nuannaar-ssa-pu-q*
tomorrow {return-HYP$_\top$-3S$_\top$| return-HYP$_\perp$-3S$_\perp$} happy-exp$^>$-DEC$_\top$-3S
If/when {he$_\top$ | he$_\perp$} returns tomorrow, he$_\top$'ll be happy. (*lit.* is expected to)

c. *Oqarpoq* {*uternerarluni* | *utertoq*}.
uqar-pu-q {*utir-nirar-**llu**-ni* | *utir-**tu**-q*}
say-DEC$_\top$-3S {return-say$_{se}$-ELA$_\top$-3S$_\top$ | return-ELA$_\perp$-3S$_\perp$}
He$_\top$ has said that {he$_\top$ | he$_\perp$} has returned.

Most Kalaallisut moods are either *fact-oriented* (DEC, QUE, FCT) or *prospect-oriented* (OPT, IMP, HYP). As (22)–(23) illustrate, prospect-oriented moods introduce future eventualities and allow future location times, whereas fact-oriented moods rule out future location times. Discourse-initially, fact-oriented moods require the *state-equivalent* (i.e. the state itself or the consequent state of an event) to hold at the speech instant (24a, b). If the topic time is not an instant but a period, then fact-oriented moods require the *event-equivalent* (i.e. the event itself or the beginning of a state) to fall within that period (see (25)–(26)). In addition, at any point in discourse, fact-oriented moods constrain the event-equivalent of the last eventuality of the verbal base to be a *currently verifiable fact* from the perspective of the speech act, i.e. to precede the speech act in the speech world. Note that in (23b), the last eventuality of the base is the state of expectation introduced by the attitudinal suffix *-ssa* ‘exp$^{>}$’, not the future eventuality introduced by the root (see also Bittner 2005, 2008).

(24) a. *Ulapippunga*.
*ulapik-**pu**-nga*
busy-DEC$_\top$-1S
I am busy.

b. *Uterpunga*.
*utir-**pu**-nga*
return-DEC$_\top$-1S
I have returned.

(25) a. *Ullumi ulapippunga*.
*ullumi ulapik-**pu**-nga*
today busy-DEC$_\top$-1S
I’ve been busy today. (NOT: I am busy (later) today.)

b. *Ullumi uterpunga.*
*Ullumi utir-**pu**-nga.*
today return-DEC$_\top$-1S
I returned today. (NOT: I return today.)

(26) *Ole nuannarpoq Aani ullumi utermat.*
*Ole nuannaar-pu-q Aani ullumi utir-**mm**-at.*
Ole happy-DEC$_\top$-3S Ann today return-FCT$_\perp$-3S$_\perp$
Ole is happy because Ann returned today. (NOT: …because Ann returns today.)

DEFINITION (currently verifiable fact). From the perspective of an event e_0, an event e is a *currently verifiable fact* iff e occurred in the same world as e_0 prior to e_0.

OBSERVATION 1. *Fact-oriented moods* constrain the event-equivalent of the last eventuality of the verbal base to be a currently verifiable fact from the perspective of the speech event.

The current verifiability requirement of Kalaallisut fact-oriented moods makes them unlike the English indicative mood. For example, in contrast to the ungrammatical Kalaallisut declarative (22a), the English non-past indicative can refer to the future, e.g. in *I **return** tomorrow*. The English past indicative can refer to what is possible rather than what is, e.g. in *If Oswald didn't kill Kennedy, someone else **killed** him*. In contrast, the Kalaallisut declarative (27) is ungrammatical: a hypothetical murder is not a currently verifiable fact. All that can be verified now is a state of expectation or belief (recall *-ssa* '-exp$^{>}$' in (2)).

(27) * *Oswaldip Kennedy toqusimanngippagu*
Oswald-p Kennedy tuqut-sima-nngit-pp-a-gu
Oswald-ERG Kennedy kill-prf-not-HYP$_{\perp}$-3S$_{\perp}$-3S
inupiloqataata toqusimavaa.
*inuk-piluk-qat-ata tuqut-sima-**pa**-a*
man-bad-other-3S$_{\perp}$.ERG kill-prf-DEC$_{\top\perp}$-3S.3S
(NOT: If Oswald didn't kill Kennedy, then someone else killed him.)

While ruling out future reference, fact-oriented moods allow negation. Kalaallisut expresses negation by means of a derivational suffix *-nngit* 'not'. The derivational status of this suffix is shown by the fact that it allows further derivation (e.g. in (28iii)). The negation *-nngit* also allows state-modifiers (e.g. 'long-MOD', 'still'), which show that it introduces a state (like the root 'asleep-'). Finally, compatibility with fact-oriented moods (i) and their elaborations (ii) shows that negative states can be currently verifiable facts.

(28) i. *Ullumi sivisuumik {makinngila- | sinippu- | *makippu-}-nga.*
*ullumi sivisuuq-mik {makik-**nngit**-la- | sinik-pu- | *makik-pu-}-nga.*
today long-MOD {get.up-not-DEC- | asleep-DEC$_{\top}$- | *get.up-DEC$_{\top}$}-1S
Today I$^{\top}$ {stayed in bed | slept | *got up} a long time.

ii. *Suli {makinngit- | sinit- |*makit}-tunga Ole iserpoq.*
*suli {makik-**nngit**- | sinik- | *makik-}-tu-nga Ole isir-pu-q*
still {get.up-not- | asleep- | *get.up-}-ELA$_{\perp}$-1S Ole enter-DEC$_{\top}$-3S
While I$^{\perp}$ was still {in bed | asleep | *…} Ole$^{\top}$ dropped in.

iii. *Nuliani aamma suli {makinngin- | sinin- | *makin-}-nerarpaa.*
*nulia-ni aamma suli {makik-**nngit**- | sinik- | *makik}-nirar-pa-a*
wife-3S$_{\top}$ also still {get.up-not-| asleep- | *get.up-}-say$_{\perp}$-DEC$_{\top\perp}$-3S.3S
He$_{\top}$ said that his$_{\top}$ wife too was still {in bed | asleep | *…}.

I propose that the current verifiability constraint of fact-oriented moods has two components: modal and temporal. Modally, the matrix declarative mood (DEC) locates the matrix eventuality throughout the output common ground (main fact), whereas the dependent factual mood (FCT) locates the subordinate eventuality throughout a superset of the common ground (background fact). Thus, both eventualities are realized in every live candidate for the speech world, so they can be verified in that world. Temporally, the declarative matrix mood locates the matrix *event-equivalent* (EVT) before the speech act. That is, from the perspective of the speech act this event is a currently verifiable fact. The dependent factual mood locates the matrix EVT within the consequent state of the subordinate EVT. Thus, the subordinate EVT is verifiable from the matrix EVT, whose temporal location within the consequent state further suggests a causal link. It does not entail it because *post hoc* is not necessarily *propter hoc*. But whether or not the (real) subordinate EVT caused the (real) matrix EVT, neither EVT can be located in the future of the speech act.

To make this proposal precise, I first formalize the modal notion of a *verifiable fact* (Section 3.2) and then, the temporal modifier *currently* (Section 3.3).

3.2 Verifiable facts

The Kalaallisut discourse (29i, ii) illustrates typical use of fact-oriented moods (DEC, FCT) and their interaction with negation (*-nngit* ‘not’). The proposed representation of this discourse in UC_ω is given in (30i, ii).

(29)	i.	*Ole*	*iserpoq.*	ii.	*Nuannaanngilaq*	*nuliani*	*naparsimammat.*
		Ole	*isir-**pu**-q*		*nuannaar-nngit-**la**-q*	*nulia-ni*	*naparsima-**mm**-at*
		Ole	enter-$DEC_\top$-3S		happy-not-DEC-3S	wife-$3S_\top$	ill-$FCT_\bot$-$3S_\bot$
		$Ole^\top$ has dropped in.			$He_\top$’s not happy, because $his_\top$ $wife^\bot$ is ill.		

(30) i. $^\top[x|\ x =_i ole]$; $[enter_{\top\omega}\langle\top\delta\rangle]$; $^\top[p|\ p = \top\omega||]$

ii. $[w|\ happy_w\langle\top\delta\rangle]$; $[\top\omega \notin \bot\omega||]$; $^\top[p|\ p = \top\omega||]$; $[x\ w|\ wife_w\langle x,\top\delta\rangle]$; $[ill_{\bot\omega}\langle\bot\delta\rangle]$; $[\top\omega|| \subseteq \bot\omega||]$

In (30i), the first box adds Ole to the $\top$-list, while the next two boxes comment on this topic. The verbal root adds the information that the topic (Ole) entered in the local topic world ($\top\omega$). This reduces the common ground ($\top\omega||$) to the worlds where this is the case. The declarative mood introduces the updated common ground as the new primary topic. This is the new topical proposition and the truth-set of the declarative sentence (29i).

In (30ii) the first three boxes represent the negated declarative matrix of (29ii) (‘happy-not-DEC-3S’). The scope of negation adds to the $\bot$-list all the worlds where the topical individual (Ole) is happy. The negation asserts that the world of evaluation is not in this set ($\bot\omega||$). The declarative mood identifies the world of evaluation as the topical speech world ($\top\omega$), and introduces the set of surviving topic worlds ($\top\omega||$) as the new primary topic. That is, in the context of (29i), the truth-set of the negated declarative matrix of (29ii) is the set of worlds (where this speech act takes place and) where Ole has entered unhappy.

The post-posed factual dependent (FCT) introduces a background fact that may have caused this matrix fact. In (30ii) the factual dependent is represented by the last three boxes. The entire sequence introduces into the background the proposition that Ole has a sick wife ($\bot\omega||$). The factual mood adds that this background proposition is a fact (i.e. true) throughout the matrix common ground ($\top\omega||$). This suggests that it may be a cause of the matrix fact (i.e. that Ole has entered unhappy in the world of the current speech act).

This suggestion is reinforced by temporal anaphora, which locates the beginning of Ole’s unhappy state within the consequent state of the beginning of his wife’s illness. This temporal relation is discussed in the next section, which explicates *current* verifiability.

3.3 Current verifiability

In what follows, e is a variable of type ε (event), s of type σ (state), and t of type τ (time). Time-related drt-notation is defined in Table 2.

Table 2 drt-abbreviations for time-related UC-terms

• static relations and operations		
$t \subseteq t'$	for	$t \subset t' \vee t = t'$
$t \leq t'$	for	$t < t' \vee t = t'$
$\text{EVT}\ e$	for	e
$\text{EVT}\ s$	for	$\text{BEG}\ s$
$\text{STA}\ s$	for	s
$\text{STA}\ e$	for	$\text{CON}\ e$
• related drt-abbreviations ($a \in \text{DR}(\Theta)$, $\mathbf{R} \in \{=, \subseteq, \subset, \leq, <\}$)		
$B_{ab}\ A_{sa}$	for	$\lambda i_s.\ B\ Ai$
$(A\ \mathbf{R}_W\ B)$	for	$\lambda i_s.\ \vartheta_{W^\circ i}\ A^\circ i\ \mathbf{R}\ \vartheta_{W^\circ i}\ B^\circ i$
$[\text{AT}_W\{A, T\}]$	for	$\lambda I_{st}\lambda j_s.\ Ij \wedge (\exists i_s(Ii \wedge \vartheta_{Wj}\ \text{EVT}\ Ai \subset Ti) \rightarrow \vartheta_{Wj}\ \text{EVT}\ Aj \subset Tj)$ $\wedge (\neg\exists i_s(Ii \wedge \vartheta_{Wj}\ \text{EVT}\ Ai \subset Ti) \rightarrow Tj \subset \vartheta_{Wj}\ \text{STA}\ Aj)$

The *global* AT-*update*, $[\text{AT}_W\{A, T\}]$, provides a unified representation for the two temporal patterns found with fact-oriented moods in Kalaallisut. Recall that by discourse-initial default, a currently verifiable state holds now (31a), whereas a currently verifiable event has a consequent state that holds now (31b). Other topic times can be set, if the current verifiability requirement of the fact-oriented mood can be met (32a, b).

(31) a. *Ulapik-**pu**-nga.*
busy-DEC$_{\text{T}}$-1S
I am busy.

b. *Utir-**pu**-nga*
return-DEC$_{\text{T}}$-1S
I have returned.

(32) a. {*Ullumi* | **aqagu*} *ulapik-**pu**-nga.*
{today | *tomorrow} busy-DEC$_{\text{T}}$-1S
I've been busy {today | *tomorrow}.

b. {*Ullumi* | **aqagu*} *utir-**pu**-nga.*
{today | *tomorrow} return-DEC$_{\text{T}}$-1S
I returned {today | *tomorrow}.

I propose to represent the default pattern (31a, b) as in (33a, b). These UC representations are interpreted relative to the default state, where the topic time ($\top\tau$) is the speech instant. Since an instant (unit set) cannot properly include anything, the global AT-updates reduce to (34a, b).

(33) a. $[s|\ busy_{\top\omega}\langle s, \text{CTR}\ \top\varepsilon\rangle]; [\text{AT}_{\top\omega}\{\bot\sigma, \top\tau\}]; [\text{EVT}\ \bot\sigma <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p = \top\omega||]$

b. $[e|\ return_{\top\omega}\langle e, \text{CTR}\ \top\varepsilon\rangle]; [\text{AT}_{\top\omega}\{\bot\varepsilon, \top\tau\}]; [\text{EVT}\ \bot\varepsilon <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p = \top\omega||]$

(34) a. $[s|\ busy_{\top\omega}\langle s, \text{CTR}\ \top\varepsilon\rangle, \top\tau \subset_i \vartheta_{\top\omega}\ s, \text{BEG}\ s <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p = \top\omega||]$

b. $[e|\ return_{\top\omega}\langle e, \text{CTR}\ \top\varepsilon\rangle, \top\tau \subset_i \vartheta_{\top\omega}\ \text{CON}\ e, e <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p = \top\omega||]$

That is, what holds at the topical instant is the state-equivalent of the verbal eventuality (STA, i.e. the state itself in (34a), consequent state in (34b)). In addition, declarative mood requires current verifiability from the perspective of the speech act. To pass this test, the event-equivalent (EVT, i.e. the beginning of the state in (34a), the event itself in (34b)) must have already happened in the speech world ($\top\omega$) prior to this speech act ($\top\varepsilon$).

In (32a, b), the temporal noun can be interpreted as a *topic-setting* sentence-modifier (e.g. 'today-$^{\top}$') or *bottom-elaborating* eventuality-modifier (e.g. 'today-$_{\varepsilon}$'). I formalize this idea by means of two special sequencing operators, *topic-comment* ($^{\top}$;) and *bottom-elaboration* ($^{\perp}$;), defined below. A topic-comment sequence ($A\ ^{\top}; B$) reduces to (A; B), iff A (*topic-update*) adds at least one object to the input $\top$-list and the top $\top$-object in the output of A is referred to in B (*comment*) by $\top a_1$, for some type a, and maintains its $\top a_1$-rank throughout B (i.e. B can add other types of topics, but not any a-topics.) Otherwise, the output of ($A\ ^{\top}; B$) is the absurd state, $\varnothing$. (We write $\mathsf{y} \prec \mathsf{z}$ for $\mathsf{z} = \langle \mathsf{z}_1, \ldots, \mathsf{z}_m, \mathsf{y}_1, \ldots, \mathsf{y}_n \rangle$, where $\mathsf{y} \in D^n$, $\mathsf{z} \in D^{m+n}$, and $m \geq 1$. '$X[Y/Z]$' stands for the result of replacing every Y in X with Z.) A background-elaboration sequence ($A\ ^{\perp}; B$) is defined analogously for $\perp$-lists.

today-$^{\top}$ |– s/s: $\lambda K_{[]}(^{\top}[t|\ t \subseteq_i day.of\langle \vartheta_{\top\omega} \top\varepsilon \rangle]\ ^{\top}; K)$ $[\,] := (st)st$

today-$_{\eta}$ |– $\underline{s}/\underline{s}$: $\lambda \underline{V}_{[s\omega]} \lambda \underline{w}_{s\omega} (\underline{V}\ \underline{w}\ ^{\perp}; [\vartheta_{\underline{w}} \perp\eta \subseteq_i day.of\langle \vartheta_{\top\omega} \top\varepsilon \rangle])$ $\eta \in \{\varepsilon, \sigma\}$, $[a] := a[\,]$

$$(^{\top};) \quad \mathsf{c}[\![A\ ^{\top}; B]\!]^g = \{\mathsf{h} \in \mathsf{c}[\![A; B]\!]^g |\ \exists a \forall \mathsf{k} \in \mathsf{c}[\![A; B]\!]^g \exists \mathsf{j} \in \mathsf{c}[\![A]\!]^g \exists \mathsf{i} \in \mathsf{c}\text{: } \top\mathsf{i} \prec \top\mathsf{j} \preceq \top\mathsf{k} \ \&\ (\top\mathsf{j})_1 = ((\top\mathsf{k})_a)_1 \ \&\ [\![B]\!]^g \neq [\![B[\top a_1/\perp a_1]]\!]^g\}$$

$$(^{\perp};) \quad \mathsf{c}[\![A\ ^{\perp}; B]\!]^g = \{\mathsf{h} \in \mathsf{c}[\![A; B]\!]^g |\ \exists a \forall \mathsf{k} \in \mathsf{c}[\![A; B]\!]^g \exists \mathsf{j} \in \mathsf{c}[\![A]\!]^g \exists \mathsf{i} \in \mathsf{c}\text{: } \perp\mathsf{i} \prec \perp\mathsf{j} \preceq \perp\mathsf{k} \ \&\ (\perp\mathsf{j})_1 = ((\perp\mathsf{k})_a)_1 \ \&\ [\![B]\!]^g \neq [\![B[\perp a_1/\top a_1]]\!]^g\}$$

If the temporal noun in (32a, b) is interpreted as 'today-$^{\top}$', we get the default-override reading (35a, b). The temporal noun updates the topic time ($\top\tau$) to part of the speech day. Since this can properly include an event, the global AT-update includes within this topical period the event-equivalent, i.e. the beginning of the state in (35a) and the event itself in (35b). Both events must be currently verifiable, i.e. must have already happened in the speech world ($\top\omega$) before the speech act ($\top\varepsilon$). This rules out future topic times. If the temporal noun is read as 'today-$_{\varepsilon}$', then it elaborates the verbal base, as in (36a, b). In this case, the topic time is still the speech instant, so we get a temporally elaborated variant of the default pattern (34a, b). For non-future location times this variant is coherent. Future location times are still ruled out because future eventualities fail the current verifiability test.

(35) a. $^{\top}[t|\ t \subseteq_i day.of\langle \vartheta_{\top\omega} \top\varepsilon \rangle]\ ^{\top}; ([s|\ busy_{\top\omega}\langle s, \text{CTR}\ \top\varepsilon \rangle, \vartheta_{\top\omega}\ \text{BEG}\ s \subset_i \top\tau, \text{BEG}\ s <_{\top\omega} \top\varepsilon]; ^{\top}[p|\ p = \top\omega||])$

b. $^{\top}[t|\ t \subseteq_i day.of\langle \vartheta_{\top\omega} \top\varepsilon \rangle]\ ^{\top}; ([e|\ return_{\top\omega}\langle e, \text{CTR}\ \top\varepsilon \rangle, \vartheta_{\top\omega}\ e \subset_i \top\tau, e <_{\top\omega} \top\varepsilon]; ^{\top}[p|\ p = \top\omega||])$

(36) a. $[s|\ busy_{\top\omega}\langle s, \text{CTR}\ \top\varepsilon \rangle, \vartheta_{\top\omega}\ s \subseteq day.of\langle \vartheta_{\top\omega} \top\varepsilon \rangle, \top\tau \subset_i \vartheta_{\top\omega}\ s, \text{BEG}\ s <_{\top\omega} \top\varepsilon]; ^{\top}[p|\ p = \top\omega||]$

b. $[e|\ return_{\top\omega}\langle e, \text{CTR}\ \top\varepsilon \rangle, \vartheta_{\top\omega}\ e \subseteq day.of\langle \vartheta_{\top\omega} \top\varepsilon \rangle, \top\tau \subset_i \vartheta_{\top\omega}\ \text{CON}\ e, e <_{\top\omega} \top\varepsilon]; ^{\top}[p|\ p = \top\omega||]$

For the two-sentence discourse (29i, ii), temporal reference is explicated in (37i, ii). The declarative verbs in (37i, ii) instantiate the default pattern (31a, b) for events ('enter-') and states ('-not'). In (37ii) the dependent factual mood locates the matrix event (beginning of Ole's unhappy state) within the consequent state of the subordinate event (beginning of his wife's illness) throughout the matrix common ground ($\top\omega||$). This suggests, but does not entail, that the subordinate fact may have caused the matrix fact.

(37i) (29i) Ole-$^{\top}$ has dropped in.
Ole-$^{\top}$ enter-DEC$_{\top}$-3S
$^{\top}[x|\ x =_i ole]^{\top}$; $([e|\ enter_{\top\omega}\langle e, \top\delta\rangle, \top\tau \subset_i \vartheta_{\top\omega}$ CON $e, e <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p = \top\omega||])$

(37ii) (29ii) He$_{\top}$'s not happy because his$_{\top}$ wife is ill.
happy-not-DEC$_{\top}$-3s wife-3s$_{\top}$ ill-FCT$_{\bot}$-3s$_{\bot}$
$[s\ w|\ happy_w\langle s, \top\delta\rangle, \top\tau \subset_i \vartheta_w\ s]; [\top\omega \notin \bot\omega||]; [s|$ CTR $s =_i \top\delta, \top\tau \subset_i \vartheta_{\top\omega}\ s,$
BEG $s <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p = \top\omega||]; ([t|\ t =_i \vartheta_{\top\omega}$ BEG $\bot\sigma]; [x\ w|\ wife_w\langle x, \top\delta, \top\tau\rangle];$
$[s|\ ill_{\bot\omega}\langle s, \bot\delta\rangle, \bot\tau \subset_i \vartheta_{\bot\omega}$ CON BEG $s]; [\top\omega|| \subseteq \bot\omega||])$

To summarize the analysis so far: fact-oriented moods assert that the verbal event-equivalent (EVT) is a currently verifiable fact. Modally, the declarative mood (DEC) locates the matrix event throughout the output common ground (main fact), whereas the factual mood (FCT) locates the subordinate event throughout a superset of this modality (background fact). Both events are thus realized in every live candidate for the speech world and so are *verifiable* in that world. Temporally, the declarative mood locates the matrix event before the speech act. So, from the perspective of the speech act the matrix event is a *currently* verifiable fact. The factual mood locates the matrix event within the consequent state of the subordinate event. The subordinate event is thus verifiable from the matrix event and hence from the speech act. The location within the consequent state further suggests that the (real) matrix event may have been caused by the (real) subordinate event. Whether or not there is such a causal link, neither event can be located in the future of the speech act.

We now turn to a special case of fact-oriented discourse—to wit, discourses that introduce currently verifiable attitudinal states.

4 Attitude reports

4.1 Observations

In English, indirect report verbs with non-finite complements are temporally *de se* in the sense of Lewis (1979). That is, the complement situation is located in time relative to the attitude-holder's now. In Kalaallisut, closest equivalents are derivational *attitude* (*att*) suffixes. Temporal anaphora shows that *att*-suffixes introduce attitude states (38a, c) or speech events (38b, d). The attitude or speech can be fact-oriented (38a, b) or prospect-oriented (38c, d). For fact-oriented *att*-suffixes, the *att*-event functions as the perspective point for locating the base-eventuality, just like the speech event does when the same verbal base is inflected for fact-oriented mood. In either case, future location times are ruled out, as fact-oriented *att*-suffixes in (38a, b) and fact-oriented moods (e.g. DEC and FCT in (25)–(26)) attest. In contrast, prospect-oriented *att*-suffixes (38c, d) and prospect-oriented moods (e.g. OPT and IMP) allow future location times.

(38) ***Att***-suffixes (sample)

a. *Ernini* (*aqagu) *ajugaasoraa.*
irni-ni (*aqagu) *ajugaa-**suri**-pa-a*
son-3S$_{\top}$ (*tomorrow) win-bel$_{\bot}$-DEC$_{\top\bot}$-3S.3S
He$_{\top}$ believes his$_{\top}$ son to have won (*tomorrow).

b. *Ernini* (*aqagu) *ajugaanerarpaa.*
irni-ni (*aqagu) *ajugaa-**nirar**-pa-a*
son-3S$_{\top}$ (*tomorrow) win-say$_{\bot}$-DEC$_{\top\bot}$-3S.3S
He$_{\top}$ has said his$_{\top}$ son has won (*tomorrow).

c. (*Aqagu*) *iser-{-niar | -ssa | -qina}-poq.*
(*aqagu*) *isir-{**-niar** | **-ssa** | **-qina**}-pu-q*
(tomorrow) enter-{-int$_{se}^{>}$ | -exp$^{>}$ | -dread$^{>}$}-DEC$_{\top}$-3S
He$_{\top}$ {intends | is expected | is liable} to drop in (tomorrow).

d. *Ikinngunni* (*aqagu*) *iseqquaa.*
ikinngut-ni (*aqagu*) *isir-**qqu**-pa-a.*
friend-3S$_{\top}$ (tomorrow) enter-bid$_{\bot}^{>}$- DEC$_{\top\bot}$-3S.3S
He$_{\top}$ has invited his$_{\top}$ friend to drop in (tomorrow).

Kalaallisut also has attitudinal roots. Lexically, these are unspecified as either fact- or prospect-oriented. However, they can be syntactically specified by a compatible *att*-suffix in the topic-elaborating mood, as (39) illustrates.

(39) Attitudinal roots elaborated by ***att***-suffixes

a. *Ole neriuppoq ajugaassalluni.*
*Ole niriuk-pu-q ajugaa-**ssa**-llu-ni.*
Ole hope-DEC$_{\top}$-3S win-des$^{>}$-ELA$_{\top}$-3S$_{\top}$
Ole hopes to win.

b. *Olep ikinngunni oqarfigaa iseqqullugu.*
*Ole-p ikinngut-ni uqar-vvigi-pa-a isir-**qqu**-llu-gu.*
Ole-ERG friend-3S$_{\top}$ say-to-DEC$_{\top\bot}$-3S.3S enter-bid$^{>}_{\bot}$-ELA$_{\top}$-3S$_{\bot}$
Ole$^{\top}$ has invited his$_{\top}$ friend to drop in.

c. *Ole isumaqarpoq ernini ajugaasoralugu.*
*Ole isuma-qar-pu-q irni-ni ajugaa-**suri**-llu-gu.*
Ole idea-have-DEC$_{\top}$-3S son-3S$_{\top}$ win-bel$_{\bot}$-ELA$_{\top}$-3S$_{\bot}$
Ole$^{\top}$ believes his$_{\top}$ son to have won.

d. *Olep oqarfigaanga ernini ajugaanerarlugu.*
*Ole-p uqar-vvigi-pa-a-nga irni-ni ajugaa-**nirar**-llu-gu.*
Ole-ERG say-to-DEC$_{\top\bot}$-3S-1S son-3S$_{\top}$ win-say$_{\bot}$-ELA$_{\top}$-3S$_{\bot}$
Ole$^{\top}$ has told me that his$_{\top}$ son has won.

We thus arrive at the following observation (see also Bittner 2005):

OBSERVATION 2. Derivational *att*-suffixes introduce:

i. fact-oriented attitudinal states (e.g. *-suri* ‘$\text{bel}_{\perp}$’, *-paluk* ‘seem’)
ii. fact-oriented speech events (e.g. *-nirar* ‘$\text{say}_{\perp}$’)
iii. prospect-oriented attitudinal states (e.g. *-ssa* ‘$\text{exp}^{>}|\text{des}^{>}$’, *-niar* ‘$\text{int}_{se}^{>}$’)
iv. prospect-oriented speech events (e.g. *-qqu* ‘$\text{bid}_{\perp}^{>}$’)

In Section 2.1, we saw some cross-linguistic evidence that conditionals are modal topic-comment structures (see also Haiman 1978). In Kalaallisut, they are also a species of prospect-oriented attitude reports (recall (1)–(3)). Combining these two ideas, I propose that the antecedent introduces a topical modality, while the matrix comment expresses an attitude to this modality, $\top\Omega$. More precisely, an *att*-suffix introduces a prospect-oriented attitude state whose modal base is $\top\Omega$. In the $\top\Omega$-worlds that best fit the projections of the attitude holder, looking from a salient event e, the *att*-base event is realized within the consequent state of e and is a verifiable fact by the end of this attitude state. In contrast, fact-oriented *att*-suffixes are temporally and modally *de se*. The *att*-base event is realized before the attitude state and in the same modality. That is, according to the attitude holder, looking from the beginning of the attitudinal state, the *att*-base event is a currently verifiable fact.

4.2 Attitudes to own vs. topical modalities

Modally, fact- and prospect-oriented *att*-reports differ as follows. In fact-oriented *att*-reports the propositional object of the attitude is realized in the ideal worlds of the attitude holder's own modality. In contrast, in prospect-oriented *att*-reports the propositional object is realized in the ideal worlds of the topical modality.

To explicate this idea I propose to modify the standard modal theory of attitudes (Hintikka 1969). On this theory, *x believes p* is true in a world *w* iff every world where all of *x*'s *w*-beliefs are true is a *p*-world. This wrongly predicts that *x* believes every proposition if *x* has conflicting beliefs in *w* (e.g. that all men are created equal and that a man has a right to own slaves). This type of problem is well known from conditionals and so is the solution—to wit, to quantify only over the best-fitting worlds (Lewis 1973, 1981, Kratzer 1981). Given a set of propositions *Q*, *w* is *Q-better* than *v*, written $v \angle_Q w$, iff every *Q*-proposition that holds in *v* also holds in *w* but not vice versa. The *ideal* of an ordered set $\langle p, \angle_Q \rangle$, written MAX($p$, Q), is the set of *p*-worlds that are not outranked by any *Q*-better *p*-world. In particular, worlds can be ranked by attitudes. Table 3 implements this idea in UC_ω and UC.

Table 3 Drt-abbreviations for attitude-related $\text{UC}_{(\omega)}$-terms

i. Attitudinal *p*-sets, induced orders and ideals ($att \in \{bel, exp, des, \dots\}$)

$att_w\, x$	for	$\lambda p.\ att(w, x, p)$	UC_ω
$att_w\, s$	for	$\lambda p.\ att(w, s, \text{CTR}\, s, p)$	UC
$att_w\, e$	for	$\lambda p.\ \exists s(att(w, s, \text{CTR}\, e, p) \wedge \vartheta_w\, e \subset \vartheta_w\, s)$	UC
$(Q{:}\ v \angle w)$	for	$\lambda p(p \in Q \wedge v \in p) \subset \lambda p(p \in Q \wedge w \in p)$	$\text{UC}_{(\omega)}$
MAX(p, Q)	for	$\lambda w.\ w \in p \wedge \neg\exists w'(w' \in p \wedge (Q{:}\ w \angle w'))$	$\text{UC}_{(\omega)}$

ii. Related drt-abbreviations ($a \in \text{DR}(\Theta)$)

$B\|\|$	for	$\lambda I_{st}\lambda j_s.\ B\{I\}$
$B\|\|_{C1,\ldots Cn}$	for	$\lambda I_{st}\lambda j_s.\ B\{\lambda i_s(Ii \wedge C_1 i = C_1 j \wedge \ldots C_n i = C_n j)\}$
$[A_{sa} \in B_{(st)sat}]$	for	$\lambda I_{st}\lambda j_s.\ Ij \wedge Aj \in BIj$
$[A_{(st)sat} \subseteq B_{(st)sat}]$	for	$\lambda I_{st}\lambda j_s.\ Ij \wedge AIj \subseteq BIj$
$(att_W\, A\colon W_1 < W_2)$	for	$\lambda i.\ (att_{W^\circ i}\, A^\circ i\colon W_1{}^\circ i < W_2{}^\circ i)$
$\text{MAX}\langle B, att_W\, A\rangle$	for	$\lambda I_{st}\lambda j_s.\ \text{MAX}(B^\circ j, att_{W^\circ j}\, A^\circ j)$
$\text{MAX}\{B\|\|, att_W\, A\}$	for	$\lambda I_{st}\lambda j_s.\ \text{MAX}(B\{I\}, att_{W^\circ j}\, A^\circ j)$

Sample entries for a fact-oriented *att*-suffix -*suri* ‘bel$_\perp$’, prospect-oriented *att*-suffix -*ssa* ‘exp$^>$|des$^>$’, and attitudinal root *niriuk*- ‘hope’, are given below. According to the attitude holder of ‘-bel$_\perp$’, the *att*-base is a verifiable fact in those worlds of his own modality ($\underline{w}\|$) that best fit his ($\underline{w}$-)beliefs. This explicates modal *de se.* The unspecified attitude-holder (unspecified individual $?\delta$) of the prospect-oriented ‘-exp$^>$’ projects that the *att*-base will become a verifiable fact in those worlds of the topical modality ($\top\Omega$) that best fit his ($\underline{w}$-)expectations. Finally, the root ‘hope-’ has a lexically unspecified modal base ($?\Omega$).

-bel$_\perp$ |– $(\underline{s}\backslash pn)\backslash\underline{s}$: $\lambda\underline{V}_{[s\omega]}\lambda\underline{x}_{s\delta}\lambda\underline{w}_{s\omega}.\ \underline{V}\perp\omega$; $[\text{MAX}\{\underline{w}\|, bel_{\underline{w}}\ \underline{x}\} \subseteq \perp\omega\|_{\perp\delta}]$
-exp$^>$ |– $\underline{s}\backslash\underline{s}$: $\lambda\underline{V}_{[s\omega]}\lambda\underline{w}_{s\omega}.\ \underline{V}\perp\omega$; $[\text{MAX}\langle\top\Omega, exp_{\underline{w}}\ ?\delta\rangle \subseteq \perp\omega\|]$
hope- |– $\underline{s}\backslash pn$: $\lambda\underline{x}_{s\delta}\lambda\underline{w}_{s\omega}.\ [\text{MAX}\langle ?\Omega, hope_{\underline{w}}\ \underline{x}\rangle \subseteq \perp\omega\|]$

For example, the fact-oriented *att*-report (40) is assigned the representation (41). In the topical speech world ($\top\omega$), Ole has a belief about his own modality ($\top\omega\|$). In the top-ranked worlds of this modality, his son’s victory is a verifiable fact.

(40) *Ole-p* *irni-ni* (**aqagu*) *ajugaa-**suri**-pa-a.*
Ole-ERG son-3S$_\top$ (*tomorrow) win-bel$_\perp$-DEC$_{\top\perp}$-3S.3S
Ole believes his son to have won (*tomorrow).

(41) $^\top[x|\ x =_i ole]$; $[x|\ son_{\top\omega}\langle x, \top\delta\rangle]$; $[w|\ win_w\langle\perp\delta\rangle]$; $[\text{MAX}\{\top\omega\|, bel_{\top\omega}\top\delta\} \subseteq \perp\omega\|_{\perp\delta}]$;
$^\top[p|\ p = \top\omega\|]$

In discourse (42), sentence (i) reports Ole’s desire and hope, while (ii) makes a related prediction. Modal reference is explicated in (43i, ii). In the input to (43i) the topical modality ($\top\Omega$) is the initial common ground. This is the modal base of Ole’s desire-and-hope. Within this topical modality, the topical Ole wins in every world that best fits what he desires and hopes in the topical speech world ($\top\omega$). The topical modality is updated to the set of surviving speech worlds, where Ole is in this attitudinal state. (43ii) represents the reading of (42ii) where the unspecified attitude-holder ($?\delta$) is resolved to the speaker (I) and the expectation is contingent on Ole’s victory (anaphora to the winning worlds by $\perp\omega$). In the topical speech world ($\top\omega$) the speaker has a certain expectation about the current topical modality ($\top\Omega$), i.e. the updated common ground where Ole is in the aforementioned state of desire and hope. In the worlds of this topical modality that best fit the speaker’s ($\top\omega$-)expectations, Ole does win (anaphora by $\perp\omega$) and his ($\top\omega$-)wife is happy.

(42) i. *Ole niriuk-pu-q (aqagu) ajugaa-**ssa**-llu-ni.*
Ole hope-DEC$_{\top}$-3S (tomorrow) win-des$^{>}$-ELA$_{\top}$-3S$_{\top}$
Ole hopes to win (tomorrow).
ii. *Nuli-a nuannaar-**ssa**-pu-q.*
wife-3S$_{\bot}$ happy-exp$^{>}$-DEC$_{\top}$-3S
His wife will be happy.

(43) i. $^{\top}[x|\ x =_i ole]$; $[w|\ win_w\langle \top\delta\rangle]$; $[\text{MAX}\langle \top\Omega, des_{\top\omega}\top\delta\rangle \subseteq \bot\omega||]$; $[\text{MAX}\{\top\Omega,$
$hope_{\top\omega}\top\delta\} \subseteq \bot\omega||]$; $^{\top}[p|\ p = \top\omega||]$
ii. $[x|\ x = \top\delta]$; $^{\top}[x|\ wife_{\top\omega}\langle x, \bot\delta\rangle]$; $[happy_{\bot\omega}\langle\top\delta\rangle]$; $[\text{MAX}\langle \top\Omega, exp_{\top\omega}\,\text{I}\rangle \subseteq \bot\omega||]$;
$^{\top}[p|\ p = \top\omega||]$

In summary, fact-oriented *att*-suffixes are modally *de se*, prospect-oriented *att*-suffixes are *de* $\top\Omega$, whereas attitudinal roots are modally unspecified.

4.3 Subjective facts vs. projected consequences

Attitudinal states have a beginning and an end, like all human states. Throughout life we form and abandon beliefs, expectations, desires, regrets, anxieties, and so on. At any point we may wish to talk about past, present, or future attitudinal states. In the temporally explicit language of UC an attitudinal *p*-set is therefore based not on an individual, but on an attitudinal state or on a concurrent event centered on the attitude holder (recall Table 3.i).

Enriched with temporal referents, the proposed lexical entries for report items are given below. According to the *ego* (CTR $\bot\sigma$) of a fact-oriented belief state, '-bel$_{\bot}$', the event of the base (EVT $\bot\eta$, with $\eta \in \{\varepsilon, \sigma\}$) is a currently verifiable fact. That is, it is realized in the same world as, and prior to, this attitudinal state. In contrast, the *ego* of a prospect-oriented state of expectation, '-exp$^{>}$', views the event of the base (EVT $\bot\eta$) as a projected consequence of a contextually salient event ($?\varepsilon$). In the ideal worlds of the topical domain ($\top\Omega$) the projected consequence is a verifiable fact by the end of this attitudinal state.

-bel$_{\bot}$ |– $(\underline{\text{s}}\backslash\text{pn})\backslash\underline{\text{s}}$: $\lambda\underline{V}\lambda\underline{x}\lambda\underline{w}.(\underline{V}\ \bot\omega^{\bot};\ [t|\ \vartheta_{\bot\omega}\,\text{EVT}\ \bot\eta <_i t,\ t \subset_i \vartheta_{\bot\omega}\,\text{STA}\ \bot\eta])$;
$[s|\ \vartheta_{\underline{w}}\, s =_i \bot\tau,\ \text{CTR}\ s =_i \underline{x}]$; $[\text{MAX}\{\underline{w}||,\ bel_{\underline{w}}\ \bot\sigma\} \subseteq \bot\omega||_{\bot\sigma,\ \bot\delta}]$
-exp$^{>}$ |– $\underline{\text{s}}\backslash\underline{\text{s}}$: $\lambda\underline{V}\lambda\underline{w}.(\underline{V}\ \bot\omega^{\bot};\ [\text{EVT}\ \bot\eta \subset_{\bot\omega} \text{CON}\ ?\varepsilon])$; $[s|\ \text{EVT}\ \bot\eta <_{\bot\omega} \text{END}\ s]$;
$[\text{MAX}\{\top\Omega,\ exp_{\underline{w}}\ \bot\sigma\} \subseteq \bot\omega||_{\bot\sigma}]$
hope- |– $\underline{\text{s}}\backslash\text{pn}$: $\lambda\underline{x}\lambda\underline{w}.\ [s|\ \text{CTR}\ s =_i \underline{x}]$; $[\text{MAX}\{?\Omega,\ hope_{\underline{w}}\ \bot\sigma\} \subseteq \bot\omega||_{\bot\sigma}\}]$

This correctly predicts that only prospect-oriented *att*-suffixes allow future location times. For discourse (42i, ii) temporal reference is explicated in (44i, ii). In (44i) topic-elaborating mood on a state of desire identifies it with the topical Ole's state of hope, by equating both with the same topical state. The resulting representation is coherent because 'tomorrow-ε'' locates the desired victory, whereas the attitudinal state of desire is verifiable now. In (44ii) the wife's happy state is an expected consequence of Ole's victory.

(44i) (42i) Ole hopes to win tomorrow.
Ole hope-DEC$_{\top}$-3S tomorrow-$_{\varepsilon}$ win-des$^{>}$-ELA$_{\top}$-3S$_{\top}$
$^{\top}[x|\ x =_i ole]$; $((^{\top}[s]; [e\ w|\ win_w\langle e, \text{CTR}\ \top\sigma\rangle, \vartheta_w\ e \subseteq_i day.after\langle \vartheta_{\top\omega}\top\varepsilon\rangle, e \subset_w \text{CON}\ \top\varepsilon]$; $[s|\ \bot\varepsilon <_{\bot\omega} \text{END}\ s]$; $[\text{MAX}\langle \top\Omega, des_{\top\omega}\ \bot\sigma\rangle \subseteq \bot\omega||_{\bot\sigma}]$; $[\top\sigma =_i \bot\sigma])\ ^{\top}$; $([s|\ \text{CTR}\ s =_i \top\delta]$; $[\text{MAX}\langle \top\Omega, hope_{\top\omega}\ \bot\sigma\rangle \subseteq \bot\omega||_{\bot\sigma}]$; $[\top\sigma =_i \bot\sigma]))$; $[\top\tau \subset_i \vartheta_{\top\omega}\ \bot\sigma, \text{BEG}\ \bot\sigma <_{\top\omega}\top\varepsilon]$; $^{\top}[p|\ p = \top\omega||]$

(44ii) (42ii) His wife will be happy.
wife-3s$_{\bot}$ happy-exp$^{>}$-DEC$_{\top}$-3S
$[x|\ x =_i \top\delta]$; $^{\top}[x|\ wife_{\top\omega}\langle x, \bot\delta, \top\tau\rangle]$; $[s|\ happy_{\bot\omega}\langle s, \top\delta\rangle, \text{BEG}\ s \subset_{\bot\omega} \text{CON}\ \bot\varepsilon]$; $[s|\ \text{BEG}\ \bot\sigma <_{\bot\omega} \text{END}\ s]$; $[\text{MAX}\langle \top\Omega, exp_{\top\omega}\ \bot\sigma\rangle \subseteq \bot\omega||_{\bot\sigma}]$; $[\top\tau \subset_i \vartheta_{\top\omega}\ \bot\sigma, \text{BEG}\ \bot\sigma <_{\top\omega}\top\varepsilon]$; $^{\top}[p|\ p = \top\omega||]$

In contrast, a future location time cannot be coherently added to the temporally explicit representation (45) of the fact-oriented belief report (40). The declarative mood asserts that Ole is in a currently verifiable state of belief. The beginning of this attitudinal state must therefore precede the speech act. But this state-onset also serves as the perspective point for Ole, the attitude holder, and according to him, his son's victory is verifiable from that point. Therefore, the son's victory cannot be located in the future of the speech act either.

(45) (40) Ole believes his son to have won (*tomorrow).
Ole-ERG son-3S$_{\top}$ (*tomorrow-$_{\varepsilon}$) win-bel$_{\bot}$-DEC$_{\top\bot}$-3S.3S
$^{\top}[x|\ x =_i ole]$; $[x|\ son_{\top\omega}\langle x, \top\delta, \top\tau\rangle]$; $[t\ e\ w|\ win_w\langle e, \bot\delta\rangle, \vartheta_w\ e <_i t, t \subset_i \vartheta_w\ \text{CON}\ e]$; $[s|\ \vartheta_{\top\omega}\ s =_i \bot\tau, \text{CTR}\ s =_i \top\delta]$; $[\text{MAX}\langle \top\omega||, bel_{\top\omega}\ \bot\sigma\rangle \subseteq \bot\omega||_{\bot\sigma, \bot\delta}]$; $[\top\tau \subset_i \vartheta_{\top\omega}\ \bot\sigma, \text{BEG}\ \bot\sigma <_{\top\omega}\top\varepsilon]$; $^{\top}[p|\ p = \top\omega||]$

In summary, *att*-suffixes in fact-oriented moods introduce currently verifiable attitudinal states (or speech events). If the *att*-suffix is likewise fact-oriented, then the attitude-holder views the *att*-base event as a currently verifiable fact of his own modality. If the *att*-suffix is prospect-oriented, then he views it as a projected consequence of a contextually salient event. In his ideal worlds of the topical modality the projected event becomes a verifiable fact by the end of the prospect-oriented attitudinal state.

5 Conditional attitudes

5.1 Observations

Cross-linguistically, conditionals behave like modal topic-comment structures (recall Section 2.1). The antecedent introduces a topical sub-domain of the modal base (Kratzer 1981), while the matrix comments on this topical sub-domain ($\top\Omega$). In Kalaallisut the antecedent is in the prospect-oriented hypothetical mood (HYP), whereas the matrix comment must contain a *prospect-oriented attitudinal correlate*, on pain of ungrammaticality (*). The correlate can be a prospect-oriented *att*-suffix (e.g. (46a, b), (47a, b)), prospect-oriented illocutionary mood (e.g. OPT in (46c)), or an implicitly attitudinal root that can be read as prospect-oriented (e.g. (47c)).

(46) *Ole ajugaa-**gu**-ni* …
Ole win-HYP$_\top$-3S$_\top$ …
If (or when) Ole$^\top$ wins …
a. … *isir-{-**ssa** | -**qina** | -**sinnaa**}-pu-q.*
… enter-{-exp$^>$ | -dread$^>$ | -possible$^>$}-DEC$_\top$-3S
… he$_\top$ is {expected to | liable to | might} drop in.
b. … *isir-{-**ssanga** | -**niar** | -**rusuk**}-pu-q.*
… enter-{-exp$_{se}^>$ | -int$_{se}^>$ | -des$_{se}^>$}-DEC$_\top$-3S
… he$_\top$ {expects | intends | wants} to drop in.
c. … *isir-**li**!* | **isir-pu-q.*
… enter-OPT.3S | *enter-DEC$_\top$-3S
… let him$_\top$ drop in! | *he$_\top$ has dropped in.

(47) *Ole ajugaa-**pp**-at* …
Ole win-HYP$_\bot$-3S$_\bot$ …
If (or when) Ole$^\bot$ wins …
a. … *Aani-p isir-{-**ssangatit** | *-suri}-pa-a.*
… Ann-ERG enter-{-exp$_\bot^>$ | *-bel$_\bot$}-DEC$_{\top\bot}$-3S.3S
… Ann {expects him$_\bot$ to drop in | *believes him$_\bot$ to have dropped in}.
b. … *Aani-p isir-{-**qqu** | *-nirar}-pa-a.*
… Ann-ERG enter-{-bid$_\bot^>$ | *-say$_\bot$}-DEC$_{\top\bot}$-3S.3S
… Ann has {told him$_\bot$ to drop in | *said he$_\bot$ has dropped in}.
c. … ***ajunngit**-la-q* | **nuannaar-pu-nga.*
… fine-DEC-3S | *happy-DEC$_\top$-1S
… that's fine (by me). | *… (NOT: I am happy.)

OBSERVATION 3. A dependent in the hypothetical mood (HYP) requires a prospect-oriented attitudinal correlate in the matrix, on pain of ungrammaticality.

I propose to derive this observation from topic-comment sequencing. Recall that a topic-comment sequence ($A^\top$; B) reduces to plain (A; B), iff the topic update A extends the input $\top$-list with at least one object, and the top object in the output of A is referred to in the comment B by an anaphor $\top a$, for some type a, and maintains its $\top a$-prominence rank throughout B. Otherwise, the input state of information is reduced to the absurd state ($\varnothing$). I propose that conditionals are topic-comment sequences with $a = \Omega$. In Kalaallisut, the dependent in the hypothetical mood introduces an Ω-topic and the topic-comment sequencing operator ($\ldots^\top;\ldots$), whereas the $\top\Omega$-anaphor comes from the attitudinal correlate.

5.2 Conditional = modal topic + attitudinal comment

In Kalaallisut the dependent hypothetical mood (HYP) forms a modal topic-comment sequence with the verbal base of the modified verb (see Section 7 for compositional details). The modal topic is the set of worlds, within a salient modal base ($?\omega||$), where the antecedent hypothesis is realized. The modified verbal base must comment on this topical subdomain, lest the output of the topic-comment sequence ($A^{\top}; B$) be the absurd state ($\emptyset$). That is why the modified verbal base must contain a $\top\Omega$-anaphor.

-HYP $\vdash$ $(\underline{s}/\underline{s})\backslash pn\backslash iv$: $\lambda \underline{P}\lambda \underline{x}\lambda \underline{V}\lambda \underline{w}.(\underline{P}\ \underline{x}\ \bot\omega;\ [\bot\omega \in\ ?\omega||];\ {}^{\top}[p|\ p = \bot\omega||])^{\top};\ \underline{V}\ \underline{w}$

For example, in discourse (48) a report of a conditional promise by Ole (48i) is followed by a conditional prediction (48ii), contingent both on its own antecedent and on Ole making good on his promise. Modal reference is explicated in (49i, ii). In (49i) the antecedent clause introduces a topical hypothesis: the set of worlds, within the common ground ($\top\omega||$), where Ole wins. In the consequent, this topical sub-domain ($\top\Omega$) is the modal base of an attitudinal comment. This introduces Ole's promise as a ($\top\omega$-)real speech event resulting in a ($\top\omega$-)real state of obligation and expectation. In the antecedent ($\top\Omega$-)worlds that best fit Ole's ($\top\omega$-)obligations and expectations he drops in. Note that Ole need not expect and has not promised to win. His promise and expectation are contingent on his victory, which may be a long shot. The intuition that (48ii) is contingent not only on its own antecedent but also on (48i) is explicated in (49ii) as modal anaphora ('modal subordination' á la Stone 1997, Brasoveanu 2007). The declarative matrix introduces a ($\top\omega$-)real state of expectation of the speaker. The modal base ($\top\Omega$) of this attitudinal state is the current antecedent hypothesis, i.e. the sub-class of the promised dropping-in worlds (modal anaphora by $\bot\omega$) where the speaker's wife buys some wine. In the modal-base ($\top\Omega$-)worlds that best fit the speaker's ($\top\omega$-)expectations the topical Ole ($\top\delta$) is happy.

(48) i. *Ole ajugaa-**gu**-ni niriursui-pu-q isir-**ssa**-llu-ni.*
Ole win-HYP$_{\top}$-3S$_{\top}$ *promise*-DEC$_{\top}$-3S enter-exp$^{>}$-ELA$_{\top}$-3S$_{\top}$
If Ole$^{\top}$ wins, he$_{\top}$ has promised to drop in.

ii. *Nulia-ra viinni-si-**pp**-at nuannaar-**ssa**-pu-q.*
wife-1S wine-get-HYP$_{\bot}$-3S$_{\bot}$ happy-exp$^{>}$-DEC$_{\top}$-3S
If my wife gets some wine, he$_{\top}$'ll be happy.

(49) i. $(({}^{\top}[x|\ x =_i ole];\ [w|\ win_w\langle\top\delta\rangle];\ [\bot\omega \in\ \top\omega||];\ {}^{\top}[p|\ p = \bot\omega||])^{\top};\ ([enter_{\bot\omega}\langle\top\delta\rangle];$
$[\text{MAX}\langle\top\boldsymbol{\Omega},\ exp_{\top\omega}\ \top\delta\rangle \subseteq \bot\omega||];\ [spk_{\top\omega}\langle\top\delta\rangle];\ [\text{MAX}\langle\top\boldsymbol{\Omega},\ obl_{\top\omega}\ \top\delta\rangle \subseteq \bot\omega||]));$
${}^{\top}[p|\ p = \top\omega||]$

ii. $(([x|\ wife_{\top\omega}\langle x, \text{I}\rangle];\ [wine.get_{\bot\omega}\langle\bot\delta\rangle];\ [\bot\omega \in\ \top\omega||];\ {}^{\top}[p|\ p = \bot\omega||])^{\top};$
$([happy_{\bot\omega}\langle\top\delta\rangle];\ [\text{MAX}\langle\top\Omega,\ exp_{\top\omega}\ \text{I}\rangle \subseteq \bot\omega||]));\ {}^{\top}[p|\ p = \top\omega||]$

Conditional expectations may also concern consequences of past events, as in the grammatical version of discourse (50i, ii), which is analyzed in (51i, ii).

(50) i. *Kennedy tuqut-taa-pu-q.*
Kennedy kill-pssv-DEC$_{\top}$-3S
Kennedy was assassinated.
ii. *Oswald-p tuqut-sima-nngit-**pp**-a-gu*
Oswald-ERG kill-prf-not-HYP$_{\bot}$-3S$_{\bot}$-3S$^{\bot}$
inuk-piluk-qat-a-ata tuqut-sima-(-**ssa**)-pa-a.*
man-bad-other-3S$_{\bot}$-ERG kill-prf-*(-exp$^{>}$)-DEC$_{\top\bot}$-3S.3S
If Oswald didn't kill him, then someone else did.

(51) i. ${}^{\top}[x|\ x =_i jfk]; [x|\ kill_{\top\omega}\langle x, \top\delta\rangle]; {}^{\top}[p|\ p = \top\omega||]$
ii. $(([w\ x|\ x =_i osw, kill_w\langle x, \top\delta\rangle]; [w|\ w \notin \bot\omega||]; [\bot\omega \in \top\omega||]; {}^{\top}[p|\ p = \bot\omega||])^{\top};$
$([x|\ x =_i \top\delta]; {}^{\top}[x|\ man_{\bot\omega}\langle x\rangle]; [bad\{\top\delta, \top\delta||_{\bot\omega}\}]; [\bot\delta_2 \in \top\delta||]; [\top\delta \neq_i \bot\delta_2];$
$[kill_{\bot\omega}\langle\top\delta, \bot\delta\rangle]; [\text{MAX}\langle\top\Omega, exp_{\top\omega}\ \text{I}\rangle \subseteq \bot\omega||])); {}^{\top}[p|\ p = \top\omega||]$

In the output of (51i) JFK is assassinated throughout the common ground (output $\top\omega||$). The conditional (51ii) introduces a ($\top\omega$-)real state of expectation based on this ($\top\omega$-)real assassination event. The modal base ($\top\Omega$) is the topical sub-domain, of the current common ground ($\top\omega||$), where the assassin is not Oswald. In the modal base worlds that best fit the attitude holder's projections the assassin is someone else.

If the $\top\Omega$-anaphor *-ssa* '-exp$^{>}$' is omitted from the consequent, the conditional (50ii) becomes ungrammatical and uninterpretable (see (52)). For without a $\top\Omega$-anaphor there is no proper comment, so the modal topic-comment sequence formed by the hypothetical mood reduces any input state to the absurd state ($\emptyset$).

(52) $\text{c}[\![(([w\ x|\ x =_i osw, kill_w\langle x, \top\delta\rangle]; [w|\ w \notin \bot\omega||]; [\bot\omega \in \top\omega||]; {}^{\top}[p|\ p = \bot\omega||])^{\top};$
$([x|\ x =_i \top\delta]; {}^{\top}[x|\ man_{\top\omega}\langle x\rangle]; [bad\{\top\delta, \top\delta||_{\top\omega}\}]; [\bot\delta_2 \in \top\delta||]; [\top\delta \neq_i \bot\delta_2];$
$[kill_{\top\omega}\langle\top\delta, \bot\delta\rangle])); {}^{\top}[p|\ p = \top\omega||]]\!]^g = \emptyset$

5.3 Projected consequences in topical sub-domains

To factor in temporal reference we first spell it out in the entries of two key moods: hypothetical (HYP) and topic-elaborating (ELA$_{\top}$):

-HYP $\vdash$ $(\underline{s}/\underline{s})\backslash pn\backslash iv$: $\lambda\underline{P}\lambda\underline{x}\lambda\underline{V}\lambda\underline{w}.\ ((\underline{P}\ \underline{x}\ \bot\omega^{\bot}; [?\varepsilon <_{\bot\omega} \text{EVT}\ \bot\eta]); [\bot\omega \in\ ?\omega||];$
${}^{\top}[p|\ p = \bot\omega||])^{\top}; \underline{V}\ \underline{w}$
-ELA$_{\top}$ $\vdash$ $(\underline{s}/\underline{s})\backslash pn\backslash iv$: $\lambda\underline{P}\lambda\underline{x}\lambda\underline{V}\lambda\underline{w}.\ ({}^{\top}[s]^{\top}; (\underline{P}\ \underline{x}\ \underline{w}^{\bot}; [\top\sigma =_i \text{STA}\ \bot\eta]))^{\top}; (\underline{V}\ \underline{w}^{\bot};$
$[\top\sigma =_i \text{STA}\ \bot\eta'])$

Hypothetical mood is prospect-oriented. It introduces a topical sub-domain of a contextually salient set of worlds ($?\omega||$), where the event-equivalent of the verbal base (EVT $\bot\eta$) is realized after a salient perspective point ($?\varepsilon$). In contrast, topic-elaborating mood is not only modally but also temporally *de se*: it identifies the dependent state-equivalent (STA $\bot\eta$) with the matrix state-equivalent (STA $\bot\eta'$) by equating both with its own topical state.

Both moods are exemplified in discourse (48i, ii). Temporal reference in this discourse is analyzed in (53i, ii) (building on the analysis of modal reference in (49i, ii)). In (53i) the hypothetical antecedent introduces a topical sub-domain of the common ground (input $\top\omega||$) where Ole wins after this speech act ($\top\varepsilon$). The matrix is required to comment ($^{\top}$;). The comment is an attitude report: in the speech world ($\top\omega$), Ole has made a promise resulting in a ($\top\varepsilon$-)current state of obligation-and-expectation in regard to the antecedent sub-domain ($\top\Omega$). In the antecedent winning worlds that best fit his ($\top\varepsilon$-)current promise Ole drops in within the consequent state of his victory (CON $\bot\varepsilon$, verification frame for the promise). The subordinated conditional prediction (48ii) introduces a ($\top\varepsilon$-)current state of expectation. The modal base (current $\top\Omega$) is the topical sub-domain, of the promised dropping-in worlds (modal anaphora by $\bot\omega$), where the antecedent prospect is realized, i.e. where the speaker's wife buys some wine after this speech act ($\top\varepsilon$). In the modal base worlds that best fit the ($\top\varepsilon$-)current ($\top\omega$-)expectations of the attitude holder (speaker?) there is a happy state of the topical Ole ($\top\delta$) that begins within the consequent state of the wine-buying event (current CON $\bot\varepsilon$, verification frame for this prediction).

(53i) (48i) If Ole$^{\top}$ wins, he$_{\top}$ has promised to drop in.
Ole win-HYP$_{\top}$-3S$_{\top}$ …
$((^{\top}[x|\ x =_i ole]; [e\ w|\ win_w\langle e,\top\delta\rangle, \top\varepsilon <_w e]; [\bot\omega \in \top\omega||]; {}^{\top}[p|\ p = \bot\omega||])^{\top}; \ldots$
… promise-DEC$_{\top}$-3S enter-exp$^{>}$-ELA$_{\top}$-3S$_{\top}$
$\ldots ((^{\top}[s]; [e|\ enter_{\bot\omega}\langle e, \text{CTR}\ \top\sigma\rangle, e \subset_{\bot\omega} \text{CON}\ \bot\varepsilon]; [s|\ \bot\varepsilon <_{\bot\omega} \text{END}\ s]; [\text{MAX}\langle\top\Omega,$
$exp_{\top\omega}\ \bot\sigma\rangle \subseteq \bot\omega||_{\bot\sigma}]; [\top\sigma =_i \bot\sigma])^{\top}; ([e|\ spk_{\top\omega}\langle e,\top\delta\rangle]; [\text{MAX}\langle\top\Omega, obl_{\top\omega}\ \text{CON}\ \bot\varepsilon\rangle$
$\subseteq \bot\omega||_{\bot\epsilon}\}]; [\top\sigma =_i \text{CON}\ \bot\varepsilon]))); [\top\tau \subset_i \text{CON}\ \bot\varepsilon, \bot\varepsilon <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p = \top\omega||]$

(53ii) (48ii) If my wife$^{\bot}$ gets some wine, he$_{\top}$'ll be happy.
wife-1S wine-get-HYP$_{\bot}$-3S$_{\bot}$…
$(([x|\ wife_{\top\omega}\langle x, \text{CTR}\ \top\varepsilon, \top\tau\rangle]; [e|\ wine_{\bot\omega}\langle \text{BCK}\ e, \vartheta_{\bot\omega}\ e\rangle, get_{\bot\omega}\langle e, \bot\delta, \text{BCK}\ e\rangle,$
$\top\varepsilon <_{\bot\omega} e]; [\bot\omega \in \top\omega||]; {}^{\top}[p|\ p = \bot\omega||])^{\top}; \ldots$
… happy-exp$^{>}$-DEC$_{\top}$-3S
$\ldots ([s|\ happy_{\bot\omega}\langle s, \top\delta\rangle, \text{BEG}\ s \subset_{\bot\omega} \text{CON}\ \bot\varepsilon]; [s|\ \text{BEG}\ \bot\sigma <_{\bot\omega} \text{END}\ s]; [\text{MAX}\langle\top\Omega,$
$exp_{\top\omega}\ \bot\sigma\rangle \subseteq \bot\omega||_{\bot\sigma}])); [\top\tau \subset_i \vartheta_{\top\omega}\ \bot\sigma, \text{BEG}\ \bot\sigma <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p = \top\omega||]$

For discourse (50i, ii), temporal reference is explicated in (54i, ii) (building on (51i, ii)). In the output of (54i) there is an assassination event before this speech act ($\top\varepsilon$) throughout the common ground ($\top\omega||$). This real event is the basis of the real state of expectation introduced in (54ii). The modal base is the topical sub-domain of the common ground ($\top\omega||$), where the assassin is not Oswald. Within this sub-domain, the worlds that best fit the attitude holder's expectations are those where the real assassination event ($\bot\varepsilon_3$) is followed by the consequent state of an assassination by an agent other than Oswald.

(54i) (50i) Kennedy was assassinated.
Kennedy-$^{\top}$ kill-pssv-DEC$_{\top}$-3S
${}^{\top}[x|\ x =_i jfk]; [e|\ kill_{\top\omega}\langle e, \text{CTR}\ e, \top\delta\rangle, \top\tau \subset_i \vartheta_{\top\omega}\ \text{CON}\ e, e <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p = \top\omega||]$

(54ii) (50ii) If Oswald didn't kill him, someone else did.
Oswald-ERG kill-prf-not-$\text{HYP}_{\perp}$-$3\text{S}_{\perp}$-$3\text{S}^{\perp}$ …
$([x|\ x =_i osw]; [e\ w|\ kill_w\langle e, \perp\delta, \top\delta\rangle]; [s|\ s =_i \text{CON}\perp\varepsilon, \top\tau \subset_i \vartheta_{\perp\omega}\, s]; [w|\ w \notin \perp\omega\|_{\top\tau}];$
$[s|\ \text{CTR}\ s =_i \perp\delta, \top\tau \subset_i \vartheta_{\perp\omega}\, s, \perp\varepsilon_2 <_{\perp\omega} \text{BEG}\ s]; [\perp\omega \in \top\omega\|]; {}^{\top}[p|\ p = \perp\omega\|])^{\top};$
$([x|\ x = \top\delta]; \ldots$
… man-bad-other-$3\text{S}_{\perp}$-ERG kill-prf-$\text{exp}^{>}$-$\text{DEC}_{\top\perp}$-3S.3S
$\ldots{}^{\top}[x|\ man_{\perp\omega}\langle x, \vartheta_{\perp\omega} \perp\varepsilon_2\rangle]; [bad\{\top\delta, \top\delta\|_{\perp\omega}, \vartheta_{\perp\omega} \perp\varepsilon_2\}]; [\perp\delta_2 \in \top\delta\|]; [\top\delta \neq_i \perp\delta_2];$
$[e|\ kill_{\perp\omega}\langle e, \top\delta, \perp\delta\rangle]; [s|\ s =_i \text{CON}\perp\varepsilon, \text{BEG}\ s \subset_{\perp\omega} \text{CON}\perp\varepsilon_3]; [s|\ \text{BEG}\perp\sigma <_{\perp\omega} \text{END}\ s];$
$[\text{MAX}\langle \top\Omega, exp_{\top\omega} \perp\sigma\rangle \subseteq \perp\omega\|_{\perp\sigma}]); [\top\tau \subset_i \vartheta_{\top\omega} \perp\sigma, \text{BEG} \perp\sigma <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p = \top\omega\|]$

In summary, Kalaallisut instantiates the cross-linguistic generalization that conditionals are modal topic-comment sequences. Given a contextually salient modal base, the antecedent introduces a topical sub-domain where a hypothetical prospect, viewed from a contextually salient perspective point, is realized. The comment introduces a prospect-oriented attitude to a projected consequence—of the antecedent event (as in (53i, ii)) or of the initial perspectival event (as in (54ii))—in this topical sub-domain. This attitudinal state is a currently verifiable fact even if the modal object of the attitude is not. Indeed, the modal object need not even be considered possible, as the next section will show.

6 Attitudes to remote modalities

6.1 Observations

Stone (1997) argues that, in addition to anaphoric tenses (Reichenbach 1947, Partee 1973, Webber 1988, a.o.), English has anaphoric modals. He proposes a parallel theory, where temporal relations between the speech time and the topic time, e.g. *past*, *present*, and *future*, are paralleled by modal relations between the speech modality and the topical modality, e.g., *real*, *vivid* (i.e. realistic, desirable, etc), and *remote* (counterfactual, undesirable, etc). Stone and Hardt (1999) further propose that the English negation *not* introduces a referent for the scope proposition and asserts that it is disjoint (remote) from the common ground.

In Kalaallisut discourse reference to remote modalities is expressed by derivational suffixes. For example, the negation suffix *-nngit* 'not' asserts that the world of evaluation is remote from the scope proposition (same as English *not*), and introduces a concurrent non-scope state (Section 3.3). Another 'negative' suffix, *-galuar* 'rem', which often elaborates negation, asserts that the world of evaluation is sub-optimal given what the speaker (or topic) believes or wants. Typical uses of this suffix are described and exemplified below (Observation 4 in (55), (58i, ii), Observation 5 in (56)–(59), Observation 6 in (58ii), (59ii)).

OBSERVATION 4. If a currently verifiable fact has an unexpected and/or undesirable circumstance, then the fact or the circumstance is marked as remote.

OBSERVATION 5. An attitude or speech whose modal object is unlikely or undesirable (or negated) is marked as remote (or negative).

OBSERVATION 6. A counterfactual, unlikely, or undesirable hypothesis is marked as remote.

(55) *Ole ullumi ajugaagaluarluni isinngilaq.*
*Ole ullumi ajugaa-**galuar**-llu-ni isir-nngit-la-q*
Ole today win-rem-ELA$_{\top}$-3S$_{\top}$ enter-not-DEC-1S
Ole won today, but didn't drop in.

(56) *Ole neriukkaluarpoq ajugaassalluni. Nulia nuannaassagaluarpoq.*
*Ole niriuk-**galuar**-pu-q ajugaa-ssa-llu-ni. nulia-a nuannaar-ssa+**galuar**-pu-q*
Ole hope-rem-DEC$_{\top}$-3S win-des$^{>}$-ELA$_{\top}$-3S$_{\top}$ wife-3S$_{\perp}$ happy-exp$^{>}$+rem-DEC$_{\top}$-3S
Ole hopes to win (long shot). His wife would be happy.

(57) *Ole aqagu iseqqunngilara. Taamaattumik isissanngilaq.*
*Ole aqagu isir-qqu+**nngit**-la-ra. taamaattumik isir-ssa+**nngit**-la-q*
Ole tomorrow enter-bid$_{\perp}^{>}$+not-DEC-1S.3S therefore enter-exp$^{>}$+not-DEC-3S
I have told Ole not to drop in tomorrow. So he won't (isn't expected to) drop in.

(58) i. *Nuliaqaraluarlunga meeraqanngilanga.*
*nulia-qar-**galuar**-llu-nga miiraq-qar-nngit-la-nga.*
wife-have-rem-ELA$_{\top}$-1S kid-have-not-DEC-1S
I have a wife, but no kid(s).

ii. *Erneqaraluaruma ajunnginnerutikkaluarpara.*
*irni-qar-**galuar**-gu-ma ajunngit-niru-tit-**galuar**-pa-ra*
son-have-rem-HYP$_{\top}$-1S fine-er-tv-rem-DEC$_{\top\perp}$-1S.3S
I wish I had a son. (*lit*. I prefer the remote hypothetical worlds where…)

iii. *Taava toquguma taassuma nuliara najussagaluarpaa.*
*taava tuqu-gu-ma taassuma nulia-ra najur-ssa+**galuar**-pa-a.*
then die-HYP$_{\top}$-1S that.ERG wife-1S be.with-exp$^{>}$+rem-DEC$_{\top\perp}$-3S.3S
Then when I die, he would've been there for my wife.

(59) i. *Kennedy toqutaavoq akerapassuaqarami.*
Kennedy tuqut-taa-pu-q akiraq-passua-qar-ga-mi
Kennedy kill-pssv-DEC$_{\top}$-3S enemy-many-have-FCT$_{\top}$-3S$_{\top}$
Kennedy was assassinated because he had many enemies.

ii. *Oswaldip toqusimanngikkaluarpagu*
*Oswald-p tuqut-sima-nngit-**galuar**-pp-a-gu*
Oswald-ERG kill-prf-not-rem-HYP$_{\perp}$-3S$_{\perp}$-3S$^{\perp}$
inupiloqataata toqusimassagaluarpaa.
*inuk-piluk-qat-a-ata tuqut-sima-ssa+**galuar**-pa-a.*
man-bad-other-3S$_{\perp}$-ERG kill-prf-exp$^{>}$+rem-DEC$_{\top\perp}$-3S.3S
If Oswald hadn't killed him someone else would've.

To account for these observations, I propose to build on the idea that negation involves discourse reference to a remote modality (Stone and Hardt 1999). For the negation suffix (*-nngit*) this idea has already been implemented (in Section 3 and (51ii)). In addition, I propose that the remoteness suffix (*-galuar*) is implicitly attitudinal: it asserts that the world of evaluation is remote from (not among) the modal base worlds that are top-ranked by the beliefs, expectations, or desires of a current center of empathy (speaker or topic). Given the proposed analysis of fact-oriented mood, hypothetical mood, and attitude reports, Observations 4–6 are then accounted for, as Sections 6.2 and 6.3 explicate for modal and temporal reference in turn.

6.2 Remoteness from attitudinal ideal

The following lexical entry implements the idea that the remoteness suffix *-galuar* 'rem' implies an attitude to a contextually salient modal base ($?\omega||$). It asserts that the world of evaluation ($\underline{w}$) is remote from ($\notin$) the top-ranked modal base worlds. The ranking criteria are the beliefs, expectations, or desires of a current center of empathy in the topical speech world ($att_{\top\omega}\ ?\delta$, with $att \in \{bel, exp, des\}$ and $?\delta \in \{\top\delta, \text{CTR}\ \top\varepsilon\}$). The modal base ($?\omega||$) includes both the speech world ($\top\omega$) and the scope world ($\bot\omega$). The world of evaluation ($\underline{w}$) is one of these two worlds. If the remoteness suffix is attached to an attitudinal RPT-suffix, then the two form a complex attitude (e.g. *-ssa+galuar* 'exp$^{>}$+rem'). In effect, their relative scope is reversed (e.g. '$\underline{s}$-exp$^{>}$+rem' is interpreted as '($\underline{s}$-rem)-exp$^{>}$').

-rem |– $\underline{s}\backslash\underline{s}$: $\lambda\underline{V}\lambda\underline{w}.\ \underline{V}\,\bot\omega; [\bot\omega, \top\omega \in\ ?\omega||]; [\underline{w} \notin \text{MAX}\{?\omega||, att_{\top\omega}\ ?\delta\}]$

For example, modal reference in discourse (58i, ii) is analyzed in (60i, ii). (The subordinated counterfactual (58iii) involves temporal anaphora; it is analyzed in Section 6.3.) In (60i) the modal base of '-rem' is the set of worlds where the speaker has a wife ($\bot\omega||$). The world of evaluation ($\top\omega$) is in this domain, but not in the speaker's preferred sub-domain. Neither is it in the sub-domain where the speaker has a kid. This suggests that the speaker would prefer a kid-and-wife world to the actual wife-only world.

(60i) (58i) I have a wife, but no kid(s).
wife-have-rem-ELA$_{\top}$-1S kid-have-not-DEC-1S
$[w|\ wife.have_w\langle \text{I}\rangle];\ [\bot\omega, \top\omega \in \bot\omega||]; [\top\omega \notin \text{MAX}\{\bot\omega||, att_{\top\omega}\ \text{I}\}]; [w|\ kid.have_w\langle \text{I}\rangle];$
$[\top\omega \notin \bot\omega||];\ ^{\top}[p|\ p = \top\omega||]$

(60ii) (58ii) I wish I had a son.
son-have-rem-HYP$_{\top}$-1S fine-er-tv-rem-DEC$_{\top\bot}$-1S.3S
$(([son.have_{\bot\omega}\langle \text{I}\rangle]; [\bot\omega, \top\omega \in \bot\omega_2||]; [\bot\omega \notin \text{MAX}\{\bot\omega_2||, bel_{\top\omega}\ \text{I}\}];\ ^{\top}[p|\ p = \bot\omega||])\ ^{\top};$
$([des_{\top\omega}\ \text{I}: \top\omega \angle \bot\omega]; [\top\Omega = \bot\omega||]; [\bot\omega, \top\omega \in \bot\omega_2||]; [\top\omega \notin \text{MAX}\{\bot\omega_2||, des_{\top\omega}\ \text{I}\}])$
$);\ ^{\top}[p|\ p = \top\omega||]$

The counterfactual (60ii) makes this explicit. The input modal base is the aforementioned domain where the speaker has a wife (current $\bot\omega_2||$). The topical hypothesis is the subdomain where he also has a son. Given the speaker's beliefs, which presumably include

(60i), this sub-domain is remote from the wife-only sub-domain the speaker believes he inhabits. The main attitudinal comment is that in the topical speech world ($\top\omega$) the speaker prefers the remote topical sub-domain ($\top\Omega$), where he also has a son, to the speech reality ($\top\omega||$), where he only has a wife.

In the counterfactual Kennedy discourse, the opening sentence (59i) introduces a background fact (FCT), while the counterfactual (59ii) projects an expected consequence of this fact in a remote modality. Modal reference in this discourse is explicated in (61i, ii). In (61i), JFK is assassinated throughout the common ground output by the declarative matrix ($\top\omega||$). The post-posed factual clause adds a background fact—to wit, a larger modal domain where JFK has many enemies ($\bot\omega||$). In the following counterfactual (61ii), hypothetical mood picks up this background fact as the modal base (current $\bot\omega_3||$) and introduces as a topical hypothesis the sub-domain where JFK is not assassinated by Oswald. The remoteness suffix adds that this sub-domain is remote from the speaker's beliefs, i.e. not the modal domain he believes he inhabits. The main attitudinal comment is that within this remote sub-domain, the worlds that best fit the speaker's ($\top\omega$-)expectations are those where JFK is assassinated by someone else.

(61i) (59i) Kennedy was assassinated because he had many enemies.
Kennedy kill-pssv-DEC$_\top$-3S enemy-many-have-FCT$_\top$-3S$_\top$
$^\top[x|\ x =_i jfk]$; $[x|\ kill_{\top\omega}\langle x,\top\delta\rangle]$; $^\top[p|\ p = \top\omega||]$; $[w|\ have.enemies_w\langle\top\delta\rangle]$; $[\top\omega|| \subseteq \bot\omega||]$

(61ii) (59ii) If Oswald hadn't killed him, someone else would've.
Oswald-ERG kill-prf-not-rem-HYP$_\bot$-3S$_\bot$-3S$^\bot$…
$(([w\ x|\ x =_i osw, kill_w\langle x,\top\delta\rangle]$; $[w|\ w \notin \bot\omega||]$; $[\bot\omega,\top\omega \in \bot\omega_3||]$; $[\bot\omega \notin \text{MAX}\{\bot\omega_3||,$ $bel_{\top\omega}\ \text{I}\}]$; $^\top[p|\ p = \bot\omega||])^\top$; $([x|\ x = \top\delta]$; …
…man-bad-other-3S$_\bot$-ERG kill-prf-exp$^>$+rem-DEC$_{\top\bot}$-3S.3S
…$^\top[x|\ man_{\bot\omega}\langle x\rangle]$; $[bad\{\top\delta, \top\delta||_{\bot\omega}\}]$; $[\bot\delta_2 \in \top\delta||]$; $[\top\delta \neq_i \bot\delta_2]$; $[kill_{\bot\omega}\langle\top\delta, \bot\delta\rangle]$;
$[\bot\omega,\top\omega \in \bot\omega_3||]$; $[\bot\omega \notin \text{MAX}\{\bot\omega_3||, bel_{\top\omega}\ \text{I}\}]$; $[\text{MAX}\langle\top\Omega, exp_{\top\omega}\ \text{I}\rangle \subseteq \bot\omega||]))$;
$^\top[p|\ p = \top\omega||]$

6.3 Projected consequences in remote modalities

Unlike stative *att*-suffixes (e.g. *-suri* 'bel$_\bot$'), which introduce attitude states, the implicitly attitudinal *-galuar* 'rem' only implies the existence of an attitude state without making it available for anaphora (e.g. temporal anaphora). The temporally explicit entry differs only in that the perspective point is a concurrent event ($?\varepsilon$), not the attitude holder ($?\delta$).

-rem |– $\underline{s}\backslash\underline{s}$: $\lambda\underline{V}\lambda\underline{w}.\ \underline{V}\bot\omega$; $[\bot\omega,\top\omega \in\ ?\omega||]$; $[\underline{w} \notin \text{MAX}\{?\omega||, att_{\top\omega}\ ?\varepsilon\}]$

Temporal reference in discourse (58i, ii) is explicated in (62i, ii) (building on (60i, ii)). (62iii) extends this analysis to the subordinated counterfactual (58iii), which on this account involves structured anaphora to a wished-for world and eventuality ($\bot\omega$ and $\bot\sigma_2$, adapting Brasoveanu 2007).

(62i) (58i) I have a wife, but no kid(s).
wife-have-rem-ELA$_{\top}$-1S …
$((^{\top}[s]; [s\ w|\ \text{CTR}\ s =_i \text{CTR}\ \top\varepsilon, \mathit{wife}_w\langle \text{BCK}\ s, \text{CTR}\ \top\varepsilon, \vartheta_w\ s\rangle]; [\bot\omega, \top\omega \in \bot\omega||];$
$[\top\omega \notin \text{MAX}\{\bot\omega||, \mathit{att}_{\top\omega}\ \text{BEG}\ \bot\sigma\}]; [\top\sigma =_i \bot\sigma])^{\top}; \ldots$
… kid-have-not-DEC-1S
$\ldots ([s\ w|\ \text{CTR}\ s =_i \text{CTR}\ \top\varepsilon, \mathit{kid}_w\langle \text{BCK}\ s, \text{CTR}\ \top\varepsilon, \vartheta_w\ s\rangle, \top\tau \subset_i \vartheta_w\ s]; [\top\omega \notin \bot\omega||_{\top\tau}];$
$[s|\ \text{CTR}\ s =_i \text{CTR}\ \top\varepsilon, \top\tau \subset_i \vartheta_{\top\omega}\ s]; [\top\sigma =_i \bot\sigma])); [\top\tau \subset_i \vartheta_{\top\omega}\ \bot\sigma, \text{BEG}\ \bot\sigma <_{\top\omega} \top\varepsilon];$
$^{\top}[p|\ p = \top\omega||]$

(62ii) (58ii) I wish I had a son.
son-have-rem-HYP$_{\top}$-1S …
$(([s|\ \text{CTR}\ s =_i \text{CTR}\ \top\varepsilon, \mathit{son}_{\bot\omega}\langle \text{BCK}\ s, \text{CTR}\ \top\varepsilon, \vartheta_{\bot\omega}\ s\rangle, s =_i \bot\sigma_2]; [\bot\omega, \top\omega \in \bot\omega_2||];$
$[\bot\omega \notin \text{MAX}\{\bot\omega_2||, \mathit{bel}_{\top\omega}\top\varepsilon\}]; [\text{BEG}\top\sigma <_{\bot\omega} \text{BEG}\bot\sigma]; ^{\top}[p|\ p = \bot\omega||])^{\top}; \ldots$
… fine-er-tv-rem-DEC$_{\top\bot}$-1s.3S
$\ldots([s|\ \mathit{des}_{\top\omega}\ s\text{: } \top\omega \angle \bot\omega]; [\top\Omega = \bot\omega||]; [\text{CTR}\ \bot\sigma =_i \text{CTR}\ \top\varepsilon]; [\bot\omega, \top\omega \in \bot\omega_2||];$
$[\top\omega \notin \text{MAX}\{\bot\omega_2||, \mathit{des}_{\top\omega}\top\varepsilon\}])); [\top\tau \subset_i \vartheta_{\top\omega}\ \bot\sigma, \text{BEG}\ \bot\sigma <_{\top\omega} \top\varepsilon]; ^{\top}[p|\ p = \top\omega||]$

(62iii) (58iii) Then when I die, he would've been there for my wife.
then die-HYP$_{\top}$-1s …
$[w|\ w =_i \bot\omega]^{\bot}; ((([e|\ \mathit{die}_{\bot\omega}\langle e, \text{CTR}\ \top\varepsilon\rangle, \top\varepsilon <_{\bot\omega} e]; ^{\top}[p|\ p = \bot\omega||])^{\top}; \ldots$
… that-ERG wife-1S be.with-exp$^{>}$+rem-DEC$_{\top\bot}$-3S.3S
$\ldots (^{\top}[x|\ x =_i \text{BCK}\ \bot\sigma_2]; [x|\ \mathit{wife}_{\top\omega}\langle x, \text{CTR}\ \top\varepsilon, \top\tau\rangle]; [s|\ \mathit{be.with}_{\bot\omega}\langle s, \top\delta, \bot\delta\rangle];$
$[\bot\omega, \top\omega \in \bot\omega_3||]; [\bot\omega \notin \text{MAX}\{\bot\omega_3||, \mathit{bel}_{\top\omega}\top\varepsilon\}]; [\text{BEG}\bot\sigma \subset_{\bot\omega} \text{CON}\bot\varepsilon];$
$[s|\ \text{BEG}\ \bot\sigma <_{\bot\omega} \text{END}\ s]; [\text{MAX}\langle\top\Omega, \mathit{exp}_{\top\omega}\ \bot\sigma\rangle \subseteq \bot\omega||_{\bot\sigma}])); [\top\tau \subset_i \vartheta_{\top\omega}\bot\sigma,$
$\text{BEG}\ \bot\sigma <_{\top\omega} \top\varepsilon]; ^{\top}[p|\ p = \top\omega||])$

More precisely, in (62i) the modal base of *-galuar* 'rem' is the set of worlds where the speaker is married ($\bot\omega||$). This set includes the real world ($\top\omega$), where the speaker is married at the time of this speech act ($\top\varepsilon$). However, the real world is remote from the speaker's wishes at the beginning of his marriage (BEG $\bot\sigma$). It is also a world where his marriage is childless. This suggests that the real world is sub-optimal *because* the speaker's marriage is childless, i.e. that he would prefer a wife-and-kid world to the real world.

The counterfactual (62ii) makes this explicit. The input modal base is the aforementioned domain (current $\bot\omega_2||$) where the speaker (CTR $\top\varepsilon$) has a wife. The topical hypothesis is the sub-domain where the wished-for ($\bot\sigma_2$-)kid is a son, born (BEG $\bot\sigma$) after the marriage ceremony (BEG $\top\sigma$). This topical sub-domain is remote from the wife-only sub-domain the speaker believes he inhabits. The attitudinal comment is that the speaker's ($\top\varepsilon$-)current wishes in the real world ($\top\omega$) rank any world ($\bot\omega$) in this remote topical sub-domain ($\top\Omega$), where he also has a son, above the real world ($\top\omega$), where he only has a wife.

In the subordinated counterfactual (62iii) the initial modal anaphor ('then') zooms in on the wished-for worlds ($\bot\omega$) and requires the rest of the counterfactual to elaborate ($^{\bot}$;). The antecedent clause introduces the event of the speaker's death, and the subset of worlds where he dies as the topical sub-domain. Since all men are mortal, this subset consists of all of the wished-for worlds. The main attitudinal comment refers to this topical sub-domain ($\top\Omega$). It projects an expected consequence of the speaker's death in this sub-domain, which alas he does not believe he inhabits. In the expected worlds of this remote sub-domain, after the speaker's death the son he wishes he had helps the wife he actually has.

The counterfactual Kennedy discourse (59i, ii) likewise projects an expected consequence in a modality the speaker does not believe to be his, but here viewed from a past perspective point. Temporal reference is analyzed in (63i, ii) (building on (61i, ii)).

(63i) (59i) Kennedy was assassinated because he had many enemies.
Kennedy-$^{\top}$ kill-pssv-$\text{DEC}_{\top}$-3S enemy-many-have-$\text{FCT}_{\top}$-$3\text{S}_{\top}$
$^{\top}[x|\ x =_i jfk]$; $[e|\ kill_{\top\omega}\langle e, \text{CTR}\ e, \top\delta\rangle, \top\tau \subset_i \vartheta_{\top\omega}\ \text{CON}\ e, e <_{\top\omega} \top\varepsilon]$; $^{\top}[p|\ p = \top\omega\|]$; $[t|\ t =_i \vartheta_{\top\omega} \bot\varepsilon]$; $[s\ w|\ \text{CTR}\ s =_i \top\delta, many.enemies_w\langle \text{BCK}\ s, \top\delta, \vartheta_w\ s\rangle, \bot\tau \subset_i \vartheta_w\ \text{CON BEG}\ s]$; $[\top\omega\| \subseteq \bot\omega\|]$

(63ii) (59ii) If Oswald hadn't killed him, someone else would've.
Oswald-$\text{ERG}^{\bot}$ kill-prf-not-rem-$\text{HYP}_{\bot}$-$3\text{S}_{\bot}$-$3\text{S}^{\bot}$…
$(([x|\ x =_i osw]$; $[e\ w|\ kill_w\langle e, \bot\delta, \top\delta\rangle]$; $[s|\ s =_i \text{CON}\ \bot\varepsilon, \top\tau \subset_i \vartheta_{\bot\omega}\ s]$; $[w|\ w \notin \bot\omega\|_{\top\tau}]$; $[s|\ \text{CTR}\ s =_i \bot\delta, \top\tau \subset_i \vartheta_{\bot\omega}\ s]$; $[\bot\omega, \top\omega \in \bot\omega_3\|]$; $[\bot\omega \notin \text{MAX}\{\bot\omega_3\|, bel_{\top\omega}\top\varepsilon\}]$; $[\text{BEG}\bot\sigma_3 <_{\bot\omega} \text{BEG}\ \bot\sigma]$; $[\bot\omega \in \bot\omega_3\|]$; $^{\top}[p|\ p = \bot\omega\|])\ ^{\top}$; $([x|\ x =_i \top\delta]$; …
… man-bad-other-$3\text{S}_{\bot}$-$\text{ERG}^{\top}$ kill-prf-$\text{exp}^{>}$+rem-$\text{DEC}_{\top\bot}$-3S-3S
… $^{\top}[x|\ man_{\bot\omega}\langle x, \bot\tau\rangle]$; $[bad\{\top\delta, \top\delta\|_{\bot\omega}, \bot\tau\}]$; $[\bot\delta_2 \in \top\delta\|]$; $[\top\delta \neq_i \bot\delta_2]$; $[e|\ kill_{\bot\omega}\langle e, \top\delta, \bot\delta\rangle]$; $[s|\ s =_i \text{CON}\ \bot\varepsilon]$; $[\bot\omega, \top\omega \in \bot\omega_3\|]$; $[\bot\omega \notin \text{MAX}\{\bot\omega_3\|, bel_{\top\omega}\top\varepsilon\}]$; $[\text{BEG}\ \bot\sigma \subset_{\bot\omega} \text{CON BEG}\ \bot\sigma_4]$; $[s|\ \text{BEG}\ \bot\sigma <_{\bot\omega} \text{END}\ s]$; $[\text{MAX}\langle\top\Omega, exp_{\top\omega}\ \bot\sigma\rangle \subseteq \bot\omega\|_{\bot\sigma}]))$; $[\top\tau \subset_i \vartheta_{\top\omega}\ \bot\sigma, \text{BEG}\ \bot\sigma <_{\top\omega} \top\varepsilon]$; $^{\top}[p|\ p = \top\omega\|]$

In (63i) the declarative clause outputs a common ground ($\top\omega\|$) where JFK's assassination is a ($\top\varepsilon$-)currently verifiable fact. The post-posed factual clause adds another currently verifiable fact as a possible cause—to wit, JFK's enemies reaching critical mass (BEG s). The resulting hate-filled state is realized in a larger class of worlds ($\bot\omega\|$), and in every common ground world ($\top\omega$) the time ($\bot\tau$) of JFK's assassination ($\bot\varepsilon$) falls within the consequent time of the beginning of this hate-filled state ($\vartheta_{\bot\omega}$ CON BEG s).

In this context, the counterfactual (63ii) introduces a ($\top\omega$-)real and ($\top\varepsilon$-)current state of expectation. It projects an expected consequence of the aforementioned event of JFK's enemies reaching critical mass (BEG$\bot\sigma_3$ in the antecedent, BEG$\bot\sigma_4$ in the consequent). The modal base for this expectation is the aforementioned set of worlds where this critical event is realized ($\bot\omega_3\|$). The topical hypothesis introduced by the hypothetical mood is the sub-domain—remote from the sub-domain the speaker believes to be his—where JFK is not assassinated by Oswald. The main attitudinal comment is that within this remote sub-domain ($\top\Omega$), the worlds that best fit the speaker's current expectations are those where, in the wake of JFK's enemies reaching critical mass, some other bad guy assassinates him.

In summary, Kalaallisut counterfactuals report attitudes to remote modalities. They involve an extra attitude, because the relation of modal remoteness is itself attitudinal. More precisely, the topical antecedent hypothesis and/or the scope of the attitudinal comment are marked as remote (*-galuar* 'rem') from an attitudinal ideal (e.g. beliefs or desires) of a current center of empathy, looking from a secondary perspective point. This secondary attitude report elaborates the main attitudinal comment about the topical antecedent hypothesis.

7 A CCG + UC fragment of Kalaallisut

To complete the analysis, I now show that the proposed UC representations can be derived from Kalaallisut discourse by universal directly compositional rules. To demonstrate that I define a fragment of Kalaallisut—rich enough to derive the counterfactual JFK discourse (59i, ii) and its UC representation (63i, ii)—in a framework that combines UC with the universal rules of Combinatory Categorial Grammar (CCG, Steedman 2000).

In CCG universal rules such as forward and backward function application (>, <) and composition (>**B**, <**B**, ≪**B**) combine lexical items into well-formed interpreted strings.

•	$X/Y\colon \beta_{ab}$	$Y\colon \alpha_a$	$\Rightarrow_{>}$	$X\colon \beta\alpha$
	$Y\colon \alpha_a$	$X\backslash Y\colon \beta_{ab}$	$\Rightarrow_{<}$	$X\colon \beta\alpha$
•	$X/Y\colon \beta_{ab}$	$Y/Z\colon \alpha_{ca}$	$\Rightarrow_{>\mathbf{B}}$	$X/Z\colon \lambda u_c.\ \beta(\alpha\, u)$
	$Y\backslash Z\colon \alpha_{ca}$	$X\backslash Y\colon \beta_{ab}$	$\Rightarrow_{<\mathbf{B}}$	$X\backslash Z\colon \lambda u_c.\ \beta(\alpha\, u)$
	$(Y\backslash Z)\backslash Z'\colon \alpha_{c'ca}$	$X\backslash Y\colon \beta_{ab}$	$\Rightarrow_{<<\mathbf{B}}$	$(X\backslash Z)\backslash Z'\colon \lambda u'_{c'} \lambda u_{c'}.\ \beta(\alpha\, u' u)$

The category s (sentence) is universal, but languages may differ on other categories as well as the category-to-type rule. For Kalaallisut, I propose an inventory of categories defined in K1 on the basis of the universal category sentence (s) plus three types of pronouns: individual (pn_δ), modal (pn_ω), and temporal (pn_τ). The Kalaallisut category-to-type rule K2 requires sentences to translate into UC updates (type [ ] := (*st*)*st*) and *a*-pronouns into *a*-projections (type *sa*). (Note that types of the form $(a_1\ldots(a_n[\,]))$ are abbreviated as $[a_1\ldots a_n]$.)

K1 (Kalaallisut categories)
- s and pn_δ, pn_τ, pn_ω, are Kalaallisut categories
- If *X* and *Y* are Kalaallisut categories, then so are (*X/Y*) and (*X**Y*).

K2 (Kalaallisut category-to-type rule)
- **tp**(s) = [ ], **tp**(pn_a) = *sa*
- **tp**(*X/Y*) = **tp**(*X**Y*) = (**tp**(*Y*) **tp**(*X*))

ABBREVIATIONS (categories and types)

$\underline{\mathrm{s}} := \mathrm{s}\backslash\mathrm{pn}_\omega$	$\mathrm{s}_a := \mathrm{s}\backslash\mathrm{pn}_a$	$\mathrm{pn} := \mathrm{pn}_\delta$	D := $s\delta$	W := $s\omega$
$\mathrm{iv} := \underline{\mathrm{s}}\backslash\mathrm{pn}_\delta$	$\mathrm{cn}_a := (\mathrm{s}_a\backslash\mathrm{pn}_\omega)\backslash\mathrm{pn}_\tau$	$\mathrm{cn} := \mathrm{cn}_\delta$	T := $s\tau$	[ ] := (*st*)*st*

Kalaallisut has four categories of roots: *intransitive verbs* (iv), *transitive verbs* (iv\pn), *common nouns* (cn_a), and *relational nouns* (cn_a\pn). Transitive verbs and relational nouns have an extra argument (object $\underline{y}_{\mathrm{D}}$ or possessor $\underline{z}_{\mathrm{D}}$), so they require an extra pronoun (pn).

die- $\vdash$ iv: $\lambda \underline{x}_{\mathrm{D}} \lambda \underline{w}_{\mathrm{W}}([e];\ [die_{\underline{w}}\langle \bot\varepsilon, \underline{x}\rangle])$
kill- $\vdash$ iv\pn: $\lambda \underline{y}_{\mathrm{D}} \lambda \underline{x}_{\mathrm{D}} \lambda \underline{w}_{\mathrm{W}}([e];\ [kill_{\underline{w}}\langle \bot\varepsilon, \underline{x}, \underline{y}\rangle])$
man- $\vdash$ cn: $\lambda \underline{t}_{\mathrm{T}} \lambda \underline{w}_{\mathrm{W}} \lambda \underline{x}_{\mathrm{D}}[man_{\underline{w}}\langle \underline{x}, \underline{t}\rangle]$
enemy- $\vdash$ cn\pn: $\lambda \underline{z}_{\mathrm{D}} \lambda \underline{t}_{\mathrm{T}} \lambda \underline{w}_{\mathrm{W}} \lambda \underline{x}_{\mathrm{D}}[enemy_{\underline{w}}\langle \underline{x}, \underline{z}, \underline{t}\rangle]$

Morphologically, verbal roots inflect for mood. Semantically, they introduce eventualities into discourse. In contrast, nominal roots inflect for case. Unlike verbs, they have a temporal argument ($\underline{t}_{\tau}$), which can be saturated by derivation (e.g. *-qar* '-have') or case inflection. The primary (last) argument of a verbal root is the world of evaluation ($\underline{w}_{\mathrm{W}}$). Nominal roots have primary arguments of various types: an individual for cn$_{(\delta)}$ (e.g. *inuk-* 'man'), a time for cn$_{\tau}$ (e.g. *ulluq-* 'day'), or a world for cn$_{\omega}$ (e.g. *isuma-* 'idea'). This interacts with lexical recentering, which can help to saturate the primary argument (see lexical recentering operators, $^{\top}(\cdot)$ and $^{\bot}(\cdot)$, below).

Kalaallisut is a polysynthetic language, with hundreds of derivational suffixes. It builds words compositionally, just like English builds sentences. Morphologically complex bases always allow further derivation, because derivational suffixes operate within the space of root categories. That is, a derivational suffix attaches to an input base of a root category and derives an output base of a root category. Kalaallisut *att*-suffixes interact with negative suffixes ('-not', '-rem') in a way similar to English *neg*-raising (Observation 5). I attribute this to additional *neg*-raising entries for negative suffixes (e.g. '+rem'), which enable them to form complex predicates with *att*-suffixes (e.g. '-exp$^{>}$+rem'), in effect reversing the relative scope within the complex. (Note that in all lexical entries, $\eta, \eta' \in \{\varepsilon, \sigma\}$.)

-bad $\vdash$ cn\cn: $\lambda \underline{N}_{[\mathrm{TWD}]}\lambda \underline{t}_{\mathrm{T}}\lambda \underline{w}_{\mathrm{W}}\lambda \underline{x}_{\mathrm{D}}.\ \underline{N}\ \underline{t}\ \underline{w}\ \underline{x};\ [bad\{\underline{x}, \underline{x}\Vert_{\underline{w}}, \underline{t}\}]$
-other $\vdash$ (cn\pn)\cn: $\lambda \underline{N}_{[\mathrm{TWD}]}\lambda \underline{z}_{\mathrm{D}}\lambda \underline{t}_{\mathrm{T}}\lambda \underline{w}_{\mathrm{W}}\lambda \underline{x}_{\mathrm{D}}.\ \underline{N}\ \underline{t}\ \underline{w}\ \underline{x};\ [\underline{z} \in \underline{x}\Vert];\ [\underline{x} \neq_i \underline{z}]$
-have $\vdash$ iv\(cn\pn): $\lambda \underline{M}_{[\mathrm{DTWD}]}\lambda \underline{x}_{\mathrm{D}}\lambda \underline{w}_{\mathrm{W}}.\ [s\vert\ \mathrm{CTR}\ s =_i \underline{x}]^{\bot};\ \underline{M}\ \underline{x}\ (\vartheta_{\underline{w}} \bot\sigma)\ \underline{w}\ (\mathrm{BCK} \bot\sigma)$
-pssv $\vdash$ iv\(iv\pn): $\lambda \underline{R}_{[\mathrm{DDW}]}\lambda \underline{x}_{\mathrm{D}}\lambda \underline{w}_{\mathrm{W}}.\ \underline{R}\ \underline{x}\ (\mathrm{CTR} \bot\eta)\ \underline{w}$
-prf $\vdash$ iv\iv: $\lambda \underline{P}_{[\mathrm{DW}]}\lambda \underline{x}_{\mathrm{D}}\lambda \underline{w}_{\mathrm{W}}.\ \underline{P}\ \underline{x}\ \underline{w}^{\bot};\ [s\vert\ s =_i \mathrm{CON\ EVT} \bot\eta]$
-exp$^{>}$ $\vdash$ $\underline{\mathrm{s}}\backslash\underline{\mathrm{s}}$: $\lambda \underline{V}_{[\mathrm{W}]}\lambda \underline{w}_{\mathrm{W}}.\ (\underline{V}\bot\omega^{\bot};\ [\mathrm{EVT} \bot\eta \subset_{\bot\omega} \mathrm{CON}\ ?\varepsilon]);\ [s\vert\ \mathrm{EVT} \bot\eta <_{\bot\omega} \mathrm{END}\ s];$
$[\mathrm{MAX}\langle \top\Omega, exp_{\underline{w}} \bot\sigma\rangle \subseteq \bot\omega\Vert_{\bot\sigma}]$
-not $\vdash$ $\underline{\mathrm{s}}\backslash\underline{\mathrm{s}}$: $\lambda \underline{V}_{[\mathrm{W}]}\lambda \underline{w}_{\mathrm{W}}.\ (\underline{V}\bot\omega^{\bot};\ [\mathrm{AT}_{\bot\omega}\{\mathrm{STA} \bot\eta, ?\tau\}]);\ ([w]^{\bot};\ [\underline{w} \notin \bot\omega_2\Vert_{?\tau}];\ [s\vert$
$\mathrm{CTR}\ s =_i \mathrm{CTR} \bot\eta];\ [\mathrm{AT}_{\underline{w}}\{\bot\sigma, ?\tau\}])$
-rem $\vdash$ $\underline{\mathrm{s}}\backslash\underline{\mathrm{s}}$: $\lambda \underline{V}_{[\mathrm{W}]}\lambda \underline{w}_{\mathrm{W}}.\ \underline{V}\bot\omega;\ [\bot\omega, \top\omega \in\ ?\omega\Vert];\ [\underline{w} \notin \mathrm{MAX}\{?\omega\Vert, att_{\top\omega}\ ?\varepsilon\}]$
+rem $\vdash$ $\underline{\mathrm{s}}\backslash\underline{\mathrm{s}}\backslash(\underline{\mathrm{s}}\backslash\underline{\mathrm{s}})$: $\lambda \underline{F}_{[[\mathrm{W}]\mathrm{W}]}\lambda \underline{V}_{[\mathrm{W}]}\lambda \underline{v}_{\mathrm{W}}.\ \underline{F}\ \lambda \underline{w}_{\mathrm{W}}(\underline{V}\bot\omega;\ [\bot\omega, \top\omega \in\ ?\omega\Vert];\ [\underline{w} \notin \mathrm{MAX}\{?\omega\Vert,$
$att_{\top\omega}\ ?\varepsilon\}])\ \underline{v}$

Verbal bases inflect for mood. The output is not a root category, so it can only feed into further inflection. The declarative matrix mood (-DEC) asserts that the iv-event (EVT $\bot\eta$) is a currently verifiable fact. It also introduces the updated common ground ($\top\omega\Vert$) as the new primary topic (the truth-set of the declarative statement). The dependent factual mood (-FCT) introduces a background fact (EVT $\bot\eta'$) which is realized throughout the matrix common ground and may have caused the matrix event (EVT $\bot\eta$). The dependent hypothetical mood (-HYP) forms a modal topic-comment sequence ($^{\top};$) with the verbal base ($\underline{\mathrm{s}}$) of the modified verb. The modal topic is the sub-domain of the modal base ($?\omega\|$) where the antecedent prospect, viewed from a salient perspective point ($?\varepsilon$), is realized.

-DEC $\vdash$ $\mathrm{s\backslash pn\backslash iv}: \lambda \underline{P}_{[\mathrm{DW}]}\lambda \underline{x}_{\mathrm{D}}.\ (\underline{P}\ \underline{x}\ \top\omega^{\perp};\ [\mathrm{AT}_{\top\omega}\{\perp\eta,\top\tau\}]);\ [\mathrm{EVT}\ \perp\eta <_{\top\omega} \top\varepsilon];$
$^{\top}[p|\ p = \top\omega\|]$

-FCT $\vdash$ $\mathrm{(s\backslash s)\backslash pn\backslash iv}: \lambda \underline{P}_{[\mathrm{DW}]}\lambda \underline{x}_{\mathrm{D}}\lambda K_{[\,]}.\ ((K^{\perp};\ [t|\ t =_i \vartheta_{\top\omega}\ \mathrm{EVT}\ \perp\eta])^{\perp};\ (\underline{P}\ \underline{x}\ \perp\omega^{\perp};$
$[\perp\tau \subset_i \vartheta_{\perp\omega}\ \mathrm{CON\ EVT}\ \perp\eta^{\urcorner}]));\ [\top\omega\| \subseteq \perp\omega\|]$

-HYP $\vdash$ $(\underline{\mathrm{s}}/\underline{\mathrm{s}})\mathrm{\backslash pn\backslash iv}: \lambda \underline{P}_{[\mathrm{DW}]}\lambda \underline{x}_{\mathrm{D}}\lambda \underline{V}_{[\mathrm{W}]}\lambda \underline{w}_{\mathrm{W}}.\ ((\underline{P}\ \underline{x}\ \perp\omega^{\perp};\ [?\varepsilon <_{\perp\omega} \mathrm{EVT}\ \perp\eta]);$
$[\perp\omega \in\ ?\omega\|];\ ^{\top}[p|\ p = \perp\omega\|])^{\top};\ \underline{V}\ \underline{w}$

The mood inflection is followed by one or two pronominal suffixes (category x\(x\pn), with x ∈ {s, s\s, s/s, $\underline{\mathrm{s}}/\underline{\mathrm{s}}$, $\underline{\mathrm{s}}\backslash\underline{\mathrm{s}}$} for subject pronouns). That is why an inflected matrix verb in Kalaallisut is a complete sentence (see Jelinek 1984 on pronominal argument languages). Possessors of relational nouns are likewise saturated by pronominal suffixes. Third person pronouns are either topical or backgrounded. Typically, they are interpreted as top or bottom anaphors that saturate the current argument slot. Alternatively, they may update the centering status of that argument (e.g. in the antecedent of (59ii), the suffix '-3S$^{\perp}$' fills the object slot with the input topic, JFK, and demotes JFK to the status of background.)

-3S$_{\top}$ $\vdash$ $\mathrm{x\backslash(x\backslash pn)}: \lambda \underline{X}_{[\mathrm{D}\ldots]}.\ \underline{X}\ \top\delta$

-3S$_{\perp(2)}$ $\vdash$ $\mathrm{x\backslash(x\backslash pn)}: \lambda \underline{X}_{[\mathrm{D}\ldots]}.\ \underline{X}\ \perp\delta_{(2)}$

-3S$^{\perp}$ $\vdash$ $(\underline{\mathrm{s}}/\underline{\mathrm{s}})\backslash((\underline{\mathrm{s}}/\underline{\mathrm{s}})\mathrm{\backslash pn}): \lambda \underline{G}_{[\mathrm{D[W]W}]}\lambda \underline{V}_{[\mathrm{W}]}.\ \underline{G}\ \top\delta\ \lambda \underline{w}_{\mathrm{W}}([x|\ x =_i \top\delta]^{\perp};\ \underline{V}\ \underline{w})$

Nominal bases inflect for case. The direct cases (absolutive and ergative) form s-modifiers. These pseudo 'subjects' and 'objects' set the topic or background for an anaphoric pronominal suffix, which is the true argument of the predicate in the modified sentence.

-Ø$^{\top}$, ERG$^{\top}$ $\vdash$ $\mathrm{(s/s)\backslash cn}: \lambda \underline{N}_{[\mathrm{TWD}]}\lambda K_{[\,]}.\ \underline{N}\ ?\tau\ ?\omega\ \top\delta^{\top};\ K$

-Ø$^{\perp}$, ERG$^{\perp}$ $\vdash$ $\mathrm{(s/s)\backslash cn}: \lambda \underline{N}_{[\mathrm{TWD}]}\lambda K_{[\,]}.\ \underline{N}\ ?\tau\ ?\omega\ \perp\delta^{\perp};\ K$

Kalaallisut is topic-prominent and polysynthetic. I attribute these typological traits partly to lexical entries, such as the above, and partly to lexical *recentering* ($^{\top}(\cdot)$, $^{\perp}(\cdot)$) and *type lifting* ($(\cdot)^{+}$, $^{+}(\cdot)$). Type lifting by $(\cdot)^{+}$ turns s-modifiers (s/s) into verbal base modifiers ($\underline{\mathrm{s}}/\underline{\mathrm{s}}$), whereas $^{+}(\cdot)$ makes verbal bases ($\underline{\mathrm{s}}$) accessible to word-external modifiers.

$^{\top}(\cdot)$ $\vdash$ $\mathrm{s}_a\backslash\mathrm{s}_a: \lambda P_{[sa]}\ \lambda \underline{u}_{sa}.\ ^{\top}[u_a]^{\top};\ P\ \underline{u}$ $\qquad a \in \mathrm{DR}(\Theta)$

$^{\perp}(\cdot)$ $\vdash$ $\mathrm{s}_a\backslash\mathrm{s}_a: \lambda P_{[sa]}\ \lambda \underline{u}_{sa}.\ [u_a]^{\perp};\ P\ \underline{u}$ $\qquad a \in \mathrm{DR}(\Theta)$

$(\cdot)^{+}$ $\vdash$ $(\underline{\mathrm{s}}/\underline{\mathrm{s}})\mathrm{\backslash(s/s)}: \lambda \underline{K}_{[[\,]]}\lambda \underline{V}_{[\mathrm{W}]}\lambda \underline{w}_{\mathrm{W}}.\ \underline{K}\ (\underline{V}\ \underline{w})$

$^{+}(\cdot)$ $\vdash$ $(\mathrm{iv}\backslash(\underline{\mathrm{s}}/\underline{\mathrm{s}}))\mathrm{\backslash iv}: \lambda \underline{P}_{[\mathrm{DW}]}\lambda \underline{F}_{[[\mathrm{W}]\mathrm{W}]}\lambda \underline{x}_{\mathrm{D}}\lambda \underline{w}_{\mathrm{W}}.\ \underline{F}\ (\underline{P}\ \underline{x})\ \underline{w}$

In this fragment, discourse (59i, ii) can be derived as follows. Complex words are incrementally built and translated into UC by universal rules of backward application and composition (<, <**B**, and ≪**B**). For example, sentence (59i) consists of three words, which are built in (64a) and (65a); the resulting translations (b) are equivalent to (c). Words are then combined, incrementally left-to-right, into sentences. For discourse (59i, ii) the two component sentences are built in (64)–(66) and (67)–(73), respectively.

(64) a.

Kennedy-	${}^{\top}(\cdot)$	-Ø$^{\top}$	kill-	-pssv	-DEC$_{\top}$	-3S
cn (= $s_{\delta}\backslash pn_{\omega}\backslash pn_{\tau}$)	$s_{\delta}\backslash s_{\delta}$	(s/s)\cn	iv\pn	iv\(iv\pn)	s\pn\iv	s\(s\pn)

Kennedy- + ${}^{\top}(\cdot)$ ——— ≪**B** ⇒ cn

cn + -Ø$^{\top}$ ——— < ⇒ s/s

kill- + -pssv ——— < ⇒ iv

iv + -DEC$_{\top}$ ——— < ⇒ s\pn

s\pn + -3S ——— < ⇒ s

s/s + s ——— > ⇒ s

b. $({}^{\top}[x]\,{}^{\top};\ [\top\delta =_i jfk])\,{}^{\top};\ ((([e];\ [kill_{\top\omega}\langle\bot\varepsilon,\ \text{CTR}\ \bot\varepsilon,\ \top\delta\rangle])\,{}^{\bot};\ [\text{AT}_{\top\omega}\{\text{EVT}\ \bot\varepsilon,\ \top\tau\}]);$
$[\text{EVT}\ \bot\varepsilon <_{\top\omega} \top\varepsilon];\ {}^{\top}[p|\ p = \top\omega||])$

c. ${}^{\top}[x|\ x =_i jfk];\ [e|\ kill_{\top\omega}\langle e,\ \text{CTR}\ e,\ \top\delta\rangle,\ \top\tau \subset_i \vartheta_{\top\omega}\ \text{CON}\ e,\ e <_{\top\omega} \top\varepsilon];\ {}^{\top}[p|\ p = \top\omega||]$

(65) a.

enemy-	-many	-have	${}^{\bot}(\cdot)$	-FCT$_{\top}$	-3S$_{\top}$
cn\pn	cn\cn	iv\(cn\pn)	$s_{\omega}\backslash s_{\omega}$	(s\s)\pn\iv	(s\s)\((s\s)\pn)

enemy- + -many ——— <**B** ⇒ cn\pn

cn\pn + -have ——— < ⇒ iv (:= s_{ω}\pn)

iv + ${}^{\bot}(\cdot)$ ——— <**B** ⇒ iv

iv + -FCT$_{\top}$ ——— < ⇒ (s\s)\pn

(s\s)\pn + -3S$_{\top}$ ——— < ⇒ s\s

b. $\lambda K_{[]}.\ ((K\,{}^{\bot};\ [t|\ t =_i \vartheta_{\top\omega}\ \text{EVT}\ \bot\varepsilon])\,{}^{\bot};\ ((([w]\,{}^{\bot};\ ([s|\ \text{CTR}\ s =_i \top\delta]\,{}^{\bot};\ [many.enemies_{\bot\omega}$
$\langle\text{BCK}\ \bot\sigma,\ \top\delta,\ \vartheta_{\bot\omega}\ \bot\sigma\rangle]))\,{}^{\bot};\ [\bot\tau \subset_i \vartheta_{\bot\omega}\ \text{CON EVT}\ \bot\sigma]));\ [\top\omega|| \subseteq \bot\omega||]$

c. $\lambda K_{[]}.\ (K\,{}^{\bot};\ [t|\ t =_i \vartheta_{\top\omega}\ \bot\varepsilon]);\ [s\ w|\ \text{CTR}\ s =_i \top\delta,\ many.enemies_w\langle\text{BCK}\ s,\ \top\delta,\ \vartheta_w\ s\rangle,$
$\bot\tau \subset_i \vartheta_w\ \text{CON BEG}\ s];\ [\top\omega|| \subseteq \bot\omega||]$

(66) (64) (65) $\Rightarrow_{<}$ s: (63i)

(67) $({}^{\bot}(\text{Oswald})\text{-ERG}^{\bot})^{+}\ \vdash\ \underline{s}/\underline{s}:\ \lambda \underline{V}_{[w]}\lambda \underline{w}_{w}.\ [x|\ x =_i osw]\,{}^{\bot};\ \underline{V}\ \underline{w}$

(68) ${}^{+}({}^{\bot}(\text{kill}))\text{-prf-not-rem-HYP}_{\bot}\text{-3S}_{\bot}\text{-3S}^{\bot}\ \vdash\ (\underline{s}/\underline{s})\backslash(\underline{s}/\underline{s}):\ \lambda \underline{F}_{[[w]w]}\lambda \underline{V}_{[w]}\lambda \underline{w}_{w}.\ (((\underline{F}\ \ \lambda \underline{v}_{w}([w]\,{}^{\bot};$
$[e|\ kill_{\underline{v}}\langle e,\ \bot\delta,\ \top\delta\rangle])\ \bot\omega);\ [s|\ s =_i \text{CON}\ \bot\varepsilon,\ \top\tau \subset_{\bot\omega} s];\ [w|\ w \notin \bot\omega||_{\top\tau}];\ [s|\ \text{CTR}\ s =_i$
$\bot\delta,\ \top\tau \subset \vartheta_{\bot\omega}\ s];\ [\bot\omega,\ \top\omega \in \bot\omega_3||];\ [\bot\omega \notin \text{MAX}\{\bot\omega_3||,\ bel_{\top\omega}\top\varepsilon\}];\ [\text{BEG}\ \bot\sigma_3 <_{\bot\omega}$
$\text{BEG}\ \bot\sigma];\ [\bot\omega \in \bot\omega_3||];\ {}^{\top}[p|\ p = \bot\omega||])\,{}^{\top};\ ([x|\ x = \top\delta]\,{}^{\bot};\ \underline{V}\ \underline{w}))$

(69) (67) (68) $\Rightarrow_{<}$ $\underline{s}/\underline{s}$: $\lambda \underline{V}_{[w]}\lambda \underline{w}_{w}.\ ([x|\ x =_i osw]; [e\ w|\ kill_w\langle e, \bot\delta, \top\delta\rangle]; [s|\ s =_i \text{CON} \bot\varepsilon, \top\tau \subset_i \vartheta_{\bot\omega}\, s]; [w|\ w \notin \bot\omega||_{\top\tau}]; [s|\ \text{CTR}\ s =_i \bot\delta, \top\tau \subset_{\bot\omega} s]; [\bot\omega, \top\omega \in \bot\omega_3||]; [\bot\omega \notin \text{MAX}\{\bot\omega_3||, bel_{\top\omega}\top\varepsilon\}]; [\text{BEG} \bot\sigma_3 <_{\bot\omega} \text{BEG} \bot\sigma]; {}^{\top}[p|\ p = \bot\omega||])^{\top}; ([x|\ x =_i \top\delta]^{\bot}; \underline{V}\ \underline{w})$

(70) $({}^{\top}$(man-bad-other-3S$_{\bot2}$)-ERG$^{\top})^{+}$ $\vdash$ $\underline{s}/\underline{s}$: $\lambda \underline{V}_{[w]}\lambda \underline{w}_{w}.\ (({}^{\top}[x|\ man_{\bot\omega}\langle x, \bot\tau\rangle]; [bad\{\top\delta, \top\delta||_{\bot\omega}, \bot\tau\}]; [\bot\delta_2 \in \top\delta||]; [\top\delta \neq_i \bot\delta_2])^{\top}; \underline{V}\ \underline{w})$

(71) (69) (70) $\Rightarrow_{>\mathbf{B}}$ $\underline{s}/\underline{s}$: $\lambda \underline{V}_{[w]}\lambda \underline{w}_{w}.\ ([x|\ x =_i osw]; [e\ w|\ kill_w\langle e, \bot\delta, \top\delta\rangle]; [s|\ s =_i \text{CON} \bot\varepsilon, \top\tau \subset_i \vartheta_{\bot\omega}\, s]; [w|\ w \notin \bot\omega||_{\top\tau}]; [s|\ \text{CTR}\ s =_i \bot\delta, \top\tau \subset \vartheta_{\bot\omega}\, s]; [\bot\omega, \top\omega \in \bot\omega_3||]; [\bot\omega \notin \text{MAX}\{\bot\omega_3||, bel_{\top\omega}\top\varepsilon\}]; [\text{BEG} \bot\sigma_3 <_{\bot\omega} \text{BEG} \bot\sigma]; {}^{\top}[p|\ p = \bot\omega||])^{\top}; ([x|\ x =_i \top\delta]^{\bot}; (({}^{\top}[x|\ man_{\bot\omega}\langle x, \bot\tau\rangle]; [bad\{\top\delta, \top\delta||_{\bot\omega}, \bot\tau\}]; [\bot\delta_2 \in \top\delta||]; [\top\delta \neq_i \bot\delta_2])^{\top}; \underline{V}\ \underline{w}))$

(72) $^{+}$(kill-prf-exp$^{>}$+rem)-DEC$_{\top\bot}$-3S-3S $\vdash$ $s\backslash(\underline{s}/\underline{s})$: $\lambda \underline{F}_{[[w]w]}.\ ((\underline{F}\ \lambda \underline{w}_{w}([e|\ kill_{\bot\omega}\langle e, \top\delta, \bot\delta\rangle, [s|\ s =_i \text{CON} \bot\varepsilon]; [\bot\omega, \top\omega \in \bot\omega_3||]; [\bot\omega \notin \text{MAX}\{\bot\omega_3||, bel_{\top\omega}\top\varepsilon\}]; [\text{BEG} \bot\sigma \subset_{\bot\omega} \text{CON BEG} \bot\sigma_4]; [s|\ \text{BEG} \bot\sigma <_{\bot\omega} \text{END}\ s]; [\text{MAX}\langle\top\Omega, exp_{\underline{w}} \bot\sigma\rangle \subseteq \bot\omega||_{\bot\sigma}])\ \top\omega); [\top\tau \subset_i \vartheta_{\top\omega} \bot\sigma, \text{BEG} \bot\sigma <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p = \top\omega||]$

(73) (71) (72) $\Rightarrow_{<}$ s: (63ii)

In general, a Kalaallisut sentence consists of a saturated matrix verb (category s or type-lifted $s\backslash(\underline{s}/\underline{s})$) plus any number of dependents, interpreted as modifiers ($\underline{s}/\underline{s}$, s/s, or s\s). Most dependents precede the matrix verb, but one or two may be post-posed (as in (66)). Multiple dependents on the same side of the matrix verb compose (by >**B** or <**B**) into a dependent cluster (as in (71)), which then combines with the matrix verb like a single dependent (by > or <, as in (73)). This left-to-right incremental analysis correctly predicts one more typological trait of Kalaallisut—to wit, the 'free' order of the dependents of a matrix verb. All of the example discourses in Sections 1–6 can be incrementally composed in this way. Thus, the proposed UC representations can be derived from Kalaallisut discourse by universal directly compositional rules of CCG.

8 From Kalaallisut to English

Typologically, Kalaallisut is a mood-based topic-prominent language with massively polysynthetic morphology and 'free' word order. At the other extreme, English is a tense-based subject-prominent language with analytic morphology and rigid word order. As a consequence, none of the Observations 1–6 about the syntax-semantics interface extend to English. Unlike Kalaallisut, English has no fact-oriented mood, no prospect-oriented hypothetical mood, no prospect-oriented attitudinal correlate requirement, and no translation equivalent for the remoteness suffix *-galuar* 'rem'.

Nevertheless, I propose that in English, too, reference to real and hypothetical past, present, and future, involves centering-based modal and temporal anaphora. This proposal builds on a CCG + UC fragment of English presented in Bittner (2009), which implements an influential theory of tense as temporal anaphora (Partee 1973, 1984) plus temporal update (Webber 1988). Here, I also implement a version of Stone's (1997) idea that, in addition to anaphoric tenses, English has a parallel system of anaphoric modals. As in Kalaallisut, universal CCG rules translate English discourses into UC. For instance, discourse (74i, ii) translates into (75i, ii), given lexical entries exemplified below. (Note that unlike Kalaallisut, which employs a global update, $[\mathrm{AT}_W\{A, T\}]$, English uses a local condition, $\mathrm{AT}_W\langle A, T\rangle := \lambda j_s((\mathrm{EVT}\,Aj = Aj \rightarrow \vartheta_{Wj}\,Aj \subset Tj) \wedge (\mathrm{STA}\,Aj = Aj \rightarrow Tj \subset \vartheta_{Wj}\,Aj))$.)

(74) i. Jim leaves today.
ii. Sue will be upset.

leave-	$\vdash$	$\underline{\mathrm{s}}: \lambda \underline{w}_{\mathrm{W}}.\ [e \mid leave_{\underline{w}}\langle e, \mathrm{CTR}\ e\rangle]$
-TNS$_{\geq}$	$\vdash$	$\mathrm{iv}\backslash\underline{\mathrm{s}}: \lambda \underline{V}_{[\mathrm{W}]}\lambda \underline{x}_{\mathrm{D}}\lambda \underline{w}_{\mathrm{W}}.\ [\vartheta_{\top\omega}\top\varepsilon \leq_i \top\tau];\ [\underline{w} \in \top\omega\|];\ (\underline{V}\ \underline{w}\ ^{\bot};\ [\mathrm{AT}_{\underline{w}}\langle\bot\eta, \top\tau\rangle, \mathrm{CTR}\ \bot\eta =_i \underline{x}])$
FUT	$\vdash$	$\mathrm{iv}/\underline{\mathrm{s}}_{\varnothing}: \lambda \underline{V}_{[\mathrm{W}]}\lambda \underline{x}_{\mathrm{D}}\lambda \underline{w}_{\mathrm{W}}.\ [\vartheta_{\top\omega}\top\varepsilon <_i \top\tau];\ [\underline{w} \in \top\omega\|];\ (\underline{V}\ \underline{w}\ ^{\bot};\ [\mathrm{AT}_{\underline{w}}\langle\bot\eta, \top\tau\rangle, \mathrm{CTR}\ \bot\eta =_i \underline{x}])$
Jim	$\vdash$	$\underline{\mathrm{s}}/\mathrm{iv}: \lambda \underline{P}_{[\mathrm{DW}]}\lambda \underline{w}_{\mathrm{W}}.\ ^{\top}[x \mid x =_i jim]\ ^{\top};\ \underline{P}\ \top\delta\ \underline{w}$
today$_{\eta}$	$\vdash$	$\mathrm{iv}\backslash\mathrm{iv}: \lambda \underline{P}_{[\mathrm{DW}]}\lambda \underline{x}_{\mathrm{D}}\lambda \underline{w}_{\mathrm{W}}.\ \underline{P}\ \underline{x}\ \underline{w}\ ^{\bot};\ [\vartheta_{\underline{w}}\ \bot\eta \subseteq day.of\langle\vartheta_{\top\omega}\top\varepsilon\rangle]$
$(\cdot)^{\top\tau}$	$\vdash$	$\mathrm{iv}\backslash\mathrm{iv}: \lambda \underline{P}_{[\mathrm{DW}]}\lambda \underline{x}_{\mathrm{D}}\lambda \underline{w}_{\mathrm{D}}.\ \underline{P}\ \underline{x}\ \underline{w}\ ^{\bot};\ ^{\top}[t \mid t \subseteq_i \vartheta_{\underline{w}}\ \mathrm{CON}\ \bot\varepsilon]$
$^{\top\tau}(\cdot)$	$\vdash$	$\mathrm{iv}\backslash\mathrm{iv}: \lambda \underline{P}_{[\mathrm{DW}]}\lambda \underline{x}_{\mathrm{D}}\lambda \underline{w}_{\mathrm{D}}.\ ^{\top}[t]\ ^{\top};\ \underline{P}\ \underline{x}\ \underline{w}$
.	$\vdash$	$\mathrm{s}\backslash\underline{\mathrm{s}}: \lambda \underline{V}_{[\mathrm{W}]}.\ \underline{V}\ \top\omega;\ ^{\top}[p \mid p = \top\omega\|]$

(75) i. Jim $(^{\top\tau}$(leave-TNS$_{\geq}$)$)^{\top\tau}$ today$_{\varepsilon}$ **.**
$^{\top}[x \mid x =_i jim];\ ^{\top}[t \mid \vartheta_{\top\omega}\top\varepsilon \leq_i t];\ [\top\omega \in \top\omega\|];\ [e \mid leave_{\top\omega}\langle e, \top\delta\rangle,\ \vartheta_{\top\omega}\ e \subset_i \top\tau,$
$\vartheta_{\top\omega}\ e \subseteq_i day.of\langle\vartheta_{\top\omega}\top\varepsilon\rangle];\ ^{\top}[t \mid t \subseteq_i \vartheta_{\top\omega}\ \mathrm{CON}\ \bot\varepsilon];\ ^{\top}[p \mid p = \top\omega\|]$
ii. Sue FUT be-Ø upset **.**
$^{\top}[x \mid x =_i sue];\ [\vartheta_{\top\omega}\top\varepsilon <_i \top\tau];\ [\top\omega \in \top\omega\|];\ [s \mid upset_{\top\omega}\langle s, \top\delta\rangle,\ \top\tau \subset_i \vartheta_{\top\omega}\ s];$
$^{\top}[p \mid p = \top\omega\|]$

I assume that the discourse-initial default state is universal ($^{st}\langle \mathsf{p}_0, \mathsf{e}_0\rangle$, defined in D7, implementing the 'commonplace effect' of Stalnaker 1978). In particular, the default topic time is the speech *instant* ($\vartheta_{\top\omega}\top\varepsilon$). Since this cannot properly include anything, a topical future *period* must be introduced in (75i) (by $^{\top\tau}(\cdot)$), to satistfy the local AT-condition and the non-past tense (-TNS$_{\geq}$). The event of Jim's arrival is properly included within this topical future. In addition, tense on an event verb may update the topic time to the consequent time (by $(\cdot)^{\top\tau}$), as in (75i). This temporal update does not affect post-verbal modifier *today*, which constrains the eventuality (Jim's arrival), not the topic time. In English, illocutionary force is in part marked by prosody. The full stop prosody ('**.**') turns a sentence radical ($\underline{\mathrm{s}}$) into a declarative sentence (s), by predicating the radical of the topic world ($\top\omega$) and introducing the updated common ground ($\top\omega\|$) as the new primary topic (adapting Stalnaker 1975). On this analysis, the indicative is not a fact-oriented mood, but a modal default.

The salient reading of (74ii) is explicated in (75ii). The future auxiliary *will* requires a future topic time and a *vivid* world of evaluation, i.e., a world within the common ground ($\top\omega||$, adapting Stone 1997). In (75ii) both of these tests are passed, by the topical future following Jim's departure ($\top\tau$) and the topic world ($\top\omega$). In the common ground worlds that survive the assertion of (75ii) Sue is sad at that topical future time. Thus, in root clauses *will* does not involve any modal quantification. All that matters is the actual future of the speech world ($\top\omega$, adapting Kamp and Reyle 1993, who only consider this world).

In contrast, in conditionals *will* quantifies over branching futures (adapting Thomason 1984), because the complementizer *if* builds a modal topic-comment sequence. The antecedent of *will* introduces a topical set of vivid futures and *will*, as part of the comment, quantifies over this set. English *if* does not require any attitudinal correlate because it is itself implicitly attitudinal (cf. Kratzer 1981), unlike the hypothetical mood in Kalaallisut.

if |– $(\underline{s}/\underline{s})/\underline{s}$: $\lambda \underline{V}_{[w]} \lambda \underline{V}'_{[w]} \lambda \underline{w}_{w}.((\underline{V}\bot\omega; {}^{\top}[p|\, p = \bot\omega||])^{\top}; (\underline{V}'\bot\omega; [\text{MAX}\langle\top\Omega, att_{\underline{w}}\, ?\varepsilon\rangle \subseteq \bot\omega||_{?\varepsilon}])))$

For example, the conditional variant of discourse (74i, ii) translates into (76). The non-past antecedent (*if Jim leaves…*) introduces a topical sub-domain of the common ground ($\top\omega||$, adapting Stalnaker 1975), where Jim leaves at a future topic time (introduced by ${}^{\top\tau}(\cdot)$, as in (75i)). The topical future for the attitudinal comment is the consequent time of this event (introduced by $(\cdot)^{\top\tau}$, as in (75i)). The attitudinal comment (*…Sue will be upset*) is analyzed as a prediction, i.e., the implicit attitude of *if* is resolved to expectation (*exp*) and the perspective point, to the speech act ($\top\varepsilon$). In the antecedent worlds that best fit the speaker's expectations Sue is sad at that future time, i.e. in the wake of Jim's departure.

(76) ${}^{\bot}$if Jim $({}^{\top\tau}$(leave-TNS$_{\geq}$))$^{\top\tau}$ …
$([w]\,{}^{\bot}; (({}^{\top}[x|\, x =_i jim]; {}^{\top}[t|\, \vartheta_{\top\omega}\top\varepsilon \leq_i t]; [\bot\omega \in \top\omega||]; [e|\, leave_{\bot\omega}\langle e, \top\delta\rangle, \vartheta_{\bot\omega}\, e \subset_i \top\tau]; {}^{\top}[t|\, t \subseteq_i \vartheta_{\bot\omega}\, \text{CON}\, \bot\varepsilon]; {}^{\top}[p|\, p = \bot\omega||])^{\top}; …$
… Sue FUT be-Ø upset (if) **.**
$… ({}^{\top}[x|\, x =_i sue]; [\vartheta_{\top\omega}\, \top\varepsilon <_i \top\tau]; [\bot\omega \in \top\omega||]; [s|\, upset_{\bot\omega}\langle s, \top\delta\rangle, \top\tau \subset_i \vartheta_{\bot\omega}\, s]; [\text{MAX}\langle\top\Omega, exp_{\top\omega}\, \top\varepsilon\rangle \subseteq \bot\omega||_{\top\varepsilon}]))); {}^{\top}[p|\, p = \top\omega||]$

Unlike Kalaallisut, English marks remoteness from attitudinal ideals (e.g. from the most desirable worlds, in the context of (77i)) by a variety of means, e.g. 'fake past' in the antecedent and a future-oriented remote modal in the matrix (as in (77ii), see Iatridou 2000, Condoravdi 2002).

(77) i. I want Jim to win tomorrow.
ii. If he lost, Sue {would | might} get upset.

Iatridou (2000) shows that past tense marking is used in this way in unrelated languages all over the world, so it cannot be chance. She proposes that past tense can indicate either that 'the topic time excludes the utterance time' (p. 246) or that 'the topic worlds exclude the actual world' (p. 247). This proposal is both too weak (not now does not mean past) and too strong (undesirable does not mean not actual, alas), but the basic idea is attractive.

Building on that, I propose that past tense ($_{<}$TNS) requires *precedence*—either the topic time precedes the perspective time in the temporal order, or the world of evaluation precedes (ranks below) the perspective world in a salient attitudinal order. The latter reading may be forced by a future-oriented modal that likewise requires remoteness (e.g. FUT$_{rem}$ or MAY$_{rem}$).

-$_{<}$TNS ⊢ $\text{iv}\backslash\underline{\text{s}}: \lambda\underline{V}_{[\text{W}]}\lambda\underline{x}_{\text{D}}\lambda\underline{w}_{\text{W}}.\ [\top\tau <_i \vartheta_{\top\omega}\top\varepsilon]; [\underline{w} \in \top\omega\|]; (\underline{V}\ \underline{w}\ ^{\bot}; [\text{AT}_{\underline{w}}\langle\bot a, \top\tau\rangle, \text{CTR}\ \bot a =_i \underline{x}])$

⊢ $\text{iv}\backslash\underline{\text{s}}: \lambda\underline{V}_{[\text{W}]}\lambda\underline{x}_{\text{D}}\lambda\underline{w}_{\text{W}}.\ [att_{\top\omega}\ ?\varepsilon\text{: } \underline{w} < ?\omega]; [\underline{w} \in \top\omega\|]; (\underline{V}\ \underline{w}\ ^{\bot}; [\text{AT}_{\underline{w}}\langle\bot a, ?\tau\rangle, \text{CTR}\ \bot a =_i \underline{x}])$

FUT$_{rem}$ ⊢ $\text{iv}/\underline{\text{s}}_{\emptyset}: \lambda\underline{V}_{[\text{W}]}\lambda\underline{x}_{\text{D}}\lambda\underline{w}_{\text{W}}.\ [\vartheta_{\top\omega}?\varepsilon <_i ?\tau]; [\underline{w} \notin \text{MAX}\{\top\omega\|, att_{\top\omega}\ ?\varepsilon\}]; (\underline{V}\ \underline{w}\ ^{\bot}; [\text{AT}_{\underline{w}}\langle\bot a, ?\tau\rangle, \text{CTR}\ \bot a =_i \underline{x}])$

MAY$_{rem}$ ⊢ $\text{iv}/\underline{\text{s}}_{\emptyset}: \lambda\underline{V}_{[\text{W}]}\lambda\underline{x}_{\text{D}}\lambda\underline{w}_{\text{W}}.\ [\vartheta_{\top\omega}?\varepsilon <_i ?\tau]; [\underline{w} \notin \text{MAX}\{\top\omega\|, att_{\top\omega}?\varepsilon\}]; ((^{\top}[p|\ p \subseteq \top\Omega]; [\underline{w} \in \top\Omega])\ ^{\top}; (\underline{V}\ \underline{w}\ ^{\bot}; [\text{AT}_{\underline{w}}\langle\bot a, ?\tau\rangle, \text{CTR}\ \bot a =_i \underline{x}]))$

On this analysis of 'fake past' and future-oriented remote modals, discourse (77i, ii) translates into (78i, ii). In the output of (78i) throughout the common ground ($\top\omega\|$), the speaker is in a current state of desire whose modal base is the initial common ground (default $\top\Omega$). In the top-ranked ($\top\Omega$-)worlds Jim wins the day after this speech act ($\top\varepsilon$-tomorrow). In the follow-up conditional (78ii), the topical antecedent hypothesis is the less desirable sub-domain, relative to the winning worlds ($\bot\omega_2$), where Jim loses the aforementioned ($\bot\tau$-)competition. The topic time for the matrix comment is the consequent time of that defeat. This topical future ($\top\tau$) and the remote hypothetical worlds ($\bot\omega$) satisfy the tests of the matrix modal (*would* or *might*). If the modal is *would*, then the main attitudinal comment is that, within the antecedent modality where Jim loses (current $\top\Omega$), in the worlds the speaker considers most likely Sue gets upset during the consequent time of Jim's defeat. If the modal is *might*, then this holds for a non-empty sub-domain of the antecedent losing modality.

(78) i. I want$_{\bot}$-TNS$_{\geq}$ Jim$^{\bot}$ INF win-Ø tomorrow$_{\varepsilon}$.

$[\vartheta_{\top\omega}\top\varepsilon \leq_i \top\tau]; [\top\omega \in \top\omega\|]; [x|\ x =_i jim]; [e\ w|\ win_w\langle e, \bot\delta\rangle, \vartheta_w\ e \subseteq_i day.after \langle\vartheta_{\top\omega}\top\varepsilon\rangle]; [s\ t|\ \vartheta_{\bot\omega}\ \bot\varepsilon \subset_i t, \vartheta_{\bot\omega}\ \text{BEG}\ s <_i t]; [\text{MAX}\langle\top\Omega, des_{\top\omega}\ \bot\sigma\rangle \subseteq \bot\omega\|_{\bot\sigma}]; [\top\tau \subset_i \vartheta_{\top\omega}\ \bot\sigma, \text{CTR}\ \bot\sigma =_i \text{CTR}\ \top\varepsilon]; {}^{\top}[p|\ p = \top\omega\|]$

ii. $^{\bot}$if he (lose-$_{<}$TNS)$^{\top\tau}$ …

$([w]\ ^{\bot}; ([des_{\top\omega}\top\varepsilon\text{: } \bot\omega < \bot\omega_2]; [\bot\omega \in \top\omega\|]; [e|\ lose_{\bot\omega}\langle e, \bot\delta\rangle, \vartheta_{\bot\omega}\ e \subset_i \bot\tau]; {}^{\top}[t|\ t \subseteq_i \vartheta_{\bot\omega}\ \text{CON}\ \bot\varepsilon]; {}^{\top}[p|\ p = \bot\omega\|])\ ^{\top}; \ldots$

… Sue FUT$_{rem}$ get-Ø upset (if) .

$\ldots\ ({}^{\top}[x|\ x =_i sue]; [\vartheta_{\top\omega}\top\varepsilon <_i \top\tau]; [\bot\omega \notin \text{MAX}\{\top\omega\|, des_{\top\omega}\top\varepsilon\}]; [e|\ upset_{\bot\omega} \langle\text{CON}\ e, \top\delta\rangle, \vartheta_{\bot\omega}\ e \subset_i \top\tau]; [\text{MAX}\langle\top\Omega, exp_{\top\omega}\top\varepsilon\rangle \subseteq \bot\omega\|_{\top\varepsilon}])); {}^{\top}[p|\ p = \top\omega\|]$

… Sue MAY$_{rem}$ get-Ø upset (if) .

$\ldots\ ({}^{\top}[x|\ x =_i sue]; [\vartheta_{\top\omega}\top\varepsilon <_i \top\tau]; [\bot\omega \notin \text{MAX}\{\top\omega\|, des_{\top\omega}\top\varepsilon\}]; {}^{\top}(([p|\ p \subseteq_i \top\Omega] [\bot\omega \in_i \top\Omega])\ ^{\top}; ([e|\ upset_{\bot\omega}\langle\text{CON}\ e, \top\delta\rangle, \vartheta_{\bot\omega}\ e \subset_i \top\tau]; [\text{MAX}\langle\top\Omega, exp_{\top\omega}\top\varepsilon\rangle \subseteq \bot\omega\|_{\top\varepsilon}]))); {}^{\top}[p|\ p = \top\omega\|]$

On this analysis, conditionals are a species of attitude reports not only in Kalaallisut but also in English, albeit with different details. This proposal is admittedly less compelling for English than for Kalaallisut, but it is compatible with some influential English-based theories of attitudes as well as indicative and counterfactual conditionals (e.g. the theories cited above). Some seemingly conflicting claims about English (e.g. Thomason 1984 vs. Kamp and Reyle 1983 on the future *will*) are reconciled as context-dependent special cases of this cross-linguistic proposal. This proposal also explains the widespread use of 'fake past' in remote conditionals, by extending the standard theory of past tense as temporal precedence to a parallel theory of remoteness as attitudinal precedence.

A general point illustrated by this cross-linguistic study is that languages may fundamentally disagree on grammatical means, like Kalaallisut and English on all the major typological traits. Therefore, they may disagree on observations about the syntax-semantics interface, like Kalaallisut and English on all of the Observations 1–6. Such systematic differences may amount to genuinely different grammatical systems for discourse reference to real and hypothetical past, present, and future.

English, with its parallel system of anaphoric tenses and modals, treats time and modality as two essentially independent dimensions. Eventualities are located at a certain time in a certain set of worlds. Accordingly, English-based theories of temporal reference generally treat it as independent of modal reference and vice versa. In contrast, the mood-based system of Kalaallisut is centered around the notion of a *currently verifiable fact* from the perspective of a certain event. That event (e_0) is located in some world at some time and to be currently verifiable from that perspective means to precede that event in *time* in the same *world* ($e <_w e_0 := [\![\vartheta]\!](w)(e) <_\tau [\![\vartheta]\!](w)(e_0)$). In this system it is possible to analyze modal reference independently of temporal reference, as we have done throughout this study. However, the analysis of temporal reference must first of all explicate the relevant perspectival discourse referents. And then it must necessarily build on modal reference to locate the related currently verifiable facts as well as current prospects, i.e. events that may become currently verifiable facts in some modality, viewed from a future perspective point.

Nevertheless, if we take each language at face value and interpret it exactly as is, then we may find that even languages with fundamentally different grammatical systems still agree on semantic universals. For example, even Kalaallisut and English agree on the basic ontology of individuals, times, events, states, and worlds, and on centering-based discourse anaphora across these semantic domains. As a consequence, by different grammatical means, both languages converge on similar truth conditions for discourses about real and hypothetical past, present, and future, which both languages treat as centering-based discourse anaphora to individuals, times, events, states, and worlds.

References

Adams, E. 1970. Subjunctive and indicative conditionals. *Foundations of Language* **6**: 89–94.

Berg, M. van den. 1996. *Some Aspects of the Internal Structure of Discourse: The Dynamics of Nominal Anaphora.* Ph. D. thesis, University of Amsterdam, ILLC.

Bittner, M. 2001. Topical referents for individuals and possibilities. *Proceedings from SALT XI* (R. Hastings *et al*., eds.), pp. 33–55. CLC, Ithaca.
Bittner, M. 2005. Future discourse in a tenseless language. *Journal of Semantics* **22**:339–87.
Bittner, M. 2008. Aspectual universals of temporal anaphora. In: *Theoretical and Cross-linguistic Approaches to the Semantics of Aspect.* (S. Rothstein, ed.), Ch. 11, pp. 349–85. John Benjamins, Amsterdam.
Bittner, M. 2009. Tense, mood, and centering. http://philpapers.org/rec/BITTMC.
Brasoveanu, A. 2007. *Structured Nominal and Modal Reference.* Ph. D. thesis, Rutgers University, New Brunswick NJ.
Chen, Y.-C. and C.-L. Yeh. 2007. Topic identification of Chinese discourse based on centering model. *Journal of Chinese Language and Computing* **17**:83–96.
Condoravdi, C. 2002. Temporal interpretation of modals. In: *The Construction of Meaning* (D. Beaver *et al*., eds.), pp. 59–88. CSLI, Ithaca.
Dekker, P. 1994. Predicate Logic with Anaphora. *Proceedings from SALT* IV (M. Harvey and L. Santelmann, eds.), pp. 79–95. CLC, Ithaca.
Grosz, B., A. Joshi, and S. Weinstein. 1995. Centering: A framework for modelling the local coherence of discourse. *Computational Linguistics* **12**:175–204.
Groenendijk, J. and M. Stokhof. 1982. Semantic analysis of *wh*-complements. *Linguistics and Philosophy* **5**:175–234.
Haiman, J. 1978. Conditionals are topics. *Language* **54**:564–89.
Hale, K. 1976. The adjoined relative clause in Australia. In: *Grammatical Categories in Australian Languages* (R. Dixon, ed.), pp. 78–105. AIAS, Canberra.
Hamblin, C. 1973. Questions in Montague English. *Foundations of Language* **10**:41–53.
Hintikka, J. 1969. Semantics for propositional attitudes. In: *Philosophical Logic* (J. W. Davis *et al.*, eds.), pp. 21–45. D. Reidel, Dordrecht.
Iatridou, S. 2000. The grammatical ingredients of counterfactuality. *Linguistic Inquiry* **31**: 231–70.
Jelinek, E. 1984. Empty categories, case, and configurationality. *Natural Language & Linguistic Theory* **2**:39–76.
Kamp, H. 1979. Events, instants, and temporal reference. In: *Semantics from Different Points of View* (R. Bäuerle *et al.*, eds.), pp. 376–471. de Gruyter, Berlin.
Kamp, H. and U. Reyle. *From Discourse to Logic.* Kluwer, Dordrecht.
Kaplan, D. 1978. On the logic of demonstratives. *Journal of Philosophical Logic* **8**:81-98
Kratzer, A. 1981. The notional category of modality. In: *Words, Worlds, and Contexts* (H.-J. Eijkmeyer and H. Rieser, eds.), pp. 38–74. de Gruyter, Berlin.
Lewis, D. 1973. Counterfactuals and comparative possibility. *Journal of Philosophical Logic* **2**:418–46.
Lewis, D. 1979. Attitudes *de dicto* and *de se*. *The Philosophical Review* **88**:513–43.
Moens, M. and M. Steedman. 1988. Temporal ontology and temporal reference. *Computational Linguistics* **14**:15–28.
Muskens, R. 1995. Tense and the logic of change. In: *Lexical Knowledge in the Organization of Language* (U. Egli *et al.*, eds.), pp. 147–84. Benjamins, Philadelphia.
Muskens, R. 1996. Combining Montague semantics and discourse representation. *Linguistics and Philosophy* **19**:143–186.
Partee, B. 1973. Some structural analogies between tenses and pronouns in English. *Journal of Philosophy* **70**:601–9.

Partee, B. 1984. Nominal and temporal anaphora. *Linguistics and Philosophy* **7**:243–86.
Reichenbach, H. 1947. *Elements of Symbolic Logic.* Macmillan, New York.
Stalnaker, R. 1975. Indicative conditionals. *Philosophia* **5**:269–86.
Stalnaker, R. 1978. Assertion. In: *Syntax and Semantics* 9: *Pragmatics.* (P. Cole, ed.), pp. 315–32. Academic Press, New York.
Steedman, M. 2000. *The Syntactic Process.* MIT Press, Cambridge, MA.
Stone, M. 1997. The anaphoric parallel between modality and tense. Technical Report IRCS 97–6. http://www.cs.rutgers.edu/~mdstone
Stone, M. and D. Hardt. 1999. Dynamic discourse referents for tense and modals. In: *Computing Meaning* (H. Bunt *et al.*, eds.), pp. 301–20. Kluwer, Dordrecht.
Thomason, R. 1984. Combinations of tense and modality. In: *Handbook of Philosophical Logic* (D. Gabbay and F. Guenther, eds.) Vol. 2, pp. 135-66. D. Reidel, Dordrecht.
Veltman, F. 1996. Defaults in update semantics. *Journal of Philosophical Logic* **25**:221-61.
Walker, M., A. Joshi, and E. Prince, eds*.* 1998. *Centering Theory in Discourse.* Clarendon Press, Oxford.
Webber, B. 1988. Tense as discourse anaphor. *Computational Linguistics* **14**:61–73.