Mood-based temporal reference

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Abstract

Last time we introduced the notion of an *illocutionary perspective*. The basic idea is that the very act of speaking up introduces several discourse referents. The speech act itself (e_0) is introduced as the *central perspective point* ($\top\varepsilon$). In addition, all the *speech spheres* (p_0) where this speech act is realized, as well as the *worlds* of each sphere ($w_0 \in p_0$) are introduced as modal topics ($\top\Omega$ and $\top\omega$).

On this view, the *speech time* is the time of the speech act in a given speech sphere (i.e. the time t s.t. $\forall w \in p_0$: $t = \vartheta_w\, e_0$). The speech time is only one of the parameters that are relevant to temporal discourse reference. Other parameters include the *consequent state* of the speech act ($^{\triangleright}e_0$), since speaking has consequences, as well as the world-dependent *culmination point* in worlds where the consequent state culminates ($(^{\blacktriangleleft\triangleright}e_0)_w$). Moreover, if the speaker ($\uparrow e_0$) reports on a prior speech event, or issues a directive, they also include the *source event* ($^{<}e_0$), or the world-dependent event that realizes this *directive* in the compliance worlds ($(^{>}e_0)_w$)

English has a tense-based temporal system, which relates verbal eventualities to the speech time ($\vartheta_{\top\omega}\top\varepsilon$) and/or to other top-ranked times ($\top\tau$, $\bot\tau$, and/or $\vartheta_{\top\omega}\bot\varepsilon$) (Ch. 3 and 5). Mandarin has an aspect-based temporal system, which relates verbal eventualities to the speech event itself ($\top\varepsilon$) and/or to other top-ranked eventualities ($\bot\varepsilon$, $\top\sigma$, $\bot\sigma$). We now extend the story to the mood-based temporal system of Kalaallisut, which relates verbal eventualities to illocutionary perspectives. An event e_1 is *verifiable* in w from the perspective of e_0 iff e_1 is realized in w prior to e_0 (i.e. $\vartheta_w\, e_1 < \vartheta_w\, e_0$, hereafter abbreviated to $e_1 <_w e_0$). This relation crucially depends on the entire illocutionary perspective, which determines both the relevant perspectival event (e_0) and the candidate speech worlds ($w_0 \in p_0$).

To explicate this idea, $UC_{\tau+}$ is combined with $UC_{\omega+}$ into a system dubbed *Update with Centering* (UC, see Appendix). The following examples illustrate verifiability-based temporal reference in Kalaallisut and its representation in UC.

Outline

1. Non-future: Verifiability from speech act
2. Future: Verifiable attitudinal states
3. Reports: Verifiability from other speech acts
4. Quantification: Verifiable habits
5. Toward a CG.UC fragment of Kalaallisut

1 NON-FUTURE: VERIFIABILITY FROM SPEECH ACT

• DISCOURSE-INITIAL DECLARATIVES

(1) *Ole* {*aallar-**pu**-q* | *suli-**pu**-q* | *ulapik-**pu**-q*}.
Ole {leave-$\mathit{DEC}_{\top}$-3SG | work-$\mathit{DEC}_{\top}$-3SG | busy-$\mathit{DEC}_{\top}$-3SG}
Ole {has left | is working | is busy}.

Model for (1) *Discourse-initial* DEC *with ε-anchored* {$\mathsf{v}^{\bullet e}$ | v^{e} | v^{s}}*-base*

⟶ real time

Discourse ref.	*Symbol*: *Description*	*Temporal-modal condition*	*Source*
$^{\top}w_0 \in {}^{\top}p_0$			
●	$^{\top}e_0$: $\uparrow e_0$ speaks to $\downarrow e_0$	$\exists t \forall w \in p_0$: $t = \vartheta_w e_0$	$^{st}e_0$
a. ●	e_1: Ole leaves $\pi_{w0}{}^{\blacktriangleleft}e_1$	$e_0 \subseteq_{w0} {}^{\triangleright}e_1$, $e_1 <_{w0} e_0$	$\mathsf{v}^{\bullet e}_{\varepsilon}$-DEC
b. ●●●●	e_1: Ole works	$e_0 \subseteq_{w0} {}^{\triangledown}e_1$, ${}^{\text{◣}\triangledown}e_1 <_{w0} e_0$	$\mathsf{v}^{e}_{\varepsilon}$-DEC
c. ———	s_1: Ole is busy	$e_0 \subseteq_{w0} s_1$, ${}^{\text{◣}}s_1 <_{w0} e_0$	$\mathsf{v}^{s}_{\varepsilon}$-DEC

(1′) Ole$^{\top}$ [$_{\text{DEC}}$ …
$^{\top}[x|\ x =_i ole]$; $\partial[spk.to_{\top\Omega}\langle \top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle]$; …
a. … leave$^{\bullet e}_{\varepsilon}$]-DEC$_{\top}$-3SG
$[e|\ leave_{\top\omega}\langle e, \top\delta, \pi_{\top\omega}{}^{\blacktriangleleft}e\rangle, \top\varepsilon \sqsubseteq_{\top\omega} {}^{\triangleright}e]$; $[\bot\varepsilon <_{\top\omega} \top\varepsilon]$; $^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}]$
b. … work$^{e}_{\varepsilon}$]-DEC$_{\top}$-3SG
$[e|\ work_{\top\omega}\langle e, \top\delta\rangle, \top\varepsilon \sqsubseteq_{\top\omega} {}^{\triangledown}e]$; $[{}^{\text{◣}\triangledown}\bot\varepsilon <_{\top\omega} \top\varepsilon]$; $^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}]$
c. … busy$^{s}_{\varepsilon}$]-DEC$_{\top}$-3SG
$[s|\ busy_{\top\omega}\langle s, \top\delta\rangle, \top\varepsilon \sqsubseteq_{\top\omega} s]$; $[{}^{\text{◣}}\bot\sigma <_{\top\omega} \top\varepsilon]$; $^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}]$

• TOPIC-SETTING TEMPORAL MODIFIERS

(2) *Ole* {*ippassaq* |****aqagu***} {*aallar-**pu**-q* | *suli-**pu**-q* | *ulapik-**pu**-q*}.
Ole {yesterday |**tomorr.*} {lv-$\mathit{DEC}_{\top}$-3SG | work-$\mathit{DEC}_{\top}$-3SG| busy-$\mathit{DEC}_{\top}$-3SG}
Ole {left | worked | was busy} {yesterday | *tomorrow}.

(2′) Ole$^{\top}$ [$_{\text{DEC}}$ yesterday$^{\top}$ …
$^{\top}[x|\ x =_i ole]$; $\partial[spk.to_{\top\Omega}\langle \top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle]$; $((([t|\ t =_i day.bfr\langle \vartheta_{\top\omega}\top\varepsilon\rangle]$;
$^{\top}[s|\ \uparrow s =_i \top\delta, s \sqsubseteq_{\top\omega} \bot\tau])\ ^{\top}$; …
a. … leave$^{\bullet e}_{\sigma}$]-DEC$_{\top}$-3SG
$[e|\ leave_{\top\omega}\langle e, \top\delta, \pi_{\top\omega}{}^{\blacktriangleleft}e\rangle, e \sqsubseteq_{\top\omega} \top\sigma])$; $[\bot\varepsilon <_{\top\omega} \top\varepsilon]$; $^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}]$
b. … work$^{e}_{\sigma}$]-DEC$_{\top}$-3SG
$[e|\ work_{\top\omega}\langle e, \top\delta\rangle, {}^{\triangledown}e \sqsubseteq_i \top\sigma])$; $[{}^{\text{◣}\triangledown}\bot\varepsilon <_{\top\omega} \top\varepsilon]$; $^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}]$
c. … busy$^{s}_{\sigma}$]-DEC$_{\top}$-3SG
$[s|\ busy_{\top\omega}\langle s, \top\delta\rangle, s \sqsubseteq_i \top\sigma])$; $[{}^{\text{◣}}\bot\sigma <_{\top\omega} \top\varepsilon]$; $^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}]$

• DISCOURSE ABOUT VERIFIABLE FACTS

(3) i. *Meeqqat ullumi sukkanniupput.*
miiraq-t ***ullumi*** *sukkanniut-**pu**-t*
kid-PL *today* race.e.o.-*DEC*$_{\top}$-3PL
The kids had a dogsled race today.

ii. *Ole ajugaagami nuannaarpoq.*
*Ole ajugaa-**ga**-mi nuannaar-**pu**-q*
Ole win-*FCT*$_{\top}$-3SG$_{\top}$ happy-*DEC*$_{\top}$-3SG
Ole$^{\top}$ won, so he$_{\top}$ was happy.

Model for (3i–ii) *Topic-setting* today (i), *or* FCT (ii), *with comment by* v$_{\sigma}$-DEC

————————➤ real time

Discourse ref.	*Symbol: Description*	*Temporal-modal condition*	*Source*
$^{\top}w_0 \in {}^{\top}p'_0 \subseteq p_0$			
●	$^{\top}e_0$: $\uparrow e_0$ speaks to $\downarrow e_0$	$\exists t \forall w \in p_0$: $t = \vartheta_w\, e_0$	$^{st}e_0$
■■■■■■■■■	t_1: e_0-day	$e_0 \subseteq_{w0} t_1$	today
——	$^{\top}s_1$: kids x_1 during t_1	$s_1 \subseteq_{w0} t_1$	today
●●	e_1: kids x_1 race against e.o.	$^{\triangledown}e_1 \sqsubseteq_{\sigma} s_1$, $^{\blacktriangleright\triangledown}e_1 <_{w0} e_0$	v^{e}_{σ}-DEC

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$w_2 \in r$			
●	e_2: Ole wins s_1-race	$e_2 =_{w2} (^{\blacktriangleleft}s_1)_{w2}$, $e_2 <_{w2} e_0$	$v^{\bullet e}$-FCT

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$^{\top}w_0 \in {}^{\top}p''_0 \subseteq p'_0 \subseteq r$			
●	e_2: Ole wins s_1-race	$e_2 =_{w0} (^{\blacktriangleleft}s_1)_{w0}$, $e_2 <_{w0} e_0$	$v^{\bullet e}$-FCT
————	$^{\top}s_2$: Ole fr. e_2 till $(^{\blacktriangleleft\triangleright}e_2)_{w0}$	$s_2 = (^{\bigcirc}e_2)_{w0}$	FCT
—(—)	s'_2: Ole is happy $s'_2 \sqsubseteq_{\sigma} s_2$,	$^{\blacktriangleright}s'_2 <_{w0} e_0$	v^{s}_{σ}-DEC

(3′) i. kid-pl$^{\top}$ [$_{\text{DEC}}$ today$^{\top}$ …
$^{\top}[x|\ ^{\mathcal{A}}x \subseteq_i kid_{\top\omega}, \mathbf{2}^{+}\langle^{\mathcal{A}}x\rangle]; \partial[spk.to_{\top\Omega}\langle\top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle]; ((([t|\ day\langle t\rangle,$
$\top\varepsilon \sqsubseteq_{\top\omega} t]; {}^{\top}[s|\ \uparrow s =_i \top\delta, s \sqsubseteq_{\top\omega} \perp\tau])\ {}^{\top}; \ldots$
… race.e.o.$^{e}_{\sigma}$]-DEC$_{\top}$-3PL
$[e|\ race.e.o._{\top\omega}\langle e, \top\delta\rangle, {}^{\triangledown}e \sqsubseteq_i \top\sigma]; [^{\blacktriangleright\triangledown}\perp\varepsilon <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}]$

ii. Ole$^{\top}$ [$_{\text{DEC}}$ win$^{\bullet e}$-FCT$_{\top}$-3SG$_{\top}$ …
$^{\top}[x|\ x =_i ole]; \partial[spk.to_{\top\Omega}\langle\top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle]; ((([e\ w|\ win_w\langle e, \top\delta\rangle, e =_w (^{\blacktriangleleft}\top\sigma)_w,$
$e <_w \top\varepsilon]; [\perp\varepsilon =_I \boldsymbol{max}\{\perp\varepsilon\|_{\perp\omega, \top\sigma}\}]; [\top\Omega \subseteq_I \perp\omega\|_{\top\sigma}]; {}^{\top}[s|\ s =_i (^{\bigcirc}\perp\varepsilon)_{\top\omega}])\ {}^{\top};$
… happy$^{s}_{\sigma}$]-DEC$_{\top}$-3SG
$[s|\ happy_{\top\omega}\langle s, \top\delta\rangle, s \sqsubseteq_i \top\sigma])); [^{\blacktriangleright}\perp\sigma <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}]$

2 FUTURE: VERIFIABLE ATTITUDINAL STATES

• REAL STATE OF INTENT & RELATED STATE OF EXPECTATION

(4) i. *Meeqqat aqagu sukkanniuniarput.*
miiraq-t ***aqagu*** *sukkanniut-*(**niar**)-pu-t*
kid-PL *tomorrow* race.e.o.-$intend^{s}_{\varepsilon}$-$DEC_{\top}$-3PL
The kids are going to have a dogsled race tomorrow.

ii. *Ole nuannaassaaq.*
*Ole nuannaar-**ssa**-pu-q*
Ole happy-*expect(ed)* $^{s}_{\varepsilon}$-$\text{DEC}_{\top}$-3SG
$\text{Ole}^{\top}$ will be happy.

Model for (4i–ii) *Topic-setting* tomorrow (i) *with comment by* v_{σ}-att^{s}

Discourse ref.	*Symbol: Description*	*Temp.-modal condition*	*Source*
$^{\top}w_0 \in {}^{\top}p''_0 \subseteq p'_0 \subseteq p_0$			
●	$^{\top}e_0$: $\uparrow e_0$ speaks to $\downarrow e_0$	$\exists t \forall w \in p_0$: $t = \vartheta_w\, e_0$	$^{st}e_0$
■■■■■	t_1: e_0-tomorrow	$t_1 = [\![day.aft]\!](\vartheta_{w0}\, e_0)$	tomorrow
———	s'_1: kids x_1 (= $\uparrow s'_1$) intend q	$e_0 \sqsubseteq_{w0} s'_1$, $\text{◣}s'_1 <_{w0} e_0$	int^{s}_{ε}-DEC
—————	s'_2: of p'_0, $\uparrow s'_2$ expects q′	$e_0 \sqsubseteq_{w0} s'_2$, $\text{◣}s'_2 <_{w0} e_0$	exp^{s}_{ε}-DEC
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$w_1 \in q = \text{OPT}(p_0, [\![int]\!](w_0, s'_1, x_1))$			
———	$^{\top}s_1$: kids x_1 during t_1	$s_1 \sqsubseteq_{w1} t_1$	tomorrow
●●	e_1: $\uparrow s'_1$ race e.o.	$^{\triangledown}e_1 \sqsubseteq_{\sigma} s_1$, $\blacktriangle e_1 = (\text{◢}s'_1)_{w1}$	v^{e}_{σ}-int^{s}
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$w_1 \in q' = \text{OPT}(p'_0, [\![exp]\!](w_0, s'_2, \uparrow s'_2))$			
——	s_2: Ole is happy	$s_2 \sqsubseteq_{\sigma} s_1$, $\text{◣}s_2 =_{w1} (\text{◢}s'_2)_{w1}$	v^{s}_{σ}-exp^{s}

(4′) i. kid-PL $[_{\text{DEC}}$ $[_{\text{-int}}$ tomorrow …
$^{\top}[x|\ ^{\mathcal{A}}x \subseteq_i kid_{\top\omega}, \mathbf{2}^{+}\langle ^{\mathcal{A}}x\rangle]; \partial[spk.to_{\top\Omega}\langle \top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle]; ([w]; (([t|\ t =_i day.aft\langle \vartheta_{\top\omega}\top\varepsilon\rangle]; {}^{\top}[s|\ \uparrow s =_i \top\delta, s \sqsubseteq_{\perp\omega} \perp\tau])\ ^{\top}; \ldots$
… race.e.o.$^{e}_{\sigma}$]-intend$^{s}_{\varepsilon}$]-$\text{DEC}_{\top}$-3PL
$[e|\ race.e.o_{\perp\omega}\langle e, \uparrow e\rangle, {}^{\triangledown}e \sqsubseteq_i \top\sigma]); [s|\ \blacktriangle\perp\varepsilon =_i (\text{◢}s)_{\perp\omega}]; [\text{OPT}\langle \top\Omega, int_{\top\omega} \perp\sigma\rangle \subseteq_I \perp\omega||_{\perp\sigma}]; [\uparrow\perp\sigma =_i \top\delta, \top\varepsilon \sqsubseteq_{\top\omega} \perp\sigma]); [\text{◣}\perp\sigma <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p =_I \top\omega||_{\top\Omega}]$

ii. $\text{Ole}^{\top}$ $[_{\text{DEC}}$ …
$^{\top}[x|\ x =_i ole]; \partial[spk.to_{\top\Omega}\langle \top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle]; \ldots$
… happy$^{s}_{\sigma}$-*expect(ed)*$^{s}_{\varepsilon}$]-$\text{DEC}_{\top}$-3SG
$[s|\ happy_{\perp\omega}\langle s, \top\delta\rangle, s \sqsubseteq_i \top\sigma]; [s|\ \text{◣}\perp\sigma =_{\perp\omega} (\text{◢}s)_{\perp\omega}]; [\text{OPT}\langle \top\Omega, exp_{\top\omega} \perp\sigma\rangle \subseteq_I \perp\omega||_{\perp\sigma}]; [\top\varepsilon \sqsubseteq_{\top\omega} \perp\sigma])); [\text{◣}\perp\sigma <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p =_I \top\omega||_{\top\Omega}]$

• REAL STATE OF INTENT & CONDITIONAL STATE OF EXPECTATION

(5) i. The kids are going to have a dogsled race tomorrow. (= (4i))

ii. *Ole ajugaa-**gu**-ni nuannaar-*(**ssa**)-pu-q*

Ole win-*HYP*$_\top$-3SG$_\top$ happy-*expect(ed)*$^s_\varepsilon$-DEC$_\top$-3SG

Ole$^\top$ will be happy.

Model for (5i–ii) *Topic-setting* tomorrow (i), *or* HYP (ii), *with comment by* v_σ-att^s

Discourse ref.	*Symbol: Description*	*Temp.-modal condition*	*Source*
$^\top w_0 \in {}^\top p''_0 \subseteq p'_0 \subseteq p_0$			
●	$^\top e_0$: $\uparrow e_0$ speaks to $\downarrow e_0$	$\exists t \forall w \in p_0$: $t = \vartheta_w\, e_0$	$^{st}e_0$
■■■■■	t_1: e_0-tomorrow	$t_1 = [\![day.aft]\!](\vartheta_{w0}\, e_0)$	tomorrow
———	s'_1: kids x_1 (= $\uparrow s'_1$) intend q	$e_0 \sqsubseteq_{w0} s'_1$, $^{◣}s'_1 <_{w0} e_0$	int$^s_\varepsilon$-DEC
—————	s''_2: of r_2, $\uparrow s''_2$ expects q′	$e_0 \sqsubseteq_{w0} s''_2$, $^{◣}s''_2 <_{w0} e_0$	exp$^s_\varepsilon$-DEC

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$w_1 \in q = \mathrm{OPT}(p_0, [\![int]\!](w_0, s'_1, x_1))$			
——	$^\top s_1$: kids x_1 during t_1	$s_1 \sqsubseteq_{w1} t_1$	tomorrow
●●	e_1: $\uparrow s'_1$ race e.o.	$^{\triangledown}e_1 \sqsubseteq_\sigma s_1$, $^{▲}e_1 = ({}^{◢}s'_1)_{w1}$	v$^e_\sigma$-int^s

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$w_1 \in {}^\top r_2 \subseteq p'_0 \cap q$			
●	e_2: Ole wins s_1-race	$e_2 =_{w1} ({}^{◢}s_1)_{w1}$, $e_1 <_{w1} e_2$	v$^{\bullet e}$-HYP
———	$^\top s_2$: O. from e_2 till $({}^{◢\triangleright}e_2)_{w1}$	$s_2 = ({}^{\circ}e_2)_{w1}$	HYP

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$w_1 \in q' = \mathrm{OPT}(r_2, [\![exp]\!](w_0, s''_2, \uparrow s''_2))$			
——	s'_2: Ole is happy	$s'_2 \sqsubseteq_\sigma s_2$, $^{◣}s'_2 =_{w1} ({}^{◢}s''_2)_{w1}$	v$^s_\sigma$-exp^s

(5′) i. kid-PL [$_{\text{DEC}}$ [$_{\text{-int}}$ tomorrow …

$^\top[x|\ {}^{\mathcal{A}}x \subseteq_i kid_{\top\omega}, \mathbf{2}^+\langle{}^{\mathcal{A}}x\rangle]$; $\partial[spk.to_{\top\Omega}\langle\top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle]$; $([w]$; $(([t|\ t =_i$ $day.aft\langle\vartheta_{\top\omega}\top\varepsilon\rangle]$; $^\top[s|\ \uparrow s =_i \top\delta, s \sqsubseteq_{\bot\omega} \bot\tau])\ ^\top$; …

… race.e.o.$^e_\sigma$]-intend$^s_\varepsilon$]-DEC$_\top$-3PL

$[e|\ race.e.o_{\bot\omega}\langle e, \uparrow e\rangle, {}^{\triangledown}e \sqsubseteq_i \top\sigma])$; $[s|\ {}^{▲}\bot\varepsilon =_i ({}^{◢}s)_{\bot\omega}]$; $[\mathrm{OPT}\langle\top\Omega, int_{\top\omega} \bot\sigma\rangle$ $\subseteq_I \bot\omega\|_{\bot\sigma}]$; $[\uparrow\bot\sigma =_i \top\delta, \top\varepsilon \sqsubseteq_{\top\omega} \bot\sigma])$; $[{}^{◣}\bot\sigma <_{\top\omega} \top\varepsilon]$; $^\top[p|\ p =_I \top\omega\|_{\top\Omega}]$

ii. Ole$^\top$ [$_{\text{DEC}}$ win$^{\bullet e}$-HYP$_\top$-3SG$_\top$ …

$^\top[x|\ x =_i ole]$; $\partial[spk.to_{\top\Omega}\langle\top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle]$; $(([e|\ win_{\bot\omega}\langle e, \top\delta\rangle, e =_{\bot\omega}$ $({}^{◢}\top\sigma)_{\bot\omega}, \bot\varepsilon <_{\bot\omega} e]$; $[\bot\varepsilon =_I \boldsymbol{max}\{\bot\varepsilon\|_{\bot\omega, \top\sigma}\}]$; $^\top[s|\ s =_i ({}^{\circ}\bot\varepsilon)_{\bot\omega}]$; $[\bot\omega \in_I \top\omega\|_{\top\Omega}]$; $^\top[p|\ p =_I \bot\omega\|_{\top\sigma}])\ ^\top$; …

… happy$^s_\sigma$-*expect(ed)*$^s_\varepsilon$]-DEC$_\top$-3SG

$[s|\ happy_{\bot\omega}\langle s, \top\delta\rangle, s \sqsubseteq_i \top\sigma]$; $[s|\ {}^{◣}\bot\sigma =_{\bot\omega} ({}^{◢}s)_{\bot\omega}]$; $[\mathrm{OPT}\langle\top\Omega, exp_{\top\omega} \bot\sigma\rangle$ $\subseteq_I \bot\omega\|_{\bot\sigma}]$; $[\top\varepsilon \sqsubseteq_{\top\omega} \bot\sigma]))$; $[{}^{◣}\bot\sigma <_{\top\omega} \top\varepsilon]$; $^\top[p|\ p =_I \top\omega\|_{\top\Omega}]$
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3 REPORTS: VERIFIABILITY FROM OTHER SPEECH ACTS

(6) *Ole* {a. *aallar-**nirar**-pu-q* | b. *suli-**nirar**-pu-q* | c. *ulapik-**nirar**-pu-q*}
Ole { leave-*say*-DEC$_{\top}$-3SG| work-*say*-DEC$_{\top}$-3SG| busy-*say*-DEC$_{\top}$-3SG}
Ole$^{\top}$ said: "I {a. have left | b. am working | c. am busy}."

Model for (6) *Topic-setting* Ole *with comment by* {a. $v^{\bullet e}$ | b. v^{e} | c. v^{s}}-say$^{\bullet e}$

<u>*Discourse ref.*</u>	<u>*Symbol*: *Description*</u>	<u>*Temporal-modal cond.*</u>	<u>*Source*</u>
$^{\top}w_0 \in {}^{\top}p'_0 \subseteq p_0$			
●	$^{\top}e_0$: $\uparrow e_0$ speaks to $\downarrow e_0$	$\exists t \forall w \in p_0$: $t = \vartheta_w\, e_0$	$^{st}e_0$
●	e'_1: Ole (= $\uparrow e'_1$) says q_1	$e'_1 <_{w0} e_0$	-say$^{\bullet e}$-DEC

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$w_1 \in q_1$			
a. ●	e_1: $\uparrow e'_1$ leaves $\pi_{w1}{}^{◀}e_1$		$v^{\bullet e}$-
●	e'_1: $\uparrow e'_1$ speaks to $\downarrow e'_1$	$e_1 <_{w1} e'_1 \subseteq_{w1} {}^{\triangleright}e_1$	-say$^{\bullet e}$
b. ●●●	e_1: $\uparrow e'_1$ is working		v^{e}-
●	e'_1: $\uparrow e'_1$ speaks to $\downarrow e'_1$	$e_1 <_{w1} e'_1 \subseteq_{w1} {}^{\triangledown}e_1$	-say$^{\bullet e}$
c. ——	s_1: $\uparrow e'_1$ is busy		v^{s}-
●	e'_1: $\uparrow e'_1$ speaks to $\downarrow e'_1$	$e_1 <_{w1} e'_1 \subseteq_{w1} s_1$	-say$^{\bullet e}$

(6′) Ole [$_{\text{DEC}}$ [$_{\text{-say}}$ …
$^{\top}[x|\ x =_i ole]; \partial[spk.to_{\top\Omega}\langle \top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle]; [w]^{\perp}; \ldots$

a. …leave$^{\bullet e}$]-say$^{\bullet e}{}_{\varepsilon}$]-DEC$_{\top}$-3SG
$([e|\ leave_{\perp\omega}\langle e, \uparrow e, \pi_{\perp\omega}{}^{◀}e\rangle]; [e\ p|\ \perp\varepsilon <_{\perp\omega} e \sqsubseteq_{\perp\omega}{}^{\triangleright} \perp\varepsilon, spk.to_p\langle e, \uparrow\perp\varepsilon, \downarrow e\rangle];$
$[\perp\Omega \subseteq_I \perp\omega||_{\perp\varepsilon}]; [say_{\top\omega}\langle \perp\varepsilon, \top\delta, \perp\Omega\rangle]); [\perp\varepsilon <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p =_I \top\omega||_{\top\Omega}]$

b. …work^{e}]-say$^{\bullet e}{}_{\varepsilon}$]-DEC$_{\top}$-3SG
$[e|\ work_{\perp\omega}\langle e, \uparrow e\rangle]; [e\ p|\ {}^{◣\triangledown}\perp\varepsilon <_{\perp\omega} e \sqsubseteq_{\perp\omega}{}^{\triangledown} \perp\varepsilon, spk.to_p\langle e, \uparrow\perp\varepsilon, \downarrow e\rangle];$
$[\perp\Omega \subseteq_I \perp\omega||_{\perp\varepsilon}]; [say_{\top\omega}\langle \perp\varepsilon, \top\delta, \perp\Omega\rangle]); [\perp\varepsilon <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p =_I \top\omega||_{\top\Omega}]$

c. …busy^{s}]-say$^{\bullet e}{}_{\varepsilon}$]-DEC$_{\top}$-3SG
$[s|\ busy_{\perp\omega}\langle s, \uparrow s\rangle]; [e\ p|\ {}^{◣}\perp\sigma <_{\perp\omega} e \sqsubseteq_{\perp\omega} \perp\sigma, spk.to_p\langle e, \uparrow\perp\sigma, \downarrow e\rangle];$
$[\perp\Omega \subseteq_I \perp\omega||_{\perp\varepsilon}]; [say_{\top\omega}\langle \perp\varepsilon, \top\delta, \perp\Omega\rangle]); [\perp\varepsilon <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p =_I \top\omega||_{\top\Omega}]$

(7) *Ole* {*ippassaq* |* ***aqagu***} {*aallar-*| *suli-* | *ulapik-*}-***nirar**-pu-q.*
Ole {yesterday |**tomorrow*} {leave- | work- | busy-}-*say*-DEC$_{\top}$-3SG
A. Ole said: "I {left | worked | 've been busy} {yesterday | *tomorrow}".
B. Ole said {yesterday | *tomorrow}: "I {left | am working | am busy}".
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Model for (7_A) *Topic-setting* yesterday *with comment by* v_σ-say$^{\bullet e}$

Discourse ref.	*Symbol: Description*	*Temporal-modal cond.*	*Source*
${}^\top w_0 \in {}^\top p'_0 \subseteq p_0$			
●	${}^\top e_0$: $\uparrow e_0$ speaks to $\downarrow e_0$	$\exists t \forall w \in p_0$: $t = \vartheta_w\, e_0$	${}^{st}e_0$
■■■■	t_1: e_0-yesterday	$t_1 = [\![day.bfr]\!](\vartheta_{w0}\, e_0)$	yesterday
●	e'_1: Ole (= $\uparrow e'_1$) says q_1	$e'_1 <_{w0} e_0$	-say$^{\bullet e}$-DEC

~~~~~~

$w_1 \in q_1$			
——	${}^\top s_1$: Ole during t_1	$s_1 \subseteq_{w1} t_1$	yesterday
●	e_1: $\uparrow e'_1$ leaves $\pi_{w1}{}^{\blacktriangleleft}e_1$	$e_1 \subseteq_{w1} s_1$	$v^{\bullet e}_\sigma$-
●	e'_1: $\uparrow e'_1$ speaks to $\downarrow e'_1$	$e_1 <_{w1} e'_1 \subseteq_{w1}{}^{\triangleright} e_1$	-say$^{\bullet e}$

($7_A{}'$) Ole [$_{DEC}$ [$_{-say}$ yesterday…

$${}^\top[x|\ x =_i ole];\ \partial[spk.to_{\top\Omega}\langle \top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle];\ [w]^{\perp};\ (([t|\ t =_i day.bfr\langle \vartheta_{\top\omega}\top\varepsilon\rangle];$$
$${}^\top[s|\ \uparrow s =_i \top\delta,\ s \sqsubseteq_{\perp\omega} \perp\tau])^{\top};\ \ldots$$

… leave$^{\bullet e}_\sigma$]-say$^{\bullet e}_\varepsilon$]-DEC$_\top$-3SG

$$[e|\ lv_{\perp\omega}\langle e, \uparrow e, \pi_{\perp\omega}{}^{\blacktriangleleft}e\rangle,\ e \sqsubseteq_{\perp\omega} \top\sigma]);\ [e\ p|\ \perp\varepsilon <_{\perp\omega} e \sqsubseteq_{\perp\omega}{}^{\triangleright} \perp\varepsilon,\ spk.to_p\langle e, \uparrow\perp\varepsilon, \downarrow e\rangle$$
$$];\ [\perp\Omega \subseteq_I \perp\omega\|_{\perp\varepsilon}];\ [say_{\top\omega}\langle \perp\varepsilon, \top\delta, \perp\Omega\rangle]);[\perp\varepsilon <_{\top\omega} \top\varepsilon];\ {}^\top[p|\ p =_I \top\omega\|_{\top\Omega}]$$

Model for (7_B) *Topic-setting* yesterday *with comment by* v_σ-say$^{\bullet e}$

Discourse ref.	*Symbol: Description*	*Temporal-modal condition*	*Source*
${}^\top w_0 \in {}^\top p'_0 \subseteq p_0$			
●	${}^\top e_0$: $\uparrow e_0$ speaks to $\downarrow e_0$	$\exists t \forall w \in p_0$: $t = \vartheta_w\, e_0$	${}^{st}e_0$
■■■■■	t_1: e_0-yesterday	$t_1 = [\![day.bfr]\!](\vartheta_{w0}\, e_0)$	yesterday
——	${}^\top s_1$: Ole during t_1	$s_1 \subseteq_{w0} t_1$	yesterday
●	e'_1: Ole (= $\uparrow e'_1$) says q_1	$e'_1 \subseteq_{w0} s_1$, $e'_1 <_{w0} e_0$	-say$^{\bullet e}_\sigma$-DEC

~~~~~~

$w_1 \in q_1$			
●	e_1: $\uparrow e'_1$ leaves $\pi_{w1}{}^{\blacktriangleleft}e_1$		$v^{\bullet e}$-
●	e'_1: $\uparrow e'_1$ speaks to $\downarrow e'_1$	$e_1 <_{w1} e'_1 \subseteq_{w1}{}^{\triangleright} e_1$	-say$^{\bullet e}$

($7_B{}'$) Ole [$_{DEC}$ yesterday [$_{-say}$ …

$${}^\top[x|\ x =_i ole];\ \partial[spk.to_{\top\Omega}\langle \top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle];\ (([t|\ t =_i day.bfr\langle \vartheta_{\top\omega}\top\varepsilon\rangle];$$
$${}^\top[s|\ \uparrow s =_i \top\delta,\ s \sqsubseteq_{\top\omega} \perp\tau])^{\top};\ ([w]^{\perp};\ \ldots$$

… [leave$^{\bullet e}$]-say$^{\bullet e}_\sigma$]-DEC$_\top$-3SG

$$[e|\ lv_{\perp\omega}\langle e, \uparrow e, \pi_{\perp\omega}{}^{\blacktriangleleft}e\rangle];\ [e\ p|\ \perp\varepsilon <_{\perp\omega} e \sqsubseteq_{\perp\omega}{}^{\triangleright} \perp\varepsilon,\ spk.to_p\langle e, \uparrow\perp\varepsilon, \downarrow e\rangle];\ [\perp\Omega \subseteq_I$$
$$\perp\omega\|_{\perp\varepsilon}];\ [say_{\top\omega}\langle \perp\varepsilon, \top\delta, \perp\Omega\rangle,\ \perp\varepsilon \sqsubseteq_{\top\omega} \top\sigma]);\ [\perp\varepsilon <_{\top\omega} \top\varepsilon];\ {}^\top[p|\ p =_I \top\omega\|_{\top\Omega}]$$

(8) i. *Aanip meeqqat aqagu sukkanniunniarnerarpai.*
*Aani-p miiraq-t aqagu sukkanniut-niar-**nirar**-pa-i.*
Ann-ERG kid-PL tomorrow race.e.o-intend-*say*-DEC$_{\top\bot}$-3SG.3PL
Ann$^{\top}$ said the kids$^{\bot}$ were going to have a dogsled race tomorrow.

ii. *Olegooq ajugaaguni nuannaassaaq.*
*Ole=**guuq** ajugaa-gu-ni nuannaar-ssa-**pu**-q.*
Ole=*RPT* win-HYP$_{\top}$-3SG$_{\top}$ happy-expect(ed)-*DEC*$_{\top}$-3SG
If Ole$^{\top}$ wins, [she] said, he$_{\top}$'ll be happy.

(8′) i. Ann-ERG$^{\top}$ kid-PL$^{\bot}$ [$_{\text{DEC}}$ [$_{\text{-say}}$ [$_{\text{-int}}$ tomorrow …
$^{\top}[x|\ x =_i ann]; [x|\ {}^{\mathcal{A}}x \subseteq_i kid_{\top\omega}, \mathbf{2}^{+}\langle {}^{\mathcal{A}}x\rangle];\ \partial[spk.to_{\top\Omega}\langle \top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle];$
$(([w]; (([t|\ t =_i day.aft\langle \vartheta_{\top\omega}\top\varepsilon\rangle];\ {}^{\top}[s|\ \uparrow s =_i \bot\delta, s \sqsubseteq_{\bot\omega} \bot\tau])\ {}^{\top}; \ldots$

… race.e.o.$^{e}{}_{\sigma}$]-intend^{s}]-say$^{\bullet e}$]-DEC$_{\top}$-3PL
$[e|\ race.e.o_{\bot\omega}\langle e,\uparrow e\rangle,\ {}^{\triangledown}e \sqsubseteq_i \top\sigma]);[s|\ {}^{\blacktriangle}\bot\varepsilon =_i (\text{◢}s)_{\bot\omega}];[w|\ \text{OPT}\langle \top\Omega, int_w \bot\sigma\rangle$
$\subseteq_I \bot\omega||_{\bot\sigma}]); [e\ p|\ \uparrow\bot\sigma =_i \bot\delta,\ \text{◣}\bot\sigma <_{\bot\omega} e \sqsubseteq_{\bot\omega} \bot\sigma, spk.to_p\langle e,\uparrow e,\downarrow e\rangle]; [\bot\Omega$
$\subseteq_I \bot\omega||_{\bot\varepsilon,\bot\delta}]; [say_{\top\omega}\langle \bot\varepsilon, \top\delta, \bot\Omega\rangle]); [\bot\varepsilon <_{\top\omega} \top\varepsilon];\ {}^{\top}[p|\ p =_I \top\omega||_{\top\Omega}]$

ii. Ole$^{\top}$=RPT$_{\bot}{}^{\top}$ [$_{\text{DEC}}$ …
$^{\top}[x|\ x =_i ole]; \partial[spk.to_{\top\Omega}\langle \bot\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle];\ {}^{\top}[p|\ spk.to_p\langle {}^{<}\top\varepsilon, \uparrow{}^{<}\top\varepsilon, \downarrow{}^{<}\top\varepsilon\rangle,$
${}^{<}\top\varepsilon =_i \bot\varepsilon, p \subseteq_i \bot\Omega];\ {}^{\top}[w|\ w \in_i \top\Omega]\ {}^{\top}; (\partial[spk.to_{\top\Omega}\langle {}^{<}\top\varepsilon, \uparrow{}^{<}\top\varepsilon, \downarrow{}^{<}\top\varepsilon\rangle];$

… win$^{\bullet e}$-HYP$_{\top}$-3SG$_{\top}$ …
$(([e|\ win_{\bot\omega}\langle e, \top\delta\rangle, e =_{\bot\omega} (\text{◢}\top\sigma)_{\bot\omega}, \top\varepsilon <_{\bot\omega} e]; [\bot\varepsilon =_I \mathbf{max}\{\bot\varepsilon||_{\bot\omega,\top\sigma}\}];$
$[t|\ t =_{\bot\omega} ({}^{\circ}\bot\varepsilon)_{\bot\omega}]; [\bot\omega \in_I \top\omega||_{\top\Omega}];\ {}^{\top}[p|\ p =_I \bot\omega||_{\bot\tau}])\ {}^{\top}; \ldots$

… happy$^{s}{}_{\tau}$-expect(ed)$^{s}{}_{\varepsilon}$]-DEC$_{\top}$-3SG]$_{\text{RPT}}$
$([s|\ hpp_{\bot\omega}\langle e,\top\delta\rangle, \text{◣}\bot\sigma \sqsubseteq_{\bot\omega}\bot\tau]; [s|\ \text{◣}\bot\sigma =_{\bot\omega} (\text{◢}s)_{\bot\omega}];[\text{OPT}\langle\top\Omega, exp_{\top\omega}\bot\sigma\rangle$
$\subseteq_I \bot\omega||_{\bot\sigma}]; [\top\varepsilon \sqsubseteq_{\top\omega} \bot\sigma])); [\text{◣}\bot\sigma <_{\top\omega} {}^{<}\top\varepsilon];\ {}^{\top}[p|\ p =_I \top\omega||_{\top\Omega}])$

4 QUANTIFICATION: VERIFIABLE HABITS

Figure 1 Temporal-modal relations to habits

$\text{◣}A_{at} <_w B \ := \ \exists u_a(u \in A \wedge u <_w B)$

$B \sqsubseteq_w A_{at} \ := \ \exists u_a \exists u'_a(u \in A \wedge u' \in A \wedge u <_w B <_w u')$

(9) *Ole ullumikkut {aallartarpoq | sulisarpoq | ulapittarpoq}*
*Ole ullumi-**kut** {aallar-*(**tar**)-pu-q | suli-*(**tar**)-pu-q | ulapik-*(**tar**)-pu-q}.*
Ole today-VIA {lv-*(habit)-DEC$_{\top}$-3SG| work-*(hab.)-... | busy-*(hab.)-...}
Ole {goes away | works | is busy} these days.

Model for (9) *Topic-setting* today-VIA *with comment by* $\{v^{\bullet e} \mid v^{e} \mid v^{s}\}_{\sigma}$-habit-

Discourse ref.	*Symbol*: *Description*	*Temporal-modal condition*	*Source*
$^{\top}w_0 \in {}^{\top}p'_0 \subseteq {}^{\top}p_0$			
●	$^{\top}e_0$: $\uparrow e_0$ speaks to $\downarrow e_0$	$\exists t \forall w \in p_0: t = \vartheta_w\, e_0$	$^{st}e_0$
… ■■■ …	t_n: day within $^{\odot}e_0$	$t_n \subseteq_{w0} {}^{\odot}e_0$	today-VIA
——	$^{\top}s_n$: Ole during day t_n	$s_n =_{w0} t_n$	VIA
	$^{\top}S_1 = \{s_1, s_2, \ldots\}$	$e_0 \subseteq_{w0} S_1$	VIA
	$\forall s_n \in S_1$: (a) | (b) | (c)		VIA…-habit
a. … ● …	e_n: Ole leaves $\pi_{w0}{}^{\blacktriangleleft}e_n$	$e_n \subseteq_{w0} s_n$	$v^{e\bullet}_{\sigma}$
	$E_1 = \{e_1, e_2, \ldots\}$	$^{\text{◣}}E_1 <_{w0} e_0$	$v^{\bullet e}_{\sigma}$-habit-DEC
b. … ●● …	e_n: Ole works	$^{\triangledown}e_n \sqsubseteq_{\sigma} s_n$	v^{e}_{σ}
	$E_1 = \{e_1, e_2, \ldots\}$	$^{\text{◣}}E_1 <_{w0} e_0$	v^{e}_{σ}-habit-DEC
c. … — …	s'_n: Ole is busy	$s'_n \sqsubseteq_{\sigma} s_n$	v^{s}_{σ}
	$S'_1 = \{s'_1, s'_2, \ldots\}$	$^{\text{◣}}S'_1 <_{w0} e_0$	v^{s}_{σ}-habit-DEC

(9′) Ole [$_{\text{DEC}}$ today-VIA…
$^{\top}[x|\ x =_i ole]$; $\partial[spk.to_{\top\Omega}\langle\top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle]$; $[t|\ day\langle t\rangle, t \sqsubseteq_{\top\omega} {}^{\odot}\top\varepsilon]$;
$({}^{\top}[s|\ \uparrow s =_i \top\delta, s =_{\top\omega} \bot\tau]^{\top}$; $({}^{\top}[S|\ S =_I \top\sigma\|_{\top\omega}]$; $[\top\varepsilon \sqsubseteq_{\top\omega} \top\sigma t]^{\top}$; …

a. … leave$^{\bullet e}_{\sigma}$-habit]-DEC$_{\top}$-3SG
$([e|\ lv_{\top\omega}\langle e, \top\delta, \pi_{\top\omega}{}^{\blacktriangleleft}e\rangle, e \sqsubseteq_{\top\omega} \top\sigma]; [\bot\varepsilon =_I \boldsymbol{max}\{\bot\varepsilon\|_{\top\omega,\top\sigma}\}]; [\top\sigma t =_I \top\sigma\|_{\top\omega}];$
$[E|\ E =_I \bot\varepsilon\|_{\top\omega}])); [{}^{\text{◣}}\bot\varepsilon t <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}]$

b. … work$^{e}_{\sigma}$-habit]-DEC$_{\top}$-3SG
$([e|\ work_{\top\omega}\langle e, \top\delta\rangle, {}^{\triangledown}e \sqsubseteq_i \top\sigma]; [\bot\varepsilon =_I \boldsymbol{max}\{\bot\varepsilon\|_{\top\omega,\top\sigma}\}]; [\top\sigma t =_I \top\sigma\|_{\top\omega}];$
$[E|\ E =_I \bot\varepsilon\|_{\top\omega}])); [{}^{\text{◣}}\bot\varepsilon t <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}]$

c. … busy$^{s}_{\sigma}$-habit]-DEC$_{\top}$-3SG
$([s|\ busy_{\top\omega}\langle s, \top\delta\rangle, s \sqsubseteq_i \top\sigma]; [\bot\sigma =_I \boldsymbol{max}\{\bot\sigma\|_{\top\omega,\top\sigma}\}]; [\top\sigma t =_I \top\sigma\|_{\top\omega}];$
$[S|\ S =_I \bot\sigma\|_{\top\omega}])); [{}^{\text{◣}}\bot\sigma t <_{\top\omega} \top\varepsilon]; {}^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}]$

(10) i. *Meeqqat sapaatikkut sukkanniuttarput.*
*Miiraq-t sapaat-**kut** sukkanniut-**tar**-pu-t.*
kid-PL Sunday-*VIA* race.e.o-*habit*-DEC$_{\top}$-3PL
The kids$^{\top}$ have dogsled races on Sundays.

ii. *Ole* (*unammigaangami*) (*amerlanertigut*) *ajugaasarpoq.*
Ole (*unammik-**gaanga**-mi*) (*amirlaniq-**kut***) *ajugaa-**tar**-pu-q*.
Ole (compete-*HAB*$_{\top}$-3SG$_{\top}$) (most-*VIA*) win-*habit*-DEC$_{\top}$-3SG
(When he$_{\top}$ competes,) Ole (usually) wins.

(10′) i. kid-PL [$_{\text{DEC}}$ Sunday-VIA …

$^{\top}[x|\ ^{\mathcal{A}}x \subseteq_i kid_{\top\omega},\ \mathbf{2}^{+}\langle {}^{\mathcal{A}}x\rangle];\ \partial[spk.to_{\top\Omega}\langle \top\varepsilon,\ \uparrow\top\varepsilon,\ \downarrow\top\varepsilon\rangle];\ (([t|\ sunday\langle t\rangle,$
$t \sqsubseteq_{\top\omega} {}^{\odot}\top\varepsilon];{}^{\top}[s|\ \uparrow s =_i \top\delta,\ s =_{\top\omega} \bot\tau];{}^{\top}[S|\ S =_I \top\sigma\|_{\top\omega,\top\delta}];\ [\top\varepsilon \sqsubseteq_{\top\omega} \top\sigma t])\ ^{\top};$

… race.e.o.$^{e}{}_{\sigma}$-habit]-DEC$_{\top}$-3PL
$([e|\ race.e.o\langle e,\top\delta\rangle,\ {}^{\triangledown}e \sqsubseteq_i \top\sigma];[\bot\varepsilon =_I \boldsymbol{max}\{\bot\varepsilon\|_{\top\omega,\top\sigma}\}];[\top\sigma t =_I \top\sigma\|_{\top\omega,\top\delta}];$
$[E|\ E =_I \bot\varepsilon\|_{\top\omega,\top\delta}]));\ [^{\blacktriangleright}\bot\varepsilon t <_{\top\omega} \top\varepsilon];\ ^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}]$

ii. A$_n$: topic-setting update(s), B: comment

A$_1$. Ole [$_{\text{DEC}}$ …
$^{\top}[x|\ x =_i ole]\ ^{\top};\ (\partial[spk.to_{\top\Omega}\langle \top\varepsilon,\ \uparrow\top\varepsilon,\ \downarrow\top\varepsilon\rangle];$ …

A$_2$. Ole [$_{\text{DEC}}$ most-VIA …
$^{\top}[x|\ x =_i ole]\ ^{\top};\ (\partial[spk.to_{\top\Omega}\langle \top\varepsilon,\ \uparrow\top\varepsilon,\ \downarrow\top\varepsilon\rangle];\ ((^{\top}[S|\ \boldsymbol{most}\langle \top\sigma t,\ S\rangle];$
$[\top\varepsilon \sqsubseteq_{\top\omega} \top\sigma t])\ ^{\top};$ …

A$_3$. Ole [$_{\text{DEC}}$ compete$^{e}{}_{\sigma}$-HAB$_{\top}$-3SG$_{\top}$…
$^{\top}[x|\ x =_i ole]\ ^{\top};\ (\partial[spk.to_{\top\Omega}\langle \top\varepsilon,\ \uparrow\top\varepsilon,\ \downarrow\top\varepsilon\rangle];\ (([e\ w|\ compete_w\langle e,\ \top\delta\rangle,$
${}^{\triangledown}e \sqsubseteq_i \top\sigma];\ [\bot\varepsilon =_I \boldsymbol{max}\{\bot\varepsilon\|_{\bot\omega,\top\sigma}\}];\ [\top\Omega \subseteq_I \bot\omega\|];\ ^{\top}[s|\ s =_i ({}^{\circ}\bot\varepsilon)_{\top\omega}];$
$^{\top}[S|\ S =_I \top\sigma\|_{\top\omega}];\ [\top\varepsilon \sqsubseteq_{\top\omega} \top\sigma t])\ ^{\top};$ …

A$_4$. Ole [$_{\text{DEC}}$ compete$^{e}{}_{\sigma}$-HAB$_{\top}$-3SG$_{\top}$ most-VIA …
$^{\top}[x|\ x =_i ole]\ ^{\top};\ (\partial[spk.to_{\top\Omega}\langle \top\varepsilon,\ \uparrow\top\varepsilon,\ \downarrow\top\varepsilon\rangle];\ (([e\ w|\ compete_w\langle e,\ \top\delta\rangle,$
${}^{\triangledown}e \sqsubseteq_i \top\sigma];\ [\bot\varepsilon =_I \boldsymbol{max}\{\bot\varepsilon\|_{\bot\omega,\top\sigma}\}];\ [\top\Omega \subseteq_I \bot\omega\|];\ ^{\top}[s|\ s =_i ({}^{\circ}\bot\varepsilon)_{\top\omega}];$
$[S|\ S =_I \top\sigma\|_{\top\omega}];\ [\top\varepsilon \sqsubseteq_{\top\omega} \bot\sigma t])\ ^{\bot};\ ((^{\top}[S|\ \boldsymbol{most}\langle \bot\sigma t,\ S\rangle];\ [\top\varepsilon \sqsubseteq_{\top\omega} \top\sigma t])$
$^{\top};$ …

B. … win$^{\bullet e}$-habit]-DEC$_{\top}$-3SG
$([e|\ win\langle e,\ \top\delta\rangle,\ e =_{\top\omega} ({}^{\blacktriangleleft}\top\sigma)_{\top\omega}];\ [\bot\varepsilon =_I \boldsymbol{max}\{\bot\varepsilon\|_{\top\omega,\top\sigma}\}];\ [\top\sigma t =_I$
$\top\sigma\|_{\top\omega,\top\delta}];\ [E|\ E =_I \bot\varepsilon\|_{\top\omega,\top\delta}])));\ [^{\blacktriangleright}\bot\varepsilon t <_{\top\omega} \top\varepsilon];\ ^{\top}[p|\ p =_I \top\omega\|_{\top\Omega}])$

5 TOWARD A CG.UC FRAGMENT OF KALAALLISUT

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 ($X\backslash Y$).

K2 (Kalaallisut category-to-type rule)

- **tp**(s) = [ ], **tp**(pn_a) = *sa*
- **tp**(X/Y) = **tp**($X\backslash Y$) = (**tp**(Y) **tp**(X))

ABBREVIATIONS (categories and types)

$\underline{\mathrm{s}} := \mathrm{s}\backslash\mathrm{pn}_\omega$ $\quad$ $\mathrm{s}_a := \mathrm{s}\backslash\mathrm{pn}_a$ $\mathrm{pn} := \mathrm{pn}_\delta$ $\quad$ $\mathsf{D} := s\delta$ $\quad$ $\mathsf{W} := s\omega$

$\mathrm{iv} := \underline{\mathrm{s}}\backslash\mathrm{pn}_\delta$ $\quad$ $\mathrm{cn}_a := (\mathrm{s}_a\backslash\mathrm{pn}_\omega)\backslash\mathrm{pn}_\tau$ $\quad$ $\mathrm{cn} := \mathrm{cn}_\delta$ $\quad$ $\mathsf{I} := s\tau$ $\quad$ $[\,] := (st)st$

Figure 2 Algebraic correlates of eventualities

$^{\odot}e$	$:=$	$(^{\triangledown\blacktriangleleft}e \sqcup {}^{\triangleright}e)$		$(^{\bigcirc}u)_w$	$:=$	$^{\sigma}(^{\varepsilon}u \sqcup (^{\blacktriangleleft\sigma}u)_w)$	
$^{\sigma}u_a$	$:=$	u	if $a = \sigma$	$^{\varepsilon}u_a$	$:=$	$^{\blacktriangleright}u$	if $a = \sigma$
	$\in$	$\{^{\triangleright}u, {}^{\triangledown}u\}$	if $a = \varepsilon$		$\in$	$\{u, {}^{\blacktriangle}u, {}^{\blacktriangleright\triangledown}u\}$	if $a = \varepsilon$

<u>Kal.</u> |– <u>CG category: UC translation</u>

win$^{\bullet e}$- |– iv: $\lambda\underline{x}\lambda\underline{w}([e]; [win_{\underline{w}}\langle\bot\varepsilon, \underline{x}\rangle, \bot\varepsilon =_{(\underline{w})} (^{\blacktriangleleft}\top\sigma)_{\underline{w}}])$

work^{e}- |– iv: $\lambda\underline{x}\lambda\underline{w}([e]; [work_{\underline{w}}\langle\bot\varepsilon, \underline{x}\rangle])$

busy^{s}- |– iv: $\lambda\underline{x}\lambda\underline{w}([s]; [busy_{\underline{w}}\langle\bot\sigma, \underline{x}\rangle])$

-int^{s} |– iv\iv: $\lambda\underline{P}\lambda\underline{x}\lambda\underline{w}(\underline{P}\uparrow\bot a\ \bot\omega\ ^{\bot}; [s|\ ^{\varepsilon}\bot a =_i (^{\blacktriangleleft}s)_{\bot\omega}]; [\mathrm{OPT}\langle\top\Omega, int_{\underline{w}}\ \bot\sigma\rangle \subseteq_I \bot\omega||_{\bot\sigma}]; [\uparrow\bot\sigma =_i \underline{x}]$

-say$^{\bullet e}$ |– iv\iv: $\lambda\underline{P}\lambda\underline{x}\lambda\underline{w}(\underline{P}\uparrow\bot a\ \bot\omega\ ^{\bot}; [e\ p|\ ^{\varepsilon}\bot a <_{\bot\omega} e \sqsubseteq_{\bot\omega} {}^{\sigma}\bot a, spk.to_p\langle e, \uparrow\bot a, \downarrow e\rangle]; [\bot\Omega \subseteq_I \bot\omega||_{\bot\varepsilon}]; [spk.to_{\underline{w}}\langle\bot\varepsilon, \underline{x}, \downarrow\bot\varepsilon\rangle]$

-habit |– iv\iv: $\lambda\underline{P}\lambda\underline{x}\lambda\underline{w}(\underline{P}\ \underline{x}\ \underline{w}\ ^{\bot}; [\bot a =_I \boldsymbol{max}\{\bot a||_{\underline{w},\top\sigma}\}]; [\top\sigma t =_I \top\sigma||_{\underline{w}}]; [A|\ A =_I \bot a||_{\underline{w}}]; [\top\varepsilon \sqsubseteq_{\underline{w}} \bot at]$

$^{\bot}(\cdot)$ |– $\underline{\mathrm{s}}\backslash\underline{\mathrm{s}}$: $\lambda\underline{V}_{[\mathsf{W}]}\lambda\underline{w}_{\mathsf{W}}([w]\ ^{\bot}; \underline{V}\ \underline{w})$

$(\cdot)_\varepsilon$ |– $\underline{\mathrm{s}}\backslash\underline{\mathrm{s}}$: $\lambda\underline{V}_{[\mathsf{W}]}\lambda\underline{w}_{\mathsf{W}}(\underline{V}\ \underline{w}\ ^{\bot}; [\top\varepsilon \sqsubseteq_{\underline{w}} {}^{\sigma}\bot a])$ $\qquad a \in \{\varepsilon, \sigma\}$

$(\cdot)_\sigma$ |– $\underline{\mathrm{s}}\backslash\underline{\mathrm{s}}$: $\lambda\underline{V}_{[\mathsf{W}]}\lambda\underline{w}_{\mathsf{W}}(\underline{V}\ \underline{w}\ ^{\bot}; [^{(\sigma)}\bot a \sqsubseteq_{(\underline{w})} \top\sigma])$

$(\cdot)_\tau$ |– $\underline{\mathrm{s}}\backslash\underline{\mathrm{s}}$: $\lambda\underline{V}_{[\mathsf{W}]}\lambda\underline{w}_{\mathsf{W}}(\underline{V}\ \underline{w}\ ^{\bot}; [^{(\varepsilon)}\bot a \sqsubseteq_{\underline{w}} \bot\tau])$

-FCT |– $(\underline{\mathrm{s}}/\underline{\mathrm{s}})\backslash(\mathrm{s}\backslash\mathrm{pn}_\omega)$: $\lambda\underline{V}'_{[\mathsf{W}]}\lambda\underline{V}_{[\mathsf{W}]}\lambda\underline{w}_{\mathsf{W}}((\underline{V}'\bot\omega\ ^{\bot}; [^{\varepsilon}\bot a <_{\bot\omega} ?\varepsilon]);[\bot a =_I \boldsymbol{max}\{\bot a||_{\bot\omega,\ldots}\}]; [\top\Omega \subseteq_I \bot\omega||_{\ldots}]; {}^{\top}[s|\ s =_i (^{\bigcirc}\bot a)_{\top\omega}])\ ^{\top}; \underline{V}\ \underline{w})$

-DEC |– $\mathrm{s}\backslash(\mathrm{s}\backslash\mathrm{pn}_\omega)$: $\lambda\underline{V}_{[\mathsf{W}]}(\partial[spk.to_{\top\Omega}\langle\top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle]; (\underline{V}\ \top\omega\ ^{\bot}; [^{\varepsilon}\bot a <_{\top\omega} \top\varepsilon]); {}^{\top}[p|\ p =_I \top\omega||_{\top\Omega}])$

-OPT |– $\mathrm{s}\backslash(\mathrm{s}\backslash\mathrm{pn}_\omega)$: $\lambda\underline{V}_{[\mathsf{W}]}(\partial[spk.to_{\top\Omega}\langle\top\varepsilon, \uparrow\top\varepsilon, \downarrow\top\varepsilon\rangle];(\underline{V}\bot\omega\ ^{\bot}; [^{\varepsilon}\bot a =_{\bot\omega} (^{\blacktriangleleft\triangleright}\top\varepsilon)_{\bot\omega}]); [p|\ p =_I \bot\omega||_{\top\delta}]; [\mathrm{OPT}\langle\top\Omega, des_{\top\omega}{}^{\odot}\top\varepsilon\rangle \subseteq_i \bot\Omega]; [\top\Omega =_I \top\omega||_{\top\Omega}])$

APPENDIX:
UPDATE WITH CENTERING (UC, Bittner 2012: Ch. 7)

D1 The set of UC *types* is the smallest set Θ such that: (i) $t, \delta, \varepsilon, \sigma, \tau, \omega, s \in \Theta$, and (ii) $(ab) \in \Theta$ if $a, b \in \Theta$. The subset $\text{DR}(\Theta) = \{\delta, \varepsilon, \sigma, \tau, \omega, \delta t, \varepsilon t, \sigma t, \tau t, \omega t\}$ is the set of *discourse referent types.*

D2.1 A UC *frame* is a set $\mathcal{F} = \{\mathcal{D}_a | \ a \in \Theta\}$ such that:

i. $\mathcal{D}_t = \{0, 1\}$, $\mathcal{D}_\delta, \mathcal{D}_\varepsilon, \mathcal{D}_\sigma, \mathcal{D}_\tau$ and $\mathcal{D}_\omega$ are non-empty pairwise disjoint sets
$\mathcal{D}_\tau = \{\text{t} | \text{ t is a non-empty convex set of integers}\}$

ii. $\mathcal{D}_s = \cup_{n \geq 0,\, m \geq 0}\{\langle\langle \text{d}_1, \ldots, \text{d}_n\rangle, \langle \text{d}'_1, \ldots, \text{d}'_m\rangle\rangle: \text{d}_i, \text{d}'_j \in \mathcal{D}_{dr}\}$,
where $\mathcal{D}_{dr} = \cup\{\mathcal{D}_a: a \in \text{DR}(\Theta)\}$

iii. $\mathcal{D}_{ab} = \{f | \ \varnothing \subset \text{Dom } f \subseteq \mathcal{D}_a \ \& \text{ Ran } f \subseteq \mathcal{D}_b\}$

D2.2 An $\mathcal{F}$-*mereology* is a structure $\mathbf{M} = \langle\{\mathcal{D}_{\delta+}, \mathcal{D}_{\delta-}\}, \sqsubseteq, {}^{\mathcal{A}}, {}^{\triangledown}, {}^{\blacktriangle}\rangle$ such that:

i. $\{\mathcal{D}_{\delta+}, \mathcal{D}_{\delta-}\}$ is a partition of $\mathcal{D}_\delta$ (into *objects* $\mathcal{D}_{\delta+}$ and *masses* $\mathcal{D}_{\delta-}$).

ii. $\forall a \in \{\delta_+, \delta_-, \varepsilon, \sigma, \tau\}$: $\langle \mathcal{D}_a, \sqsubseteq_a\rangle$ is a join-semilattice
$\text{t}_1 \sqsubseteq_\tau \text{t}_2 \quad :\Leftrightarrow \ \text{t}_1 \subseteq \text{t}_2$ (*temporal inclusion*)

iii. $\forall a \in \{\delta_+, \varepsilon, \tau\}$:
$\text{y} \in {}^{\mathcal{A}}\text{x} \quad \Leftrightarrow \quad \text{y} \sqsubseteq_a \text{x} \ \& \ \forall \text{z}: \text{z} \sqsubseteq_a \text{y} \rightarrow \text{z} = \text{y}$
$\text{y} \in {}^{\mathcal{A}}\mathcal{D}_a \quad \Leftrightarrow \quad \exists \text{x} \in \mathcal{D}_a: \text{y} \in {}^{\mathcal{A}}\text{x}$

iv. $\forall a \in \{\delta_+, \varepsilon\}$:
$\text{x} = {}^{\blacktriangle}\text{y} \ \& \ \text{y} \in \mathcal{D}_a \Rightarrow \text{y} \notin {}^{\mathcal{A}}\mathcal{D}_a \ \& \ \text{x} \in {}^{\mathcal{A}}\mathcal{D}_a$
$\text{z} = {}^{\triangledown}\text{y} \ \& \ \text{y} \in \mathcal{D}_a \Rightarrow \text{y} \notin {}^{\mathcal{A}}\mathcal{D}_a \ \& \ \text{z} \in \mathcal{D}_{\pm(a)}$, where $\pm(\delta_+) = \delta_- \ \& \ \pm(\varepsilon) = \sigma$

D2.3 An $\mathbf{M}$-*network* is a structure $\mathbf{N} = \langle \mathcal{D}_\upsilon, \vartheta, \pi, <_\tau, {}^{\triangleright}, {}^{\blacktriangleleft}, {}^{\text{◣}}, {}^{\text{◢}}, \uparrow, \downarrow, {}^{<}, {}^{>}\rangle$ s.t.:

i. $\mathcal{D}_\upsilon = \mathcal{D}_\varepsilon \cup \mathcal{D}_\sigma$ (*eventualities*)
$\pi: \mathcal{D}_\upsilon \rightarrow [\mathcal{D}_\omega \rightarrow \mathcal{D}_{\delta-}]$ (*place*)
$\vartheta: \mathcal{D}_\upsilon \rightarrow [\mathcal{D}_\omega \rightarrow \mathcal{D}_\tau]$ (*run time*)
$\text{t}_1 <_\tau \text{t}_2 \quad :\Leftrightarrow \ \forall \text{n} \in \text{t}_1 \forall \text{m} \in \text{t}_2: \text{n} < \text{m}$ (*temporal precedence*)
$\text{t}_1 -\!\!<_\tau \text{t}_2 \quad :\Leftrightarrow \ \text{t}_1 <_\tau \text{t}_2 \ \& \ \neg\exists \text{t}: \text{t}_1 <_\tau \text{t} <_\tau \text{t}_2$ (*immediate precedence*)

ii. $\text{e}' = {}^{\blacktriangle}\text{e} \ \ \& \ \vartheta_\text{w}\,\text{e} = \text{t} \ \Rightarrow \vartheta_\text{w}\,\text{e}' = \text{t}$ (*atomic-equivalent*)
$\text{s} = {}^{\triangledown}\text{e} \ \ \& \ \vartheta_\text{w}\,\text{e} = \text{t} \ \Rightarrow \vartheta_\text{w}\,\text{s} = \text{t}$ (*state-equivalent*)
$\text{e}' = {}^{\blacktriangleleft}\text{e} \ \ \& \ \vartheta_\text{w}\,\text{e} = \text{t} \ \Rightarrow \text{e} \in {}^{\mathcal{A}}\mathcal{D}_\varepsilon \ \& \ \text{e}' \in \mathcal{D}_\varepsilon \ \& \ \vartheta_\text{w}\,\text{e}' -\!\!<_\tau \text{t}$ (*prep.-process*)
$\text{s} = {}^{\triangleright}\text{e} \ \ \& \ \vartheta_\text{w}\,\text{e} = \text{t} \ \Rightarrow \text{e} \in {}^{\mathcal{A}}\mathcal{D}_\varepsilon \ \& \ \text{s} \in \mathcal{D}_\sigma \ \& \ \text{t} -\!\!<_\tau \vartheta_\text{w}\,\text{s}$ (*consequent state*)
$\text{e} = {}^{\text{◣}}\text{s} \ \ \& \ \vartheta_\text{w}\,\text{s} = \text{t} \ \Rightarrow \text{e} \in {}^{\mathcal{A}}\mathcal{D}_\varepsilon \ \& \ \text{s} \in \mathcal{D}_\sigma \ \& \ \vartheta_\text{w}\,\text{e} \sqcup_\tau \vartheta_\text{w}{}^{\triangleright}\text{e} = \text{t}$ (*start pt.*)
$\text{e} = ({}^{\text{◢}}\text{s})_\text{w} \ \& \ \vartheta_\text{w}\,\text{e} = \text{t} \ \Rightarrow \text{e} \in {}^{\mathcal{A}}\mathcal{D}_\varepsilon \ \& \ \text{s} \in \mathcal{D}_\sigma \ \& \ \vartheta_\text{w}\,\text{s} -\!\!<_\tau \text{t}$ (*culmination pt.*)

iii. $\text{x} = \uparrow\text{u} \quad \Rightarrow \ \text{u} \in \mathcal{D}_\upsilon \ \& \ \text{x} \in \mathcal{D}_\delta$ (*central individual*)
$\text{y} = \downarrow\text{u} \quad \Rightarrow \ \text{u} \in \mathcal{D}_\upsilon \ \& \ \text{y} \in \mathcal{D}_\delta \ \& \ \exists \text{x}: \text{x} = \uparrow\text{u}$ (*background individual*)
$\text{x} = \uparrow\text{u} \quad \Leftrightarrow \ \text{x} = \uparrow f(\text{u})$ $\quad f \in \{{}^{\triangledown}, {}^{\blacktriangle}, {}^{\triangleright}, {}^{\blacktriangleleft}, {}^{\text{◣}}, {}^{\text{◢}}\}$
$\text{u}_1 \sqsubseteq_a \text{u}_2 \ \& \ f(\text{u}_2) \in \mathcal{D}_b \Rightarrow f(\text{u}_1) \sqsubseteq_b f(\text{u}_2)$ $\quad f \in \{\vartheta, \pi, \uparrow, \downarrow, {}^{\triangledown}\}$

iv. $\text{e}' = {}^{<}\text{e} \ \ \& \ \vartheta_\text{w}\,\text{e} = \text{t} \ \Rightarrow \uparrow\text{e}' \neq \uparrow\text{e} \ \& \ \vartheta_\text{w}\,\text{e}' <_\tau \text{t}$ (*speaker source*)
$\text{e}' = ({}^{>}\text{e})_\text{w} \ \& \ \vartheta_\text{w}\,\text{e}' = \text{t} \ \Rightarrow \uparrow\text{e}' = \downarrow\text{e} \ \& \ \text{t} = \vartheta_\text{w}({}^{\text{◢}\triangleright}\text{e})_\text{w}$ (*speaker directive*)

D3 A UC *model* is a tuple $\mathcal{M} = \langle \mathcal{F}, \mathbf{M}, \mathbf{N}, [\![\cdot]\!] \rangle$ s.t. $\mathcal{F}$ is a UC-frame, **M** is an $\mathcal{F}$-mereology, **N** is an **M**-network, $[\![\cdot]\!]$ maps any $A \in Con_a$ to $[\![A]\!] \in \mathcal{D}_a$, and:

i. $\langle \mathrm{e}, \uparrow\mathrm{e}, \downarrow\mathrm{e} \rangle \in [\![spk.to]\!](\mathrm{w}) \ \Rightarrow \exists \mathrm{e}': \mathrm{e}' = ({}^{\text{◢}\triangleright}\mathrm{e})_{\mathrm{w}}$

$\mathrm{e}' = {}^{<}\mathrm{e} \ \& \ \vartheta_{\mathrm{w}}\, \mathrm{e} = \mathrm{t} \ \Rightarrow \langle \mathrm{e}, \uparrow\mathrm{e}, \downarrow\mathrm{e} \rangle \in [\![spk.to]\!](\mathrm{w})$

$\mathrm{e}' = ({}^{>}\mathrm{e})_{\mathrm{w}} \ \Rightarrow \langle \mathrm{e}, \uparrow\mathrm{e}, \downarrow\mathrm{e} \rangle \in [\![spk.to]\!](\mathrm{w})$

ii. $\forall\ A \in Con_{\omega\delta\ldots t}$, $\mathrm{w} \in \mathcal{D}_{\omega}$, $\mathrm{u} \in \mathcal{D}_{\upsilon}$, $\mathrm{d}, \mathrm{d}' \in \mathcal{D}_{\delta}$:

$\langle \mathrm{u}, \mathrm{d}, \ldots \rangle \in [\![A]\!](\mathrm{w}) \ \Leftrightarrow \langle \mathrm{u}, \uparrow\mathrm{u}, \ldots \rangle \in [\![A]\!](\mathrm{w}) \ \& \ \uparrow\mathrm{u} = \mathrm{d}$

$\langle \mathrm{u}, \mathrm{d}, \mathrm{d}', \ldots \rangle \in [\![A]\!](\mathrm{w}) \ \Leftrightarrow \langle \mathrm{u}, \mathrm{d}, \downarrow\mathrm{u}, \ldots \rangle \in [\![A]\!](\mathrm{w}) \ \& \ \downarrow\mathrm{u} = \mathrm{d}'$

iii. $\forall a \in \mathrm{DR}(\Theta)$, $\mathrm{i} \in \mathcal{D}_s$:

$[\![\top a]\!](\mathrm{i}) \doteq ((\text{①}\mathrm{i})_a)_1$ $\quad [\![\top' a]\!](\mathrm{i}) \doteq ((\text{①}\mathrm{i})_a)_2$ $\quad [\![\top^{\Rightarrow} a]\!](\mathrm{i}) \doteq \{((\text{①}\mathrm{i})_a)_n : n \geq 1\}$

$[\![\bot a]\!](\mathrm{i}) \doteq ((\text{②}\mathrm{i})_a)_1$ $\quad [\![\bot' a]\!](\mathrm{i}) \doteq ((\text{②}\mathrm{i})_a)_2$ $\quad [\![\bot^{\Rightarrow} a]\!](\mathrm{i}) \doteq \{((\text{②}\mathrm{i})_a)_n : n \geq 1\}$

D4 (UC syntax)

i.	$Con_a \cup Var_a \subseteq Term_a$	
ii.	$(A_a = B_a) \in Term_t$	, if $A_a, B_a \in Term_a$
	$(A_\tau < B_\tau) \in Term_t$	, if $A_\tau, B_\tau \in Term_\tau$
	$(A_s \precsim B_s) \in Term_t$	, if $A_s, B_s \in Term_s$
	$(A_a \sqsubseteq B_a) \in Term_t$	, if $A_a, B_a \in Term_a$ & $a \in \mathrm{DR}(\Theta)$
iii.	$\boldsymbol{n}(A), \boldsymbol{n}^{+}(A) \in Term_t$	, if $A \in Term_{at}$ and $\boldsymbol{n} \in \{\mathbf{1}, \mathbf{2}, \ldots\}$
	$\boldsymbol{most}(A, B) \in Term_t$	, if $A, B \in Term_{at}$
iv.	$\neg\varphi, (\varphi \wedge \psi) \in Term_t$	, if $\varphi, \psi \in Term_t$
v.	$\exists u_a \varphi \in Term_t$	, if $u_a \in Var_a$ and $\varphi \in Term_t$
vi.	$\lambda u_a(B) \in Term_{ab}$	, if $u_a \in Var_a$ and $B \in Term_b$
vii.	$BA \in Term_b$	, if $B \in Term_{ab}$ and $A \in Term_a$
viii.	$\vartheta_W A \in Term_\tau$ & $\pi_W A \in Term_\delta$	, if $W \in Term_\omega$ & $A \in Term_\varepsilon \cup Term_\sigma$
	$\uparrow A, \downarrow A \in Term_\delta$	, if $A \in Term_\varepsilon \cup Term_\sigma$
	${}^{<}A \in Term_\varepsilon$ & ${}^{>}A \in Term_{\omega\varepsilon}$	, if $A \in Term_\varepsilon$
	${}^{\blacktriangleleft}A \in Term_\varepsilon$ & ${}^{\triangleright}A \in Term_\sigma$	, if $A \in Term_\varepsilon$
	${}^{\text{◣}}A \in Term_\varepsilon$ & ${}^{\text{◢}}A \in Term_{\omega\varepsilon}$	, if $A \in Term_\sigma$
	${}^{\blacktriangle}A_a \in Term_a$	, if $a \in \{\delta, \varepsilon\}$ & $A \in Term_a$
	${}^{\triangledown}A \in Term_{f(a)}$	, if $a \in \{\delta, \varepsilon\}$, $A \in Term_a$, $f(\delta) = \delta$, $f(\varepsilon) = \sigma$
	${}^{\mathcal{A}}A_a \in Term_{at}$	, if $a \in \{\delta, \varepsilon, \tau\}$ & $A_a \in Term_a$
ix.	$(A\ {}^{\top}\!\bullet\ B), (A\ {}^{\bot}\!\bullet\ B) \in Term_s$	, if $A \in Term_e$ and $B \in Term_s$
x.	$(A\ {}^{\top}; B), (A\ {}^{\bot}; B) \in Term_{(st)st}$	, if $A, B \in Term_{(st)st}$

D5 (UC semantics)

i.	$[\![A]\!]^g = [\![A]\!]$	, if $A \in Con_a$
	$[\![A]\!]^g = g(A)$	, if $A \in Var_a$
ii.	$[\![(A_a = B_a)]\!]^g = 1$	, if $[\![A_a]\!]^g = [\![B_a]\!]^g$; else, 0
	$[\![(A_\tau < B_\tau)]\!]^g = 1$	, if $[\![A_\tau]\!]^g <_\tau [\![B_\tau]\!]^g$; else, 0
	$[\![(A_s \precsim B_s)]\!]^g = 1$	, if $[\![A_s]\!]^g \precsim_s [\![B_s]\!]^g$; else, 0
	$[\![(A_a \sqsubseteq B_a)]\!]^g = 1$	, if $[\![A_a]\!]^g \sqsubseteq_a [\![B_a]\!]^g$; else, 0

iii. $[\![\boldsymbol{n}(A)]\!]^g \;=\; 1$, if $|[\![A]\!]^g| = n$; else, 0

$[\![\boldsymbol{n}^+(A)]\!]^g \;=\; 1$, if $|[\![A]\!]^g| \geq n$; else, 0

$[\![\boldsymbol{most}(A, B)]\!]^g \;=\; 1$, if $|[\![A]\!]^g \cap [\![B]\!]| \geq |[\![A]\!]^g \backslash [\![B]\!]|$; else, 0

iv. $[\![\neg\varphi]\!]^g \;=\; 1$, if $[\![\varphi]\!]^g = 0$; else, 0

$[\![(\varphi \wedge \psi)]\!]^g \;=\; 1$, if $[\![\varphi]\!]^g = 1$ and $[\![\psi]\!]^g = 1$; else, 0

v. $[\![\exists u_a\varphi]\!]^g \;=\; 1$, if $\{\mathsf{d} \in \mathcal{D}_a |\ [\![\varphi]\!]^{g[u/\mathsf{d}]} = 1\} \neq \varnothing$; else, 0

vi. $[\![\lambda u_a(B)]\!]^g(\mathsf{d}) \;\doteq\; [\![B]\!]^{g[u/\mathsf{d}]}$, if $\mathsf{d} \in \mathcal{D}_a$

vii. $[\![BA]\!]^g \;\doteq\; [\![B]\!]^g([\![A]\!]^g)$

viii. $[\![f_W A]\!]^g \;\doteq\; f([\![W]\!]^g)([\![A]\!]^g)$, if $f \in \{\vartheta, \pi\}$

$[\![fA]\!]^g \;\doteq\; f([\![A]\!]^g)$, if $f \in \{\uparrow, \downarrow, {}^{<}, {}^{>}, {}^{\blacktriangleleft}, {}^{\triangleright}, {}^{\text{◣}}, {}^{\text{◢}}, {}^{\blacktriangle}, {}^{\triangledown}, {}^{\mathcal{A}}\}$

ix. $[\![(A\ {}^{\top}\!\bullet B)]\!]^g \;\doteq\; \langle([\![A]\!]^g \cdot \text{①}[\![B]\!]^g), \text{②}[\![B]\!]^g\rangle$

$[\![(A\ {}^{\bot}\!\bullet B)]\!]^g \;\doteq\; \langle\text{①}[\![B]\!]^g, ([\![A]\!]^g \cdot \text{②}[\![B]\!]^g)\rangle$

x. $\mathsf{c}[\![(A\ {}^{\top}; B)]\!]^g \;=\; \{\mathsf{k} \in \mathsf{c}[\![A]\!]^g[\![B]\!]^g |\ \exists \mathsf{i} \in \mathsf{c} \exists \mathsf{j} \in \mathsf{c}[\![A]\!]^g \exists a \in \mathrm{DR}(\Theta)\text{: } (\text{①}\mathsf{j})_1 \in \mathcal{D}_a$
$\ \&\ \text{①}\mathsf{i} \prec \text{①}\mathsf{j}\ \&\ (\text{①}\mathsf{j})_a = (\text{①}\mathsf{k})_a\ \&\ [\![B]\!]^g \neq [\![B[\top a/\bot a]]\!]^g\}$

$\mathsf{c}[\![(A\ {}^{\bot}; B)]\!]^g \;=\; \{\mathsf{k} \in \mathsf{c}[\![A]\!]^g[\![B]\!]^g |\ \exists \mathsf{i} \in \mathsf{c} \exists \mathsf{j} \in \mathsf{c}[\![A]\!]^g \exists a \in \mathrm{DR}(\Theta)\text{: } (\text{②}\mathsf{j})_1 \in \mathcal{D}_a$
$\ \&\ \text{②}\mathsf{i} \prec \text{②}\mathsf{j}\ \&\ (\text{②}\mathsf{j})_a = (\text{②}\mathsf{k})_a\ \&\ [\![B]\!]^g \neq [\![B[\bot a/\top a]]\!]^g\}$

D6 For $(st)st$-term K, model $\mathcal{M}$, assignment g, info-state c, and $\mathsf{i} \in \mathsf{c}$:

i. $\mathcal{I}_{\mathcal{M}, g}(\mathsf{i}, \mathsf{c}) \;=\; [\![\lambda w(\exists k(Ik \wedge \top\Omega i = \top\Omega k \wedge w = \top\omega k))]\!]^{g[i/\mathsf{i}][I/\mathsf{c}]}$

ii. K is *at-issue* iff $\exists\mathcal{M}\exists\mathsf{c}\exists\mathsf{i} \in \mathsf{c}\exists\mathsf{j}\text{: } \mathsf{i} \precsim_s \mathsf{j}\ \&\ \forall g\text{: } \mathcal{I}_{\mathcal{M}, g}(\mathsf{j}, \mathsf{c}[\![K]\!]^g) \subset \mathcal{I}_{\mathcal{M}, g}(\mathsf{i}, \mathsf{c})$

D7 (truth, falsity) For $(st)st$-term K, model $\mathcal{M}$, info-state c, and world w:

i. $\mathcal{M}, \mathsf{c}, \mathsf{w} \models K$ iff K is at-issue $\&\ \exists\mathsf{i} \in \mathsf{c}\forall g\text{: } \mathsf{w} \in \mathcal{I}_{\mathcal{M}, g}(\mathsf{i}, \mathsf{c}[\![K]\!]^g)$

ii. $\mathcal{M}, \mathsf{c}, \mathsf{w} \not\models K$ iff K is at-issue $\&\ \neg\exists\mathsf{i} \in \mathsf{c}\forall g\text{: } \mathsf{w} \in \mathcal{I}_{\mathcal{M}, g}(\mathsf{i}, \mathsf{c}[\![K]\!]^g)$

D8 (*startup info-state*)

$^{st}\mathsf{e} = \{\langle\langle\mathsf{w}, \mathsf{p}, \mathsf{e}\rangle, \langle\rangle\rangle |\ \exists\mathsf{t}\text{: } \mathsf{w} \in \mathsf{p} \subseteq \{\mathsf{v} |\ \langle\mathsf{e}, \uparrow\mathsf{e}, \downarrow\mathsf{e}\rangle \in [\![\mathit{spk.to}]\!](\mathsf{v})\ \&\ \vartheta_{\mathsf{v}}\,\mathsf{e} = \mathsf{t}\}\}$

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