Scope in English & Kalaallisut: Analysis in CCG+UC_2

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1. SCOPE PREDICTION & SAMPLE DATA

- SCOPE PREDICTION
  The scope of SA (syntactic argument) may be ambiguous
  The scope of BA (morph. bound argument) and any modifiers is unambiguous

- ENGLISH SA & BA
  (Last month Ole$^{\top}$ ordered three books$^{\perp}$.)

DO. He$_{\top}$ has*n't* received *one*$_{\perp}$ *book* yet. (transitive DO QP)
∃¬. one is still missing | ¬∃. hasn't received any

SU. **One book** has*n't* been received yet. (passive SU QP)
∃¬. one is still missing

(Ole$^{\top}$ has invited his students$^{\perp}$ to come and see him individually. But…)
TV. He$_{\top}$ has*n't* been *approach*ed yet. (passive TV-CTR)
¬∃. none have come yet

BY. He$_{\top}$ has*n't* been approached BY *one*$_{\perp}$ *student* yet. (passive BY-QP)
¬∃. none have come yet | ∃¬. one still hasn't come

- KALAALLISUT BA

-pn$_{\perp}$. *Suli atuagaq ataasiq tigu-nngi(t)-la-a-Ø.* (trans. s^{+}…*-pn*$_{\perp}$)
still $^{\perp}$*book*$_{\perp}$ *one*$_{\perp}$ receive-*not*-DEC-3S$_{(\top)}$.*3S*$_{(\perp)}$
∃¬. one is still missing

-pn$_{\top}$. *Suli atuagaq ataasiq tigu-niqa(r)-nngi(t)-la-q.* (pssv. s^{+}…**-pn**$_{\top}$)
still $^{\top}$**book**$_{\top}$ **one**$_{\top}$ receive-pssv-*not*-DEC-**3S**$_{(\top)}$
∃¬. one is still missing

-antip. *Suli atuakkamik ataatsimik tigu-si-nngi(t)-la-q.* (antip. s^{+}…*-antip*)
still *book*-$_{\delta}$MOD *one*-MOD$_{\delta}$ receive-*antip*-*not*-DEC-3S$_{(\top)}$
¬∃. hasn't received any

cn-. *Suli ataatsimik atuagar-si-nngi(t)-la-q.* ('NI' $^{+}$s…*cn*-)
still *one*-MOD$_{\delta}$ *book*-rcv-*not*-DEC-3S$_{(\top)}$
¬∃. hasn't received any

(Yesterday I saw a bear | big bear near the village. Today…)
cn-. *Ole alla-mik nanu-si-pu-q angisuu-mik.* ('NI' $^{+}$s…*cn*-…$^{+}$s)
Ole *other*-MOD$_{\delta}$ *bear*-see-DEC-3S$_{(\top)}$ *big*-MOD$_{\delta}$
big > *other*: Ole saw *another* bear, a *big* one.

cn-. *Ole angisuu-mik nanu-si-pu-q alla-mik.* ('NI' $^{+}$s…*cn*-…$^{+}$s)
Ole *big*-MOD$_{\delta}$ *bear*-see-DEC-3S$_{(\top)}$ *other*-MOD$_{\delta}$
other > *big*: Ole saw *another big* bear.

2. SCOPE IN ENGLISH

2.1 ENGLISH LEXICON

• <u>lexical categories</u> ($\text{TV} = \text{x}_{[]}/\text{PN}'$ where $\mathbf{tp}(\text{x}_{[]}) = []$)

receive-	TV: $\lambda \underline{y}([e]^{\perp}; [rcv\langle \perp\varepsilon, \text{CTR} \perp\varepsilon, \underline{y}\rangle])$
have-	$\text{IV}/\text{IV}_{\text{pf}}$: $\lambda K.\ K$
be-	$\text{IV}/\text{IV}_{\text{ps}}$: $\lambda K(K^{\perp}; [e \mid e \subseteq_i \perp\varepsilon, \text{CTR } e =_i \text{BCK} \perp\varepsilon])$
book	CN: $\lambda x.\ bk\ x$
one	NP/CN: $\lambda P \lambda \underline{x}([P\langle ?\delta\rangle]; [\underline{x} \in ?\delta\|\,])$

• <u>grammatical categories</u> ($\text{VP} = \text{s}\backslash\text{PN}$, $\text{QP}^{\top} = \text{s}/\text{VP}$, $\text{QP}^{\perp} = \text{x}_{[]}\backslash(\text{x}_{[]}/\text{PN}')$)

I, HE	$\text{QP}^{\top}$: $\lambda \underline{P}.\ \underline{P}\ \text{CTR}\langle \top\varepsilon\rangle$, $\lambda \underline{P}.\ \underline{P}\ ?\delta$	$(?\delta \in \{\top\delta, \perp\delta, \top\delta_2\})$
ME, SLF	PN': $\text{CTR}\langle \top\varepsilon\rangle$, $\text{CTR}\langle \perp\varepsilon\rangle$	
HIM	$\text{QP}^{\perp}$: $\lambda \underline{P}([?\delta \neq_i \text{CTR}\langle \perp\varepsilon\rangle]; \underline{P}\ ?\delta)$	$(?\delta \in \{\top\delta, \perp\delta, \top\delta_2\})$
$^{\top}$	$\text{QP}^{\top}/\text{NP}$: $\lambda \underline{P}' \lambda \underline{P}((([\mathbf{x}]^{\top}; \underline{P}' \top\delta)^{\top}; \underline{P} \top\delta)$	
$_{\perp}$	$\text{QP}^{\perp}/\text{NP}$: $\lambda \underline{P}' \lambda \underline{P}((([y]^{\perp}; \underline{P}' \perp\delta)^{\perp}; \underline{P} \perp\delta)$	
BY	$\text{PP}_{\text{ps}}/\text{QP}^{\perp}$: $\lambda \underline{Q} \lambda K(\underline{Q}\ \lambda \underline{x}(K^{\perp}; [\text{CTR} \perp\varepsilon =_i \underline{x}]))$	$(\text{PP}_{\text{ps}} = \text{IV}_{\text{ps}}\backslash\text{IV}_{\text{ps}})$
	$\text{PP}_{\text{s}}/\text{QP}^{\perp}$: $\lambda \underline{Q} \lambda K(\underline{Q}\ \lambda \underline{x}(K^{\perp}; [\perp\varepsilon \subseteq_i \perp\varepsilon_2, \text{CTR} \perp\varepsilon_2 =_i \underline{x}]))$	$(\text{PP}_{\text{s}} = \text{s}\backslash\text{s})$
-PS	$\text{IV}_{\text{ps}}\backslash\text{TV}$: $\lambda \underline{P}.\ \underline{P}\ \text{BCK}\langle \perp\varepsilon\rangle$	
-PF	$\text{IV}_{\text{pf}}\backslash\text{IV}$: $\lambda K.\ K$	
-TNS	$\text{VP}\backslash\text{IV}$: $\lambda K \lambda \underline{x}(K^{\perp}; [\text{CTR} \perp\varepsilon =_i \underline{x}])$	
=N'T	$\text{VP}\backslash\text{VP}$: $\lambda \underline{P} \lambda \underline{x}[\sim(\underline{P}\ \underline{x})]$	

• <u>complex lexical items</u>

• has*n't*

have- | -TNS | =*N'T*

$\text{IV}/\text{IV}_{\text{pf}}$: $\lambda K.\ K$ | $\text{VP}\backslash\text{IV}$: $\lambda K \lambda \underline{x}(K^{\perp}; [\text{CTR} \perp\varepsilon =_i \underline{x}])$ | $\text{VP}\backslash\text{VP}$: $\lambda \underline{P} \lambda \underline{x}[\sim(\underline{P}\ \underline{x})]$

———————————————— $>\mathbf{B}_{\times}$

$\text{VP}/\text{IV}_{\text{pf}}$: $\lambda K \lambda \underline{x}(K^{\perp}; [\text{CTR} \perp\varepsilon =_i \underline{x}])$

———————————————— $>\mathbf{B}_{\times}$

$\text{VP}/\text{IV}_{\text{pf}}$: $\lambda K \lambda \underline{x}.[\sim(K^{\perp}; [\text{CTR} \perp\varepsilon =_i \underline{x}])]$

• been

be- | -PF

$\text{IV}/\text{IV}_{\text{ps}}$: $\lambda K(K^{\perp}; [e \mid e \subseteq_i \perp\varepsilon, \text{CTR } e =_i \text{BCK} \perp\varepsilon])$ | $\text{IV}_{\text{pf}}\backslash\text{IV}$: $\lambda K.\ K$

———————————————— $<\mathbf{B}_{\times}$

$\text{IV}_{\text{pf}}/\text{IV}_{\text{ps}}$: $\lambda K(K^{\perp}; [e \mid e \subseteq_i \perp\varepsilon, \text{CTR } e =_i \text{BCK} \perp\varepsilon])$

• received

receive- | -PF

$\text{TV}\ (= \text{x}_{[]}/\text{PN}')$: $\lambda \underline{y}([e]^{\perp}; [rcv\langle \perp\varepsilon, \text{CTR} \perp\varepsilon, \underline{y}\rangle])$ | $\text{IV}_{\text{pf}}\backslash\text{IV}$: $\lambda K.\ K$

———————————————— $<\mathbf{B}_{\times}$

$\text{IV}_{\text{pf}}/\text{PN}'$: $\lambda \underline{y}([e]^{\perp}; [rcv\langle \perp\varepsilon, \text{CTR} \perp\varepsilon, \underline{y}\rangle])$

|

receive- | -PS

TV: $\lambda \underline{y}([e]^{\perp}; [rcv\langle \perp\varepsilon, \text{CTR} \perp\varepsilon, \underline{y}\rangle])$ | $\text{IV}_{\text{ps}}\backslash\text{TV}$: $\lambda \underline{P}.\ \underline{P}\ \text{BCK}\langle \perp\varepsilon\rangle$

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IV_{ps}: $[e \mid rcv\langle e, \text{CTR } e, \text{BCK } e\rangle]$

2.2 AMBIGUOUS SCOPE FOR DIRECT OBJECT QP$^{\perp}$

(Last month $^{\top}$Ole ordered $^{\perp}$three books.)
He$_{\top}$ has*n't* received *one book* yet.
HE have-TNS=*N'T* receive-PF $^{\perp}$- *one book* yet
$\neg\exists$. hasn't received any
$\exists\neg$. one is still missing

<u>*Narrow scope* DO</u> ($x_{[]} = IV_{pf}$)

- HE has*n't* …
  HE — have-TNS=*N'T*
  QP$^{\top}$ (= s/VP): $\lambda \underline{P}.\ \underline{P}\ \top\delta$ — VP/IV$_{pf}$: $\lambda K \lambda \underline{x}[\sim(K\ ^{\perp};\ [\text{CTR}\ \perp\varepsilon =_i \underline{x}])]$
  ——————————————— >**B**
  s/IV$_{pf}$: $\lambda K[\sim(K\ ^{\perp};\ [\text{CTR}\ \perp\varepsilon =_i \top\delta])]$

- … receive-PF $^{\perp}$*one book* (yet).
  receive-PF
  ——————————————— <**B**$_{\times}$
  IV$_{pf}$/PN$'$: $\lambda \underline{y}([e]\ ^{\perp};\ [rcv\langle \perp\varepsilon, \text{CTR}\ \perp\varepsilon, \underline{y}\rangle])$
  $^{\perp}$ — *one* — *book*
  QP$^{\perp}$/NP: $\lambda \underline{P}' \lambda \underline{P}(([y]\ ^{\perp};\ \underline{P}'\ \perp\delta)\ ^{\perp};\ \underline{P}\ \perp\delta)$ — NP/CN: $\lambda P \lambda \underline{x}([P\langle \perp\delta_2\rangle];\ [\underline{x} \in \perp\delta_2||])$ — CN: $\lambda x.\ bk\ x$
  ——————————————— >**B**
  QP$^{\perp}$/CN: $\lambda \underline{P}' \lambda \underline{P}(([y]\ ^{\perp};\ ([P'\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||]))\ ^{\perp};\ \underline{P}\ \perp\delta)$
  ——————————————— >
  QP$^{\perp}$: $\lambda \underline{P}(([y]\ ^{\perp};\ ([bk\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||]))\ ^{\perp};\ \underline{P}\ \perp\delta)$
  QP$^{\perp}$ (= $x_{[]}\backslash(x_{[]}$/PN$'$)): $\lambda \underline{P}(([y];\ [bk\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||])\ ^{\perp};\ \underline{P}\ \perp\delta)$
  ——————————————— <
  IV$_{pf}$: $(([y];\ [bk\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||])\ ^{\perp};\ ([e]\ ^{\perp};\ [rcv\langle \perp\varepsilon, \text{CTR}\ \perp\varepsilon, \perp\delta\rangle]))$
  IV$_{pf}$: $([y];\ [bk\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||];\ [e|\ rcv\langle e, \text{CTR}\ e, \perp\delta\rangle])$

- HE has*n't* [receive-PF $^{\perp}$*one book*] (yet).
  ——————————————— >
  s: $[\sim(([y];\ [bk\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||];\ [e|\ rcv\langle e, \text{CTR}\ e, \perp\delta\rangle])\ ^{\perp};\ [\text{CTR}\ \perp\varepsilon =_i \top\delta])]$
  s: $[\sim([y];\ [bk\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||];\ [e|\ rcv\langle e, \text{CTR}\ e, \perp\delta\rangle, \text{CTR}\ e =_i \top\delta])]$
  s: $[\sim([y];\ [bk\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||];\ [e|\ rcv\langle e, \top\delta, \perp\delta\rangle])]$

Wide scope DO ($x_{[]} = s$)

- HE has*n't* receive-PF …

HE | have-TNS=*N'T* | receive-PF

QP$^{\top}$ (= s/VP): $\lambda \underline{P}.\ \underline{P}\ \top\delta$

VP/IV$_{pf}$: $\lambda K \lambda \underline{x}[\sim(K^{\perp};\ [\text{CTR}\ \perp\varepsilon =_i \underline{x}])]$

IV$_{pf}$/PN$'$: $\lambda \underline{y}([e]^{\perp};\ [rcv\langle \perp\varepsilon, \text{CTR}\ \perp\varepsilon, \underline{y}\rangle])$

$>$**B**

VP/PN$'$: $\lambda \underline{y} \lambda \underline{x}[\sim(([e]^{\perp};\ [rcv\langle \perp\varepsilon, \text{CTR}\ \perp\varepsilon, \underline{y}\rangle])^{\perp};\ [\text{CTR}\ \perp\varepsilon =_i \underline{x}])]$
VP/PN$'$: $\lambda \underline{y} \lambda \underline{x}[\sim([e|\ rcv\langle e, \text{CTR}\ e, \underline{y}\rangle]^{\perp};\ [\text{CTR}\ \perp\varepsilon =_i \underline{x}])]$
VP/PN$'$: $\lambda \underline{y} \lambda \underline{x}[\sim[e|\ rcv\langle e, \underline{x}, \underline{y}\rangle]]$

$>$**B**

s/PN$'$: $\lambda \underline{y}[\sim[e|\ rcv\langle e, \top\delta, \underline{y}\rangle]]$

- … $^{\perp}$*one book* (yet).

$\perp$ | *one* | *book*

QP$^{\perp}$/NP: $\lambda \underline{P}' \lambda \underline{P}(([y]^{\perp};\ \underline{P}'\perp\delta)^{\perp};\ \underline{P}\ \perp\delta)$

NP/CN: $\lambda P \lambda \underline{x}([P\langle \perp\delta_2\rangle];\ [\underline{x} \in \perp\delta_2||])$

CN: $\lambda x.\ bk\ x$

$>$**B**

QP$^{\perp}$/CN: $\lambda \underline{P}' \lambda \underline{P}(([y]^{\perp};\ ([P'\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||]))^{\perp};\ \underline{P}\ \perp\delta)$

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QP$^{\perp}$ ($= x_{[]}\backslash(x_{[]}$/PN$'$)): $\lambda \underline{P}(([y]^{\perp};\ ([bk\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||]))^{\perp};\ \underline{P}\ \perp\delta)$
QP$^{\perp}$ ($= x_{[]}\backslash(x_{[]}$/PN$'$)): $\lambda \underline{P}(([y];\ [bk\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||])^{\perp};\ \underline{P}\ \perp\delta)$

- [HE has*n't* receive-PF] $^{\perp}$*one book* (yet).

$<$

s: $(([y];\ [bk\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||])^{\perp};\ [\sim[e|\ rcv\langle \perp\varepsilon, \top\delta, \perp\delta\rangle]])$
s: $([y];\ [bk\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||];\ [\sim[e|\ rcv\langle \perp\varepsilon, \top\delta, \perp\delta\rangle]])$

2.3 Only Wide Scope for Subject QP$^{\top}$ (= s/vp)

(Last month $^{\top}$Ole ordered $^{\perp}$three books.)
$^{\top}$**One book** has*n't* been received yet.
$\exists\neg$. one is still missing

- $^{\top}$One book …

$^{\top}$-	one	book
QP$^{\top}$/NP: $\lambda \underline{P}'\lambda \underline{P}(([\mathbf{x}]^{\top};\ \underline{P}'\top\delta)^{\top};\ \underline{P}\top\delta)$	NP/CN: $\lambda P\lambda \underline{x}([P\langle\perp\delta\rangle];\ [\underline{x}\in\perp\delta\|\|])$	CN: $\lambda x.\ bk\ x$

$>$**B**

QP$^{\top}$/CN: $\lambda \underline{P}'\lambda \underline{P}(([\mathbf{x}]^{\top};\ ([P'\langle\perp\delta\rangle];\ [\top\delta\in\perp\delta\|\|]))^{\top};\ \underline{P}\top\delta)$

$>$

QP$^{\top}$ (= s/VP): $\lambda \underline{P}(([\mathbf{x}]^{\top};\ ([bk\langle\perp\delta\rangle];\ [\top\delta\in\perp\delta\|\|]))^{\top};\ \underline{P}\top\delta)$
QP$^{\top}$ (= s/VP): $\lambda \underline{P}(([\mathbf{x}];\ [bk\langle\perp\delta\rangle];\ [\top\delta\in\perp\delta\|\|])^{\top};\ \underline{P}\top\delta)$

- … hasn't been received.

have-TNS=*N'T*	be-PF
VP/IV$_{pf}$: $\lambda K\lambda \underline{x}[\sim(K^{\perp};\ [\text{CTR}\perp\varepsilon =_i \underline{x}])]$	IV$_{pf}$/IV$_{ps}$: $\lambda K(K^{\perp};\ [e\mid e\sqsubseteq_i\perp\varepsilon,\ \text{CTR}\ e =_i \text{BCK}\perp\varepsilon])$

$>$**B**

VP/IV$_{ps}$: $\lambda K\lambda \underline{x}[\sim((K^{\perp};\ [e\mid e\sqsubseteq_i\perp\varepsilon,\ \text{CTR}\ e =_i \text{BCK}\perp\varepsilon])^{\perp};\ [\text{CTR}\perp\varepsilon =_i \underline{x}])]$
VP/IV$_{ps}$: $\lambda K\lambda \underline{x}[\sim(K^{\perp};\ [e\mid e\sqsubseteq_i\perp\varepsilon,\ \text{CTR}\ e =_i \text{BCK}\perp\varepsilon,\ \text{CTR}\ e =_i \underline{x}])]$

receive-PS

$<$

IV$_{ps}$: $[e\mid rcv\langle e,\ \text{CTR}\ e,\ \text{BCK}\ e\rangle]$

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VP: $\lambda \underline{x}[\sim([e\mid rcv\langle e,\ \text{CTR}\ e,\ \text{BCK}\ e\rangle]^{\perp};\ [e\mid e\sqsubseteq_i\perp\varepsilon,\ \text{CTR}\ e =_i \text{BCK}\perp\varepsilon,\ \text{CTR}\ e =_i \underline{x}])]$
VP: $\lambda \underline{x}[\sim[e'\ e\mid rcv\langle e,\ \text{CTR}\ e,\ \text{BCK}\ e\rangle,\ e'\sqsubseteq_i e,\ \text{CTR}\ e' =_i \text{BCK}\ e,\ \text{CTR}\ e' =_i \underline{x}]]$
VP: $\lambda \underline{x}[\sim[e'\ e\mid rcv\langle e,\ \text{CTR}\ e,\ \top\delta\rangle,\ e'\sqsubseteq_i e,\ \text{CTR}\ e' =_i \underline{x}]]$

- $^{\top}$**One book** has*n't* been received.

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s: $(([\mathbf{x}];\ [bk\langle\perp\delta\rangle];\ [\top\delta\in\perp\delta\|\|])^{\top};\ [\sim[e'\ e\mid rcv\langle e,\ \text{CTR}\ e,\ \top\delta\rangle,\ e'\sqsubseteq_i e,\ \text{CTR}\ e' =_i \top\delta]])$
s: $([\mathbf{x}];\ [bk\langle\perp\delta\rangle];\ [\top\delta\in\perp\delta\|\|];\ [\sim[e'\ e\mid rcv\langle e,\ \text{CTR}\ e,\ \top\delta\rangle,\ e'\sqsubseteq_i e,\ \text{CTR}\ e' =_i \top\delta]])$

2.4 ONLY NARROW SCOPE FOR PASSIVE 'IMPLICIT AGENT'

(Ole$^{\top}$ has invited his students$^{\perp}$ to come and see him individually. But…)
He has*n't* been *approach*ed yet.
$\neg\exists$. none have approached him yet

- HE …
  HE

  QP$^{\top}$ (= s/VP):
  $\lambda \underline{P}.\ \underline{P}\ \top\delta$

- … has*n't* been *approach*ed (yet).

  have-TNS=*N'T* — VP/IV$_{pf}$: $\lambda K \lambda \underline{x}[\sim(K^{\perp}; [\text{CTR } \perp\varepsilon =_i \underline{x}])]$

  be-PF — IV$_{pf}$/IV$_{ps}$: $\lambda K(K^{\perp}; [e|\ e \subseteq_i \perp\varepsilon, \text{CTR } e =_i \text{BCK } \perp\varepsilon])$

  $>$**B**

  VP/IV$_{ps}$: $\lambda K \lambda \underline{x}[\sim((K^{\perp}; [e|\ e \subseteq_i \perp\varepsilon, \text{CTR } e =_i \text{BCK } \perp\varepsilon])^{\perp}; [\text{CTR } \perp\varepsilon =_i \underline{x}])]$
  VP/IV$_{ps}$: $\lambda K \lambda \underline{x}[\sim(K^{\perp}; [e|\ e \subseteq_i \perp\varepsilon, \text{CTR } e =_i \text{BCK } \perp\varepsilon, \text{CTR } e =_i \underline{x}])]$

  approach-PS
  $<$
  IV$_{ps}$: $[e|\ apr\langle e, \text{CTR } e, \text{BCK } e\rangle]$

  $>$

  VP: $\lambda \underline{x}[\sim([e|\ apr\langle e, \text{CTR } e, \text{BCK } e\rangle]^{\perp}; [e|\ e \subseteq_i \perp\varepsilon, \text{CTR } e =_i \text{BCK } \perp\varepsilon, \text{CTR } e =_i \underline{x}])]$
  VP: $\lambda \underline{x}[\sim[e'\,e|\ apr\langle e, \text{CTR } e, \text{BCK } e\rangle, e' \subseteq_i e, \text{CTR } e' =_i \text{BCK } e, \text{CTR } e' =_i \underline{x}]]$
  VP: $\lambda \underline{x}[\sim[e'\,e|\ apr\langle e, \text{CTR } e, \top\delta\rangle, e' \subseteq_i e, \text{CTR } e' =_i \underline{x}]]$

- HE has*n't* been *approach*ed (yet).

  $>$

  s: $\lambda \underline{P}(\underline{P}\ \top\delta)\ \lambda \underline{x}[\sim[e'\,e|\ apr\langle e, \text{CTR } e, \top\delta\rangle, e' \subseteq_i e, \text{CTR } e' =_i \underline{x}]]$
  s: $[\sim[e'\,e|\ apr\langle e, \text{CTR } e, \top\delta\rangle, e' \subseteq_i e, \text{CTR } e' =_i \top\delta]]$

2.5 AMBIGUOUS SCOPE FOR PASSIVE *by*-PHRASE

(Ole$^{\top}$ has invited his students$^{\bot}$ to come and see him individually. But…)
He$_{\top}$ has*n't* been approached *BY one*$_{\bot}$ *student* yet.
∃¬. one still hasn't come
¬∃. none have come yet

Narrow scope BY QP *attached to* IV$_{ps}$

- HE …

  HE

  QP$^{\top}$ (= s/VP):
  $\lambda \underline{P}.\ \underline{P}\ \top\delta$

- … has*n't* been [approached *BY one*$_{\bot}$ *student*] (yet).

  have-TNS=*N'T* be-PF

  ——— >**B**

  VP/IV$_{ps}$: $\lambda K \lambda \underline{x}[\sim(K^{\bot}; [e|\ e \subseteq_i \bot\varepsilon, \text{CTR}\ e =_i \text{BCK}\ \bot\varepsilon, \text{CTR}\ e =_i \underline{x}])]$

  approach-PS

  ——— <

  IV$_{ps}$: $[e|\ app\langle e, \text{CTR}\ e, \text{BCK}\ e\rangle]$

  BY

  ———

  PP$_{ps}$/QP$^{\bot}$: $\lambda \underline{Q} \lambda K(\underline{Q}\ \lambda \underline{x}(K^{\bot}; [\text{CTR}\ \bot\varepsilon =_i \underline{x}]))$

  $^{\bot}$-*one student*

  ——— >

  QP$^{\bot}$: $\lambda \underline{P}(([y];\ [std\langle \bot\delta_2\rangle]; [\bot\delta \in \bot\delta_2||])^{\bot}; \underline{P}\ \bot\delta)$

  ——— >

  PP$_{ps}$ (= IV$_{ps}$\IV$_{ps}$):
  $\lambda K(([y]; [std\langle \bot\delta_2\rangle]; [\bot\delta \in \bot\delta_2||])^{\bot}; (K^{\bot}; [\text{CTR}\ \bot\varepsilon =_i \bot\delta]))$

  ——— <

  IV$_{ps}$: $\lambda K(([y]; [std\langle \bot\delta_2\rangle]; [\bot\delta \in \bot\delta_2||])^{\bot}; (K^{\bot}; [\text{CTR}\ \bot\varepsilon =_i \bot\delta]))$
  $[e|\ app\langle e, \text{CTR}\ e, \text{BCK}\ e\rangle]$

  IV$_{ps}$: $([y]; [std\langle \bot\delta_2\rangle]; [\bot\delta \in \bot\delta_2||]; [e|\ app\langle e, \bot\delta, \text{BCK}\ e\rangle])$

  ——— >

  VP: $\lambda \underline{x}[\sim(([y]; [std\langle \bot\delta_2\rangle]; [\bot\delta \in \bot\delta_2||]; [e|\ app\langle e, \bot\delta, \text{BCK}\ e\rangle])$
  $^{\bot}; [e|\ e \subseteq_i \bot\varepsilon, \text{CTR}\ e =_i \text{BCK}\ \bot\varepsilon, \text{CTR}\ e =_i \underline{x}])]$

  VP: $\lambda \underline{x}[\sim([y]; [std\langle \bot\delta_2\rangle]; [\bot\delta \in \bot\delta_2||]; [e'\,e|\ app\langle e, \bot\delta, \text{BCK}\ e\rangle,$
  $e' \subseteq_i e, \text{CTR}\ e' =_i \text{BCK}\ e, \text{CTR}\ e' =_i \underline{x}])]$

  VP: $\lambda \underline{x}[\sim([y]; [std\langle \bot\delta_2\rangle]; [\bot\delta \in \bot\delta_2||]; [e'\,e|\ app\langle e, \bot\delta, \top\delta\rangle, e' \subseteq_i e, \text{CTR}\ e' =_i \underline{x}])]$

- HE has*n't* been [approached *BY one*$_{\bot}$ *student*] (yet).

  ——— >

  s: $[\sim([y]; [std\langle \bot\delta_2\rangle]; [\bot\delta \in \bot\delta_2||]; [e'\,e|\ app\langle e, \bot\delta, \top\delta\rangle, e' \subseteq_i e, \text{CTR}\ e' =_i \top\delta])]$

Wide scope BY QP *attached to* VP (= s\PN)

- HE …

  HE

  ————————

  $\text{QP}^{\top}$ (= s/VP):

  $\lambda \underline{P}.\ \underline{P}\ \top\delta$

- … [has*n't* been approached] *BY* $one_{\perp}$ *student* (yet).

  have-TNS=*N'T* be-PF

  ———————————————————————— >**B**

  VP/IV_{ps}: $\lambda K \lambda \underline{x}[\sim(K^{\perp};\ [e|\ e \subseteq_i \perp\varepsilon,\ \text{CTR}\ e =_i \text{BCK}\ \perp\varepsilon,\ \text{CTR}\ e =_i \underline{x}])]$

  approach-PS

  ———————— <

  IV_{ps}: $[e|\ app\langle e, \text{CTR}\ e, \text{BCK}\ e\rangle]$

  ———————————————————————— >

  VP (= s\PN):

  $\lambda \underline{x}[\sim([e|\ app\langle e, \text{CTR}\ e, \text{BCK}\ e\rangle]^{\perp};\ [e|\ e \subseteq_i \perp\varepsilon,\ \text{CTR}\ e =_i \text{BCK}\ \perp\varepsilon,\ \text{CTR}\ e =_i \underline{x}])]$

  $\lambda \underline{x}[\sim[e'\ e|\ app\langle e, \text{CTR}\ e, \text{BCK}\ e\rangle,\ e' \subseteq_i e,\ \text{CTR}\ e' =_i \text{BCK}\ e,\ \text{CTR}\ e' =_i \underline{x}]]$

  $\lambda \underline{x}[\sim[e'\ e|\ app\langle e, \text{CTR}\ e, \underline{x}\rangle,\ e' \subseteq_i e,\ \text{CTR}\ e' =_i \underline{x}]]$

  BY

  ————————————

  $\text{PP}_s/\text{QP}^{\perp}$: $\lambda \underline{Q} \lambda K(\underline{Q}\ \lambda \underline{x}(K^{\perp};\ [\text{CTR}\ \perp\varepsilon_2 =_i \underline{x}]))$

  $^{\perp}$-*one student*

  ———————————————— >

  $\text{QP}^{\perp}$: $\lambda \underline{P}(([y];\ [std\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||])^{\perp};\ \underline{P}\ \perp\delta)$

  ———————————————————— >

  PP_s (= s\s):

  $\lambda K(([y];\ [std\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||])^{\perp};\ (K^{\perp};\ [\text{CTR}\ \perp\varepsilon_2 =_i \perp\delta]))$

  ———————————————————————————— <**B**

  VP (= s\PN):

  $\lambda \underline{x}(\lambda K(((([y];\ [std\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||])^{\perp};\ (K^{\perp};\ [\text{CTR}\ \perp\varepsilon_2 =_i \perp\delta]))$

  $\quad [\sim[e'\ e|\ app\langle e, \text{CTR}\ e, \underline{x}\rangle,\ e' \subseteq_i e,\ \text{CTR}\ e' =_i \underline{x}]]))$

  $\lambda \underline{x}(\lambda K(((([y];\ [std\langle \perp\delta_2\rangle];\ [\perp\delta \in \perp\delta_2||])^{\perp};$

  $\quad ([\sim[e'\ e|\ app\langle e, \text{CTR}\ e, \underline{x}\rangle,\ e' \subseteq_i e,\ \text{CTR}\ e' =_i \underline{x}]]^{\perp};\ [\text{CTR}\ \perp\varepsilon_2 =_i \perp\delta]))$

  Oops! The antecedent (e) for $\perp\varepsilon_2$ is trapped inside the scope of negation (~). So this background-elaboration sequence ($A^{\perp}$; B) denotes the absurd state (i.e. wide scope BY QP is wrongly ruled out).

  Outline of solution: Adopt a different analysis of negation, as modal discourse reference to an unrealized scenario (adapting Stone & Hardt 1997 'Dynamic discourse referents for tenses and modals', see pdf on Stone's web page under *Computational semantics*)

3. SCOPE IN KALAALLISUT

3.1 KALAALLISUT LEXICON

<table>
<tr><td colspan="4">• <u>lexical categories</u> (iv = s\pn, tv = iv\pn)</td></tr>
<tr><td>book-</td><td>cn: $\lambda \underline{x}[bk\langle \underline{x}\rangle]$</td><td></td><td>atuaga(q)-</td></tr>
<tr><td>one-</td><td>cn: $\lambda \underline{x}([?\delta \in \underline{x}||]; [\underline{x} \in ?\delta||])$</td><td></td><td>ataasi(q)-</td></tr>
<tr><td>other-</td><td>cn: $\lambda \underline{x}([?\delta \in \underline{x}||]; [\underline{x} \neq_i ?\delta])$</td><td></td><td>alla-</td></tr>
<tr><td>big-</td><td>cn: $\lambda \underline{x}[big\{\underline{x}, \underline{x}||\}]$</td><td></td><td>angisuu(q)-</td></tr>
<tr><td>receive-</td><td>tv: $\lambda \underline{y}\lambda \underline{x}([e]^{\perp}; [rcv\langle \perp\varepsilon, \underline{x}, \underline{y}\rangle])$</td><td></td><td>tigu-</td></tr>
<tr><td>-rcv</td><td>iv\cn: $\lambda \underline{P}\lambda \underline{x}(\underline{P}\ \perp\delta^{\perp}; ([e]^{\perp}; [rcv\langle\perp\varepsilon, \underline{x}, \perp\delta\rangle]))$</td><td></td><td>-si</td></tr>
<tr><td>-see</td><td>iv\cn: $\lambda \underline{P}\lambda \underline{x}(\underline{P}\ \perp\delta^{\perp}; ([e]^{\perp}; [see\langle\perp\varepsilon, \underline{x}, \perp\delta\rangle]))$</td><td></td><td>-si</td></tr>
<tr><td>-pssv</td><td>iv\tv: $\lambda \underline{R}\lambda \underline{x}.\ \underline{R}\ \underline{x}\ \textsc{ctr}\langle\perp\varepsilon\rangle$</td><td></td><td>-niqar|taa</td></tr>
<tr><td>-antip</td><td>iv\tv: $\lambda\underline{R}\lambda\underline{x}.\ \underline{R}\ \textsc{bck}\langle\perp\varepsilon\rangle\ \underline{x}$</td><td></td><td>-si|(ss)i|nnig|llir</td></tr>
<tr><td>-not</td><td>iv\iv: $\lambda\underline{P}\lambda\underline{x}[\sim(\underline{P}\ \underline{x})]$</td><td></td><td>-nngit</td></tr>
<tr><td colspan="4">• <u>grammatical categories</u> ($s^+ = s/s$, $^+s = s\backslash s$)</td></tr>
<tr><td>-DEC</td><td>(s\pn)\iv: $\lambda\underline{P}\lambda\underline{x}.\ \underline{P}\ \underline{x}$</td><td></td><td>-pu|pa|la</td></tr>
<tr><td>-(ERG)$_{\top}$</td><td>x\cn: $\lambda\underline{P}\,\lambda K(\underline{P}\ \top\delta^{\top}; K)$</td><td>($x \in \{s^+, {}^+s\}$)</td><td>-Ø|p…(-3$_{\top}$)</td></tr>
<tr><td>-(ERG)$_{\perp}$</td><td>x\cn: $\lambda\underline{P}\,\lambda K(\underline{P}\ \perp\delta^{\perp}; K)$</td><td>($x \in \{s^+, {}^+s\}$)</td><td>-Ø|p…(-3$_{\perp}$)</td></tr>
<tr><td>-MOD$_{\delta}$</td><td>$s^+\backslash cn$: $\lambda\underline{P}\lambda K(\underline{P}\ \perp\delta^{\perp}; (K^{\perp}; [\textsc{bck}\ \perp\varepsilon =_i \perp\delta]))$</td><td></td><td>-mik</td></tr>
<tr><td>-$_{\delta}$MOD</td><td>$^+s\backslash cn$: $\lambda\underline{P}\lambda K(K^{\perp}; \underline{P}\ \perp\delta)$</td><td></td><td>-mik</td></tr>
<tr><td>-3S$_{(\top)}$</td><td>s\(s\pn): $\lambda\underline{P}.\ \underline{P}\ \top\delta$</td><td></td><td>-q|a…</td></tr>
<tr><td>-3S$_{(\perp)}$</td><td>s\(s\pn): $\lambda\underline{P}.\ \underline{P}\ \perp\delta$</td><td></td><td>-Ø…</td></tr>
<tr><td colspan="4">• <u>lexical operators</u></td></tr>
<tr><td>$^{\top}(\cdot)$-</td><td>cn/cn: $\lambda\underline{P}\lambda\underline{x}([\mathbf{x}]^{\top}; \underline{P}\ \underline{x})$</td><td></td><td>$\top a$-accomm.</td></tr>
<tr><td>$^{\perp}(\cdot)$-</td><td>cn/cn: $\lambda\underline{P}\lambda\underline{x}([y]^{\perp}; \underline{P}\ \underline{x})$</td><td></td><td>$\perp a$-accomm.</td></tr>
<tr><td>-$^{\backslash}(\cdot)$</td><td>$(cn\backslash {}^+s)\backslash cn$: $\lambda\underline{P}\lambda\underline{J}\lambda\underline{x}.\ \underline{J}(\underline{P}\ \underline{x})$</td><td></td><td>cn-lift</td></tr>
<tr><td></td><td>$(iv\backslash s^+)\backslash iv$: $\lambda\underline{P}\lambda\underline{J}\lambda\underline{x}.\ \underline{J}(\underline{P}\ \underline{x})$</td><td></td><td>iv-lift</td></tr>
<tr><td>-$^{\backslash\backslash}(\cdot)$</td><td>(s\(s\x))\x: $\lambda\underline{J}\lambda\underline{H}.\ \underline{H}\ \underline{J}$</td><td>($x \in \{s^+, {}^+s\}$)</td><td>post iv-lift</td></tr>
</table>

3.2 KALAALLISUT TRANSITIVE: WIDE SCOPE $s^{+}\ldots\text{-}pn_{\bot}$

(Last month $^{\top}$Ole ordered $^{\bot}$three books.)
(suli) atuaqaq ataasiq tigu-nngi(t)-la-a-Ø
(still) $^{\bot}book_{\bot}$ $one_{\bot}$ receive-*not*-DEC-$3S_{(\top)}$-$3S_{(\bot)}$
∃¬. one book is still missing

- $^{\bot}$book-$_{\bot}$ one-$_{\bot}$ …

$^{\bot}(\cdot)$- | *book* | -$_{\bot}$

cn/cn: $\lambda\underline{P}\lambda\underline{x}([y]\ ^{\bot};\ \underline{P}\ \underline{x})$ | cn: $\lambda\underline{x}[bk\langle\underline{x}\rangle]$ | $^{+}$s\cn: $\lambda\underline{P}\lambda K(\underline{P}\ \bot\delta\ ^{\bot};\ K)$

>: cn: $\lambda\underline{x}([y]\ ^{\bot};\ [bk\langle\underline{x}\rangle])$

<: $^{+}$s: $\lambda K([y|\ bk\langle y\rangle]\ ^{\bot};\ K)$

one- | -\(·) | -$_{\bot}$

cn: $\lambda\underline{x}([\bot\delta_2 \in \underline{x}||];\ [\underline{x} \in \bot\delta_2||])$ | (cn\$^{+}$s)\cn: $\lambda\underline{P}\lambda\underline{J}\lambda\underline{x}.\ \underline{J}(\underline{P}\ \underline{x})$ | s^{+}\cn: $\lambda\underline{P}\lambda K(\underline{P}\ \bot\delta\ ^{\bot};\ K)$

<: cn\$^{+}$s: $\lambda\underline{J}\lambda\underline{x}.\ \underline{J}([\bot\delta_2 \in \underline{x}||];\ [\underline{x} \in \bot\delta_2||])$

<**B**: s^{+}\$^{+}$s: $\lambda\underline{J}\lambda K(\underline{J}([\bot\delta_2 \in \bot\delta||];\ [\bot\delta \in \bot\delta_2||])\ ^{\bot};\ K)$

<: s^{+} (= s/s): $\lambda K(([y|\ bk\langle y\rangle];\ [\bot\delta_2 \in \bot\delta||];\ [\bot\delta \in \bot\delta_2||])\ ^{\bot};\ K)$

- … ⊤ hasn't received ⊥.

receive- | *-not* | -DEC | **-3s$_{(\top)}$** | *-3s$_{(\bot)}$*

tv (= iv\pn): $\lambda\underline{y}\lambda\underline{x}([e]\ ^{\bot};\ [rcv\langle\bot\varepsilon,\ \underline{x},\ \underline{y}\rangle])$ | iv\iv: $\lambda\underline{P}\lambda\underline{x}[\sim(\underline{P}\ \underline{x})]$ | (s\pn)\iv: $\lambda\underline{P}\lambda\underline{x}.\ \underline{P}\ \underline{x}$ | s\(s\pn): $\lambda\underline{P}.\ \underline{P}\ \top\delta$ | s\(s\pn): $\lambda\underline{P}.\ \underline{P}\ \bot\delta$

<**B**: tv (= iv\pn): $\lambda\underline{y}\lambda\underline{x}[\sim([e]\ ^{\bot};\ [rcv\langle\bot\varepsilon,\ \underline{x},\ \underline{y}\rangle])]$

<**B**: (s\pn)\pn: $\lambda\underline{y}\lambda\underline{x}[\sim([e]\ ^{\bot};\ [rcv\langle\bot\varepsilon,\ \underline{x},\ \underline{y}\rangle])]$

<**B**: s\pn: $\lambda\underline{y}[\sim([e]\ ^{\bot};\ [rcv\langle\bot\varepsilon,\ \top\delta,\ \underline{y}\rangle])]$

<: s: $[\sim[e|\ rcv\langle e,\ \top\delta,\ \bot\delta\rangle]]$

- >: s: $([y|\ bk\langle y\rangle];\ [\bot\delta_2 \in \bot\delta||];\ [\bot\delta \in \bot\delta_2||];\ [\sim[e|\ rcv\langle e,\ \top\delta,\ \bot\delta\rangle]])$

3.3 KALAALLISUT 'PASSIVE': WIDE SCOPE $s^{+}\ldots$-**pn**$_{\top}$

(Last month $^{\top}$Ole ordered $^{\bot}$three books.)
(suli) atuaqaq ataasiq tigu-niqa(r)-nngi(t)-la-q
(still) $^{\top}$**book**$_{\top}$ **one**$_{\top}$ receive-pssv-*not*-DEC-**3s**$_{(\top)}$
$\exists\neg$. one book is still missing

- $^{\top}$book-$_{\top}$ one-$_{\top}$ …

$^{\top}(\cdot)$- | **book** | -$_{\top}$

cn/cn: $\lambda \underline{P} \lambda \underline{x}([\mathbf{x}]\ ^{\top};\ \underline{P}\ \underline{x})$
cn: $\lambda \underline{x}[bk\langle \underline{x}\rangle]$
$^{+}$s\cn: $\lambda \underline{P} \lambda K(\underline{P}\ \top\delta\ ^{\top};\ K)$

——— >
cn: $\lambda \underline{x}([\mathbf{x}]\ ^{\top};\ [bk\langle \underline{x}\rangle])$
——— <
$^{+}$s: $\lambda K(([\mathbf{x}]\ ^{\top};\ [bk\langle \top\delta\rangle])\ ^{\top};\ K)$
$^{+}$s: $\lambda K([\mathbf{x}|\ bk\langle \mathbf{x}\rangle]\ ^{\top};\ K)$

one- | -\\$(\cdot)$ | -$_{\top}$

cn: $\lambda \underline{x}([\bot\delta \in \underline{x}||];\ [\underline{x} \in \bot\delta||])$
(cn\\$^{+}$s)\cn: $\lambda \underline{P} \lambda \underline{J} \lambda \underline{x}.\ \underline{J}(\underline{P}\ \underline{x})$
s^{+}\cn: $\lambda \underline{P} \lambda K(\underline{P}\ \top\delta\ ^{\top};\ K)$

——— <
cn\\$^{+}$s: $\lambda \underline{J} \lambda \underline{x}.\ \underline{J}([\bot\delta \in \underline{x}||];\ [\underline{x} \in \bot\delta||])$
——— <**B**
s^{+}\\$^{+}$s: $\lambda \underline{J} \lambda K(\underline{J}([\bot\delta \in \top\delta||];\ [\top\delta \in \bot\delta||])\ ^{\top};\ K)$
——— <
s^{+} (= s/s): $\lambda K(([\mathbf{x}|\ bk\langle \mathbf{x}\rangle];\ [\bot\delta \in \top\delta||];\ [\top\delta \in \bot\delta||])\ ^{\top};\ K)$

- … $\top$ has*n't* been received.

receive- | -pssv | -*not* | -DEC | **-3s**$_{(\top)}$

tv: $\lambda \underline{y} \lambda \underline{x}([e]\ ^{\bot};\ [rcv\langle \bot\varepsilon,\ \underline{x},\ \underline{y}\rangle])$
iv\tv: $\lambda \underline{R} \lambda \underline{y}.\ \underline{R}\ \underline{y}\ \text{CTR}\langle \bot\varepsilon\rangle$
iv\iv: $\lambda \underline{P} \lambda \underline{x}[\sim(\underline{P}\ \underline{x})]$
(s\pn)\iv: $\lambda \underline{P} \lambda \underline{x}.\ \underline{P}\ \underline{x}$
s\(s\pn): $\lambda \underline{P}.\ \underline{P}\ \top\delta$

——— <
iv: $\lambda \underline{y}([e]\ ^{\bot};\ [rcv\langle \bot\varepsilon,\ \text{CTR}\ \bot\varepsilon,\ \underline{y}\rangle])$
——— <
iv: $\lambda \underline{x}[\sim([e]\ ^{\bot};\ [rcv\langle \bot\varepsilon,\ \text{CTR}\ \bot\varepsilon,\ \underline{x}\rangle])]$
——— <
s\pn: $\lambda \underline{x}[\sim([e]\ ^{\bot};\ [rcv\langle \bot\varepsilon,\ \text{CTR}\ \bot\varepsilon,\ \underline{x}\rangle])]$
——— <
s: $[\sim[e|\ rcv\langle e,\ \text{CTR}\ e,\ \top\delta\rangle]]$

- $^{\top}$**one-**$_{\top}$ **book**$_{\top}$ [$\top$ has*n't* been received].

——— >
s: $([\mathbf{x}|\ bk\langle \mathbf{x}\rangle];\ [\bot\delta \in \top\delta||];\ [\top\delta \in \bot\delta||];\ [\sim[e|\ rcv\langle e,\ \text{CTR}\ e,\ \top\delta\rangle]])$

3.4 KALAALLISUT ANTIPASSIVE: NARROW SCOPE s^{+}…-*antip*

(Last month $^{\top}$Ole ordered $^{\bot}$three books.)
(suli) atuakka-mik ataatsi-mik tigu-si-nngi(t)-la-q
(still) $^{\bot}$*book*-MOD$_{\delta}$ *one*-$_{\delta}$MOD $^{\backslash}$(receive-*antip*)-*not*-DEC-3S$_{(\top)}$
¬∃. hasn't received anything

- $^{\bot}$*book*-MOD$_{\delta}$ *one*-$_{\delta}$MOD …

$^{\bot}(\cdot)$- — *book* — -MOD$_{\delta}$

cn/cn: $\lambda \underline{P}\lambda \underline{x}([y]\,^{\bot};\, \underline{P}\,\underline{x})$ cn: $\lambda \underline{x}[bk\langle \underline{x}\rangle]$ $s^{+}\backslash$cn: $\lambda \underline{P}\lambda K(\underline{P}\bot\delta^{\bot};\,(K^{\bot};\,[\text{BCK}\langle\bot\varepsilon\rangle =_{i} \bot\delta]))$

———— >

cn: $\lambda \underline{x}([y]\,^{\bot};\,[bk\langle \underline{x}\rangle])$

———— <

s^{+} (= s/s): $\lambda K([y|\ bk\langle y\rangle]\,^{\bot};\,(K^{\bot};\,[\text{BCK}\langle\bot\varepsilon\rangle =_{i} \bot\delta]))$

one- — -$_{\delta}$MOD

cn: $\lambda \underline{x}([\bot\delta_2 \in \underline{x}||];\,[\underline{x} \in \bot\delta_2||])$ $^{+}s\backslash$cn: $\lambda \underline{P}\lambda K(K^{\bot};\,\underline{P}\,\bot\delta)$

———— <

$^{+}$s (= s\s): $\lambda K(K^{\bot};\,([\bot\delta_2 \in \bot\delta||];\,[\bot\delta \in \bot\delta_2||]))$

———— <$\mathbf{B}_{\times}$

s^{+} (= s/s): $\lambda K([y|\ bk\langle y\rangle]\,^{\bot};\,(K^{\bot};\,([\bot\delta_2 \in \bot\delta||];\,[\bot\delta \in \bot\delta_2||];\,[\text{BCK}\langle\bot\varepsilon\rangle =_{i} \bot\delta]))$

- … ⊤ has*n't* *J*-[received *anything*].

receive- — *-antip* — -$^{\backslash}(\cdot)$ — *-not*-DEC-3S$_{(\top)}$

tv: $\lambda \underline{y}\lambda \underline{x}([e]\,^{\bot};\,[rcv\langle\bot\varepsilon, \underline{x}, \underline{y}\rangle])$ iv\tv: $\lambda \underline{R}\lambda \underline{x}.\ \underline{R}\ \text{BCK}\langle\bot\varepsilon\rangle\ \underline{x}$ (iv\s^{+})\iv: $\lambda \underline{P}\lambda \underline{J}\lambda \underline{x}.\ \underline{J}(\underline{P}\,\underline{x})$ s\iv: $\lambda \underline{P}\lambda \underline{x}[\sim(\underline{P}\ \top\delta)]$

———— <

iv: $\lambda \underline{x}([e]\,^{\bot};\,[rcv\langle\bot\varepsilon, \underline{x}, \text{BCK}\ \bot\varepsilon\rangle])$

———— <

iv\s^{+}: $\lambda \underline{J}\lambda \underline{x}.\ \underline{J}([e]\,^{\bot};\,[rcv\langle\bot\varepsilon, \underline{x}, \text{BCK}\ \bot\varepsilon\rangle])$

———— <**B**

s\s^{+}: $\lambda \underline{J}[\sim \underline{J}[e|\ rcv\langle e, \top\delta, \text{BCK}\ e\rangle]]$

- ———— <

s: $[\sim([y|\ bk\langle y\rangle];\,[e|\ rcv\langle e, \top\delta, \text{BCK}\ e\rangle];\,[\bot\delta_2 \in \bot\delta||];\,[\bot\delta \in \bot\delta_2||];\,[\text{BCK}\langle\bot\varepsilon\rangle =_{i} \bot\delta])]$
s: $[\sim([y|\ bk\langle y\rangle];\,[\bot\delta_2 \in \bot\delta||];\,[\bot\delta \in \bot\delta_2||];\,[e|\ rcv\langle e, \top\delta, \text{BCK}\ e\rangle];\,[\text{BCK}\langle\bot\varepsilon\rangle =_{i} \bot\delta])]$
s: $[\sim([y|\ bk\langle y\rangle];\,[\bot\delta_2 \in \bot\delta||];\,[\bot\delta \in \bot\delta_2||];\,[e|\ rcv\langle e, \top\delta, \bot\delta\rangle])]$

3.5 KALAALLISUT 'NOUN INCORPORATION': NARROW SCOPE $^{+}$s… *cn-*

(Last month $^{\top}$Ole ordered $^{\perp}$three books.)

a. (suli) ataatsi-mik atuagar-si-nngi(t)-la-q
(still) *one-*$_{\delta}$MOD \($^{\perp}$*book*)-receive-*not*-DEC-3S$_{(\top)}$
$\neg\exists$. hasn't received any book

- *One-*$_{\delta}$MOD…

one- | -$_{\delta}$MOD
---
cn: $\lambda \underline{x}([\perp\delta_2 \in \underline{x}||]; [\underline{x} \in \perp\delta_2||])$ | $^{+}$s\cn: $\lambda \underline{P} \lambda K(K^{\perp}; \underline{P} \perp\delta)$
——— <
$^{+}$s (= s\s): $\lambda K(K^{\perp}; ([\perp\delta_2 \in \perp\delta||]; [\perp\delta \in \perp\delta_2||]))$

- … ⊤ has*n't* [received any *J-book*].

$^{\perp}(\cdot)$- | *book-* | -$^{\backslash}(\cdot)$ | -rcv | -*not*-DEC-3S$_{(\top)}$
---
cn/cn: $\lambda \underline{P} \lambda \underline{x}([y]^{\perp}; \underline{P}\, \underline{x})$ | cn $\lambda \underline{x}[bk\langle \underline{x}\rangle]$ | (cn\$^{+}$s)\cn: $\lambda \underline{P} \lambda \underline{J} \lambda \underline{x}.\ \underline{J}(\underline{P}\, \underline{x})$ | iv\cn: $\lambda \underline{P} \lambda \underline{x}(\underline{P} \perp\delta^{\perp}; ([e]^{\perp}; [rcv\langle \perp\varepsilon, \underline{x}, \perp\delta\rangle]))$ | s\iv: $\lambda \underline{P}[\sim(\underline{P} \top\delta)]$
——— >
cn: $\lambda \underline{x}([y]^{\perp}; [bk\langle \underline{x}\rangle])$
——— <
cn\$^{+}$s: $\lambda \underline{J} \lambda \underline{x}.\ \underline{J}([y]^{\perp}; [bk\langle \underline{x}\rangle])$
——— <**B**
iv\$^{+}$s: $\lambda \underline{J} \lambda \underline{x}(\underline{J}[y|\ bk\langle y\rangle]^{\perp}; ([e]^{\perp}; [rcv\langle \perp\varepsilon, \underline{x}, \perp\delta\rangle]))$
——— <**B**
s\$^{+}$s: $\lambda \underline{J}[\sim(\underline{J}[y|\ bk\langle y\rangle]^{\perp}; [e|\ rcv\langle e, \top\delta, \perp\delta\rangle])]$

- *one-*$_{\delta}$MOD [⊤ has*n't* [received any *J-book*]].

——— <
s: $\lambda \underline{J}[\sim(\underline{J}[y|\ bk\langle y\rangle]^{\perp}; [e|\ rcv\langle e, \top\delta, \perp\delta\rangle])]\ \lambda K(K^{\perp}; ([\perp\delta_2 \in \perp\delta||]; [\perp\delta \in \perp\delta_2||]))$
s: $[\sim(([y|\ bk\langle y\rangle]^{\perp}; ([\perp\delta_2 \in \perp\delta||]; [\perp\delta \in \perp\delta_2||]))^{\perp}; [e|\ rcv\langle e, \top\delta, \perp\delta\rangle])]$
s: $[\sim([y|\ bk\langle y\rangle]; [\perp\delta_2 \in \perp\delta||]; [\perp\delta \in \perp\delta_2||]; [e|\ rcv\langle e, \top\delta, \perp\delta\rangle])]$

3.6 MULTIPLE *cn*-MODIFIERS: $[[{}^{+}\mathrm{s}\ldots\ cn\text{-}\ldots]\ {}^{+}\mathrm{s}]$

(Yesterday I saw a bear near the village. Today …)

b. *Ole* *alla-mik* *nanu-si-pu-q* *angisuu-mik.*
$^{\top}\mathrm{Ole}_{\top}$ other-$_{\delta}$MOD $^{\backslash}(^{\backslash}(^{\bot}\mathrm{bear}))$-see-DEC$_{\mathrm{iv}}$-3S$_{(\top)}$ $^{\backslash\backslash}$(big-$_{\delta}$MOD)
Ole saw *another* bear, a *big* one.

- ⊤ saw a <u>J</u>(other bear) …

other- | -$_{\delta}$MOD

$\mathrm{cn}: \lambda \underline{x}([\bot\delta_2 \in \underline{x}||]; [\underline{x} \neq_i \bot\delta_2])$ $\quad {}^{+}\mathrm{s\backslash cn}: \lambda \underline{P}\lambda K(K^{\bot}; \underline{P}\ \bot\delta)$ $\quad <$

${}^{+}\mathrm{s}\ (= \mathrm{s\backslash s}): \lambda K(K^{\bot}; ([\bot\delta_2 \in \bot\delta||]; [\bot\delta \neq_i \bot\delta_2]))$

$^{\bot}(\cdot)$- | *bear-* | -$^{\backslash}(\cdot)$ | -$^{\backslash}(\cdot)$

$\mathrm{cn/cn}: \lambda \underline{P}\lambda \underline{x}([y]^{\bot}; \underline{P}\ \underline{x})$ $\quad \mathrm{cn}\ \lambda \underline{x}[bear\langle \underline{x}\rangle]$ $\quad (\mathrm{cn\backslash^{+}s)\backslash cn}: \lambda \underline{P}\lambda \underline{J}\lambda \underline{x}.\ \underline{J}(\underline{P}\ \underline{x})$ $\quad (\mathrm{cn\backslash^{+}s)\backslash cn}: \lambda \underline{P}\lambda \underline{J}\lambda \underline{x}.\ \underline{J}(\underline{P}\ \underline{x})$

$>$ $\quad \mathrm{cn}: \lambda \underline{x}([y]^{\bot}; [bear\langle \underline{x}\rangle])$

$<$ $\quad \mathrm{cn\backslash^{+}s}: \lambda \underline{J}'\lambda \underline{x}.\ \underline{J}'([y]^{\bot}; [bear\langle \underline{x}\rangle])$

$<\mathbf{B}$ $\quad (\mathrm{cn\backslash^{+}s)\backslash^{+}s}: \lambda \underline{J}'\lambda \underline{J}\lambda \underline{x}.\ \underline{J}(\underline{J}'([y]^{\bot}; [bear\langle \underline{x}\rangle]))$

-see | -DEC-3S$_{(\top)}$

$\mathrm{iv\backslash cn}: \lambda \underline{P}\lambda \underline{x}(\underline{P}\ \bot\delta^{\bot}; ([e]^{\bot}; [see\langle \bot\varepsilon, \underline{x}, \bot\delta\rangle]))$ $\quad \mathrm{s\backslash iv}: \lambda \underline{P}.\ \underline{P}\ \top\delta$

$<<\mathbf{B}$ $\quad (\mathrm{iv\backslash^{+}s)\backslash^{+}s}: \lambda \underline{J}'\lambda \underline{J}\lambda \underline{x}(\underline{J}(\underline{J}'[y|\ bear\langle y\rangle])^{\bot}; ([e]^{\bot}; [see\langle \bot\varepsilon, \underline{x}, \bot\delta\rangle]))$

$<<\mathbf{B}$ $\quad (\mathrm{s\backslash^{+}s)\backslash^{+}s}: \lambda \underline{J}'\lambda \underline{J}(\underline{J}(\underline{J}'[y|\ bear\langle y\rangle])^{\bot}; [e|\ see\langle e, \top\delta, \bot\delta\rangle])$

$<\mathbf{B}$ $\quad \mathrm{s\backslash^{+}s}: \lambda \underline{J}(\underline{J}([y|\ bear\langle y\rangle]; [\bot\delta_2 \in \bot\delta||]; [\bot\delta \neq_i \bot\delta_2])^{\bot}; [e|\ see\langle e, \top\delta, \bot\delta\rangle])$

- … a *big one.*

big- | -$_{\delta}$MOD | -$^{\backslash\backslash}(\cdot)$

$\mathrm{cn}: \lambda \underline{x}[big\{\underline{x}, \underline{x}||\}]$ $\quad {}^{+}\mathrm{s\backslash cn}: \lambda \underline{P}\lambda K(K^{\bot}; \underline{P}\ \bot\delta)$ $\quad (\mathrm{s\backslash(s\backslash^{+}s))\backslash^{+}s}: \lambda \underline{J}\lambda \underline{H}.\ \underline{H}\ \underline{J}$

$<$ $\quad {}^{+}\mathrm{s}: \lambda K(K^{\bot}; [big\{\bot\delta, \bot\delta||\}])$

$<$ $\quad \mathrm{s\backslash(s\backslash^{+}s)}: \lambda \underline{H}.\ \underline{H}(\lambda K(K^{\bot}; [big\{\bot\delta, \bot\delta||\}]))$

- [⊤ saw a <u>J</u>-*other bear*] *a big one.*
- $\mathrm{s}: (([y|\ bear\langle y\rangle]; [\bot\delta_2 \in \bot\delta||]; [\bot\delta \neq_i \bot\delta_2])^{\bot}; [big\{\bot\delta, \bot\delta||\}])^{\bot}; [e|\ see\langle e, \top\delta, \bot\delta\rangle])$
  $\mathrm{s}: ([y|\ bear\langle y\rangle]; [\bot\delta_2 \in \bot\delta||]; [\bot\delta \neq_i \bot\delta_2]; [big\{\bot\delta, \bot\delta||\}]; [e|\ see\langle e, \top\delta, \bot\delta\rangle])$

(Yesterday I saw a big bear near the village. Today…)

b. *Ole* *angisuu-mik* *nanu-si-pu-q* *alla-mik.*
$^{\top}$Ole$_{\top}$ big-$_{\delta}$MOD $^{\backslash}$($^{\backslash}$($^{\perp}$bear))-see-DEC$_{iv}$-3S$_{(\top)}$ $^{\backslash\backslash}$(another-$_{\delta}$MOD)
Ole (too) saw *a big* bear, *another one*.

- ⊤ saw a *J-big bear* …

big- -$_{\delta}$MOD

cn: $\lambda \underline{x}[big\{\underline{x}, \underline{x}||\}]$ $^{+}$s\cn: $\lambda \underline{P}\lambda K(K^{\perp}; \underline{P} \perp\delta)$
——— <
$^{+}$s (= s\s): $\lambda K(K^{\perp}; [big\{\perp\delta, \perp\delta||\}])$

$^{\perp}(\cdot)$- *bear-* -$^{\backslash}(\cdot)$ -$^{\backslash}(\cdot)$

cn/cn: $\lambda \underline{P}\lambda \underline{x}([y]^{\perp}; \underline{P}\ \underline{x})$ cn $\lambda \underline{x}[bear\langle \underline{x}\rangle]$ (cn\$^{+}$s)\cn: $\lambda \underline{P}\lambda \underline{J}\lambda \underline{x}.\ \underline{J}(\underline{P}\ \underline{x})$ (cn\$^{+}$s)\cn: $\lambda \underline{P}\lambda \underline{J}\lambda \underline{x}.\ \underline{J}(\underline{P}\ \underline{x})$
——— >
cn: $\lambda \underline{x}([y]^{\perp}; [bear\langle \underline{x}\rangle])$
——— <
cn\$^{+}$s: $\lambda \underline{J}'\lambda \underline{x}.\ \underline{J}'([y]^{\perp}; [bear\langle \underline{x}\rangle])$
——— <**B**
(cn\$^{+}$s)\$^{+}$s: $\lambda \underline{J}'\lambda \underline{J}\lambda \underline{x}.\ \underline{J}(\underline{J}'([y]^{\perp}; [bear\langle \underline{x}\rangle]))$

-see -DEC$_{iv}$-3S$_{(\top)}$

iv\cn: $\lambda \underline{P}\lambda \underline{x}(\underline{P} \perp\delta^{\perp}; ([e]^{\perp}; [see\langle \perp\varepsilon, \underline{x}, \perp\delta\rangle]))$ s\iv: $\lambda \underline{P}.\ \underline{P} \top\delta$
——— <<**B**
(iv\$^{+}$s)\$^{+}$s: $\lambda \underline{J}'\lambda \underline{J}\lambda \underline{x}(\underline{J}(\underline{J}'[y|\ bear\langle y\rangle])^{\perp}; ([e]^{\perp}; [see\langle \perp\varepsilon, \underline{x}, \perp\delta\rangle]))$
——— <<**B**
(s\$^{+}$s)\$^{+}$s: $\lambda \underline{J}'\lambda \underline{J}(\underline{J}(\underline{J}'[y|\ bear\langle y\rangle])^{\perp}; [e|\ see\langle e, \top\delta, \perp\delta\rangle])$
——— <**B**
s\$^{+}$s: $\lambda \underline{J}(\underline{J}([y|\ bear\langle y\rangle]; [big\{\perp\delta, \perp\delta||\}])^{\perp}; [e|\ see\langle e, \top\delta, \perp\delta\rangle])$

- … *another one.*

other- -$_{\delta}$MOD -$^{\backslash\backslash}(\cdot)$

cn: $\lambda \underline{x}([\perp\delta_2 \in \underline{x}||]; [\underline{x} \neq_i \perp\delta_2])$ $^{+}$s\cn: $\lambda \underline{P}\lambda K(K^{\perp}; \underline{P} \perp\delta)$ (s\(s\$^{+}$s))\$^{+}$s: $\lambda \underline{J}\lambda \underline{H}.\ \underline{H}\ \underline{J}$
——— <
$^{+}$s: $\lambda K(K^{\perp}; ([\perp\delta_2 \in \perp\delta||]; [\perp\delta \neq_i \perp\delta_2]))$
——— <
s\(s\$^{+}$s): $\lambda \underline{H}.\ \underline{H}(\lambda K(K^{\perp}; ([\perp\delta_2 \in \perp\delta||]; [\perp\delta \neq_i \perp\delta_2]))$

- [⊤ saw a *J-big bear*] *another one.*
s: $(([y|\ bear\langle y\rangle]; [big\{\perp\delta, \perp\delta||\}]; [\perp\delta_2 \in \perp\delta||]; [\perp\delta \neq_i \perp\delta_2]))^{\perp}; [e|\ see\langle e, \top\delta, \perp\delta\rangle])$
s: $([y|\ bear\langle y\rangle]; [big\{\perp\delta, \perp\delta||\}]; [\perp\delta_2 \in \perp\delta||]; [\perp\delta \neq_i \perp\delta_2]; [e|\ see\langle e, \top\delta, \perp\delta\rangle])$

APPENDIX. UC_1 WITH EVENTS (UC_2)

DEFINITION 1 (Lists & infotention states) Let D be a non-empty set.

- $\langle D\rangle^{n,m} = D^n \times D^m$ is the set of ⊤⊥-*lists* of n topical D-objects (the ⊤-*list*) and m background D-objects (the ⊥-*list*).
- For any ⊤⊥-list $\mathsf{i} = \langle \mathsf{i}_1, \mathsf{i}_2\rangle \in \langle D\rangle^{n,m}$, $\top\mathsf{i} = \mathsf{i}_1$ and $\bot\mathsf{i} = \mathsf{i}_2$. Thus, $\mathsf{i} = \langle \top\mathsf{i}, \bot\mathsf{i}\rangle$.
- An *n,m-infotention state* is any subset of $\langle D\rangle^{n,m}$. $\varnothing$ is the *absurd state.*

DEFINITION 2 (UC_2 types) The set of UC_2 *types* is the smallest set Θ such that (i) $\{t, \delta, \varepsilon\} \subseteq \Theta$, (ii) if $a, b \in \Theta$, then $(ab) \in \Theta$, and (iii) $s \in \Theta$.

DEFINITION 3 (UC_2 frames) A UC_2 *frame* is a set $\{D_a|\ a \in \Theta\}$ of non-empty pairwise disjoint sets D_a s.t. (i) $D_t = \{1, 0\}$, (ii) $D_{ab} = \{f|\ \varnothing \subset \mathrm{Dom}\, f \subseteq D_a \wedge \mathrm{Ran}\, f \subseteq D_b\}$, and (iii) $D_s = \cup_{n, m \geq 0} \langle D_\delta \cup D_\varepsilon\rangle^{n,m}$.

DEFINITION 4 (UC_2 syntax) Define for all $a \in \Theta$ the set of a-terms as follows

i. $Con_a \cup {}^{\top}Var_a \cup {}^{\bot}Var_a \subseteq Term_a$
ii. $\lambda u_a(B) \in Term_{ab}$, if $u_a \in {}^{\top}Var_a \cup {}^{\bot}Var_a$ and $B \in Term_b$
iii. $BA \in Term_b$, if $B \in Term_{ab}$ and $A \in Term_a$
iv. $\neg A$, $(A \rightarrow B)$, $(A \wedge B)$, $(A \vee B) \in Term_t$, if $A, B \in Term_t$
v. $\forall u_a B$, $\exists u_a B \in Term_t$, if $u_a \in {}^{\top}Var_a \cup {}^{\bot}Var_a$ and $B \in Term_t$
vi. $(A = B) \in Term_t$, if $A, B \in Term_a$
vii. $(u_a \cdot B) \in Term_s$, if $a \in \{\delta, \varepsilon\}$, $u \in {}^{\top}Var_a \cup {}^{\bot}Var_a$ and $B \in Term_s$
viii. $\top a_n, \bot a_n \in Term_{sa}$, if $a \in \{\delta, \varepsilon\}$ and $n \geq 1$.
ix. $A\{B\} \in Term_{at}$, if $a \in \{\delta, \varepsilon\}$, $A \in Term_{sa}$ and $B \in Term_{st}$
x. $\downarrow A$, $(A; B)$, $(A^{\top}; B)$, $(A^{\bot}; B) \in Term_{(st)st}$, if $A, B \in Term_{(st)st}$
xi. $(A \subseteq B) \in Term_t$, if $A, B \in Term_\varepsilon$
xii. $BA \in Term_\delta$, if $B \in \{\text{CTR}, \text{BCK}, \text{DAT}\}$ and $A \in Term_\varepsilon$

ABBREVIATIONS 1 For $f \in D_{a_1 \ldots a_n t}$, $\langle \mathsf{a}_1, \ldots, \mathsf{a}_n\rangle \in D_{a_1} \times \ldots D_{a_n}$, $A \subseteq D_{a_1} \times \ldots D_{a_n}$:
(i) $f(\mathsf{a}_1, \ldots, \mathsf{a}_n) := f(\mathsf{a}_1)\ldots(\mathsf{a}_n)$, (ii) ${}^{\{\}}f := \{\langle \mathsf{a}_1, \ldots, \mathsf{a}_n\rangle|\ f(\mathsf{a}_1, \ldots, \mathsf{a}_n) = 1\}$
(iii) ${}^{\chi}A = \iota f \in D_{a_1 \ldots a_n t}.(A = {}^{\{\}}f)$

DEFINITION 5 (UC_2-models) A UC_2-model is a structure $M = \langle \{D_a|\ a \in \Theta\}, \subseteq_\varepsilon, \mathsf{e}_0, [\![\cdot]\!]\rangle$, where (i) $\{D_a|\ a \in \Theta\}$ is a UC_2 frame, (ii) $\subseteq_\varepsilon$ (ε-part of) is a weak partial order on D_ε, (iii) $\mathsf{e}_0 \in D_\varepsilon$ and (iv) $[\![\cdot]\!]$ assigns to each $A \in Con_a$ a value $[\![A]\!] \in D_a$, and to $B \in \{\text{CTR}, \text{BCK}, \text{DAT}\}$ a value $[\![B]\!] \in D_{\varepsilon\delta}$ such that:

a. $\langle \mathsf{e}, \mathsf{d}, \ldots\rangle \in [\![A]\!] \rightarrow [\![\text{CTR}]\!](\mathsf{e}) = \mathsf{d}$ if $A \in Con_{\varepsilon\delta\ldots t}$
b. $\langle \mathsf{e}, \mathsf{d}, \mathsf{d}', \ldots\rangle \in [\![A]\!] \rightarrow [\![\text{BCK}]\!](\mathsf{e}) = \mathsf{d}'$ if $A \in Con_{\varepsilon\delta\delta\ldots t}$
c. $\exists \mathsf{d}, \mathsf{d}' \in D_\delta$: $\langle \mathsf{e}_0, \mathsf{d}\rangle \in {}^{\{\}}[\![spk]\!] \wedge [\![\text{DAT}]\!](\mathsf{e}_0) = \mathsf{d}'$

ABBREVIATIONS 2 (Projections & dot-extensions). For any non-empty set D,

- $(\mathsf{x})_n$ = the nth coordinate, x_n for $\mathsf{x} \in D^{n+m}$
  $(\mathsf{x})_a$ = the subsequence of x consisting of $\mathsf{x}_i \in D_a$ for $a \in \{\delta, \varepsilon\}$
- $(\mathsf{d} \cdot \mathsf{x}) = \langle \mathsf{d}, \mathsf{x}_1, \ldots, \mathsf{x}_n \rangle$ for $\mathsf{d} \in D$, $\mathsf{x} \in D^n$
- $\mathsf{y} \cdot\!> \mathsf{x}$ iff $\mathsf{y} = (\mathsf{y}_1 \cdot \ldots(\mathsf{y}_m \cdot \mathsf{x}))$ for $\mathsf{y} \in D^{m+n}$, $\mathsf{x} \in D^n$

DEFINITION 6 (UC_2 semantics). The value $[\![A]\!]^g$ of a term A given $[\![\cdot]\!]$ and an assignment g is defined as follows (we write (i) '$X \doteq Y$' for 'X is Y, if Y is defined, else X is undefined', (ii) '$\mathsf{c}[\![X]\!]$' for '$[\![X]\!](\mathsf{c})$', for any $\mathsf{c} \in D_{st}$ (iii) '$X[Y/Z]$' for the result of replacing every occurrence of Y in X with Z, and (iv) use the Von Neumann definition, so $0 = \varnothing$ and $1 = \{\varnothing\}$):

i. $[\![u]\!]^g = g(u)$ if $u \in {}^{\top}Var_a \cup {}^{\perp}Var_a$
   $[\![A]\!]^g = [\![A]\!]$ if $A \in Con_a$

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. $[\![\neg A]\!]^g \doteq 1 \backslash [\![A]\!]^g$
   $[\![A \rightarrow B]\!]^g \doteq 1 \backslash ([\![A]\!]^g \backslash [\![B]\!]^g)$
   $[\![A \wedge B]\!]^g \doteq [\![A]\!]^g \cap [\![B]\!]^g$
   $[\![A \vee B]\!]^g \doteq [\![A]\!]^g \cup [\![B]\!]^g$

v. $[\![\forall u_a A]\!]^g \doteq \bigcap_{\mathsf{d} \in D_a} [\![A]\!]^{g[u/\mathsf{d}]}$
   $[\![\exists u_a A]\!]^g \doteq \bigcup_{\mathsf{d} \in D_a} [\![A]\!]^{g[u/\mathsf{d}]}$

vi. $[\![A = B]\!]^g = |\{\langle \mathsf{d}, \mathsf{d}' \rangle \in D_a{}^2 | \ \mathsf{d} = [\![A]\!]^g \wedge \mathsf{d}' = [\![B]\!]^g \wedge \mathsf{d} = \mathsf{d}'\}|$

vii. $[\![u_a \cdot B_s]\!]^g \doteq \langle (g(u_a) \cdot \top[\![B]\!]^g), \perp[\![B]\!]^g \rangle$ if $u_a \in {}^{\top}Var_a$
   $\doteq \langle \top[\![B]\!]^g, (g(u_a) \cdot \perp[\![B]\!]^g) \rangle$ if $u_a \in {}^{\perp}Var_a$

viii. $[\![\top a_n]\!]^g(\mathsf{i}) \doteq ((\top\mathsf{i})_a)_n$ if $\mathsf{i} \in D_s$
   $[\![\perp a_n]\!]^g(\mathsf{i}) \doteq ((\perp\mathsf{i})_a)_n$

ix. $[\![A\{B\}]\!]^g \doteq {}^{\chi}\{[\![A]\!]^g(\mathsf{i}) | \ \mathsf{i} \in {}^{\{\}}[\![B]\!]^g\}$

x. $\mathsf{c}[\![{\downarrow}A]\!]^g \doteq {}^{\chi}\{\mathsf{i} \in {}^{\{\}}\mathsf{c} | \ \exists \mathsf{j}: \top\mathsf{j} \cdot\!\geq \top\mathsf{i} \wedge \perp\mathsf{j} \cdot\!\geq \perp\mathsf{i} \wedge \mathsf{j} \in {}^{\{\}}(\mathsf{c}[\![A]\!]^g)\}$
   $\mathsf{c}[\![A; B]\!]^g \doteq \mathsf{c}[\![A]\!]^g[\![B]\!]^g$
   $\mathsf{c}[\![A^{\top}; B]\!]^g \doteq \{\mathsf{l} \in \mathsf{c}[\![A; B]\!]^g | \ \forall \mathsf{k} \in \mathsf{c}[\![A; B]\!]^g \exists \mathsf{j} \in \mathsf{c}[\![A]\!]^g \exists \mathsf{i} \in \mathsf{c} \exists \mathsf{d} \in D_e$:
   $\top\mathsf{k} \cdot\!\geq \top\mathsf{j} \cdot\!> \top\mathsf{i} \wedge (\top\mathsf{j})_1 = \mathsf{d} \wedge [\![B]\!]^g \neq [\![B[\top_1/\perp_1]]\!]^g \wedge (\top\mathsf{j})_1 = \mathsf{d}\}$
   $\mathsf{c}[\![A^{\perp}; B]\!]^g \doteq \{\mathsf{l} \in \mathsf{c}[\![A; B]\!]^g | \ \forall \mathsf{k} \in \mathsf{c}[\![A; B]\!]^g \exists \mathsf{j} \in \mathsf{c}[\![A]\!]^g \exists \mathsf{i} \in \mathsf{c} \exists \mathsf{d} \in D_e$:
   $\perp\mathsf{k} \cdot\!\geq \perp\mathsf{j} \cdot\!> \perp\mathsf{i} \wedge (\perp\mathsf{j})_1 = \mathsf{d} \wedge [\![B]\!]^g \neq [\![B[\perp_1/\top_1]]\!]^g \wedge (\perp\mathsf{j})_1 = \mathsf{d}\}$

xi. $[\![A \subseteq B]\!]^g \doteq |\{\langle \mathsf{e}, \mathsf{e}' \rangle \in D_{\varepsilon}{}^2 | \ \mathsf{e} = [\![A]\!]^g \wedge \mathsf{e}' = [\![B]\!]^g \wedge \mathsf{e} \subseteq_{\varepsilon} \mathsf{e}'\}|$

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

DEFINITION 7 (UC_2 defaults). For any UC_2 model $\langle\{D_a|\ a \in \Theta\}, \subseteq_\varepsilon, \mathsf{e}_0, [\![\cdot]\!]\rangle$, the *speech event*, e_0, induces the *default infotention state* $\mathsf{c}_0 = {}^{\chi}\{\langle\langle \mathsf{e}_0\rangle, \langle\ \rangle\rangle\}$.

DEFINITION 8 (Truth) An $(st)st$ term K is *true* in M iff $\forall g$: $\mathsf{c}_0[\![K]\!]^g \neq \varnothing$

- Table 1 (UC_2 variables)

	$a \in \Theta$	Abbrev.	${}^{\top}Var_a$	${}^{\bot}Var_a$	Name of objects
i.	δ		$\mathbf{x}, \mathbf{y}$	x, y, z	individuals
	ε		$\mathbf{e}$	e	eventualities
ii.	s			i, j	$\top\bot$-lists
	st			I, J	infotention states
	$(st)st$	[]		K	updates
iii.	$s\delta$	D		$\underline{x}, \underline{y}, \underline{z}$	δ-projections
	$s\varepsilon$	E		$\underline{e}$	ε-projections
	[][]	$[]^2$		$\underline{J}$	dynamic []-operators

- Table 2 (drt notation)

	Abbrev.	for	UC term	Example
i.	Static relations			
	$A_a \neq B_a$	for	$\neg(A = B)$	$\top_1 i \neq x$
	$A_a \in B_{at}$	for	BA	$\bot_2 j \in \bot_1\{I\}$
ii.	Local projections ($a \in \{\delta, \varepsilon\}$, $\mathbf{R} \in \{=, \neq, \subseteq\}$)			
	$\top a, \bot a$	for	$\top a_1, \bot a_1$	$\top\varepsilon, \bot\delta$
	$A_a{}^\circ$	for	$\lambda i.\ A$	$\mathbf{x}^\circ, x^\circ$
	$A_{sa}{}^\circ$	for	$\lambda i.\ Ai$	$\top\varepsilon^\circ, \bot\delta^\circ$
	$(B_{ab}\ A_{sa})^\circ$	for	$\lambda i.\ B\ A^\circ i$	$(\text{CTR}\ \top\varepsilon)^\circ$
	$A\ \mathbf{R}_i\ B$	for	$\lambda i.\ A^\circ i\ \mathbf{R}\ B^\circ i$	$(e \subseteq_i \bot\varepsilon)$
	$B\langle A_1,\ldots A_n\rangle$	for	$\lambda i.\ B\ A_1{}^\circ i\ \ldots\ A_n{}^\circ i$	$see\langle y, \bot\delta\rangle$
	$\sim K$	for	$\lambda i.\ \neg\exists j(j \in {\downarrow}K\ \lambda k(k = i))$	$\sim[y\vert\ man\langle y\rangle]$
	(C_1, C_2)	for	$\lambda i.\ C_1 i \wedge C_2 i$	
iii.	Local drt-boxes			
	$[u]$	for	$\lambda Ij.\ \exists u\exists i(j = (u \cdot i) \wedge Ii)$	$[\mathbf{x}]$
	$[C]$	for	$\lambda Ij.\ Ij \wedge Cj$	$[man\ \bot\delta]$
	$[u\vert\ C]$	for	$\lambda Ij.\ \exists u\exists i(j = (u \cdot i) \wedge Ii \wedge Ci)$	$[y\vert\ man\langle y\rangle]$
	$[u\ u'\vert\ C]$	for	$\lambda Ij.\ \exists u\exists u'\exists i(j = (u \cdot (u' \cdot i)) \wedge Ii \wedge Ci)$	
iv.	Global drt-boxes ($a \in \{\delta, \varepsilon\}$)			
	$[A \in B\Vert]$	for	$\lambda Ij.\ Ij \wedge Aj \in B\{I\})$	$[\bot\delta_2 \in \bot\delta\Vert]$
	$[B\{A, A'\Vert\}]$	for	$\lambda Ij.\ B\ Aj\ A'\{I\}$	$[big\{\bot\delta, \bot\delta\Vert\}]$