Intensionality

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1. *Holes in inference patterns*

- Terms and identity

(1a) 31 is prime. $\varphi[31]$ [$\equiv P(\underline{31})$]
The number of persons in this room is 31. $n = 31$
∴ The number of persons in this room is prime. $\varphi[n]$ [$\equiv P(\underline{n})$]

(b) According to elementary arithmetic, 31 prime.
The number of persons in this room is 31.
∵ According to elementary arithmetic, the number of persons in this room is prime.

(2a) John's salary is higher than Mary's. $\varphi[j,\underline{m}]$ [$\equiv s(j) > s(m)$]
John is the dean. $j = d$
Mary is the vice dean. $m = v$
∴ The dean's salary is higher than the vice dean's. $\varphi[\underline{d},\underline{v}]$

(b) Bill knows that the dean's salary is higher than the vice dean's.
John is the dean.
Mary is the vice dean.
∵ Bill knows that John's salary is higher than Mary's.

- Problems with existential quantification

(3a) Urs is a Swiss millionaire. $\varphi[M]$ [$\equiv S(u)$ & $\underline{M}(u)$]
All millionaires admire Scrooge McDuck. $(\forall x)\,[M(x) \rightarrow A(x)]$
[Only millionaires admire Scrooge McDuck.] $(\forall x)\,[A(x) \rightarrow M(x)]$
∴ Urs is a Swiss admirer of Scrooge McDuck. $\varphi[A]$ [$\equiv S(u)$ & $A(u)$]

Kim is an alleged millionaire.
All millionaires admire Scrooge McDuck.
Only millionaires admire Scrooge McDuck.
∵ Kim is an alleged admirer of Scrooge McDuck.

(4a) Paul is wearing a pink shirt with green sleeves.
All pink shirts with green sleeves have striped collars and gold buttons.
[Only pink shirts with green sleeves have striped collars and gold buttons.]
∴ Paul is wearing a shirt with striped collars and gold buttons.

(b) Paul is looking for a pink shirt with green sleeves.
All pink shirts with green sleeves have striped collars and gold buttons.
Only pink shirts with green sleeves have striped collars and gold buttons.
∵ Paul is looking for a shirt with striped collars and gold buttons.

(5a) Susan is entering a restaurant on Main Street.
The only restaurants on Main Street are *La Gourmande* and *Le Gourmet*.
∴ Susan is entering *La Gourmande, or [Susan is entering] Le Gourmet*.

(b) Susan is looking for a restaurant on Main Street.
The only restaurants on Main Street are *La Gourmande* and *Le Gourmet*.
∵ Susan is looking for *La Gourmande, or [Susan is entering] Le Gourmet*.

(6a) Paul is wearing a pink shirt with green sleeves.
∴ There are pink shirts with green sleeves.

(b) Paul is looking for a pink shirt with green sleeves.
∵ There are pink shirts with green sleeves.

(7a) There have never been any pictures of Lily.
∴ It is not true that Pete showed Roger a picture of Lily.

(b) There have never been any pictures of Lily.
∴ It is not true that Pete owed Roger a picture of Lily.

2. Extensions

- Compositionality

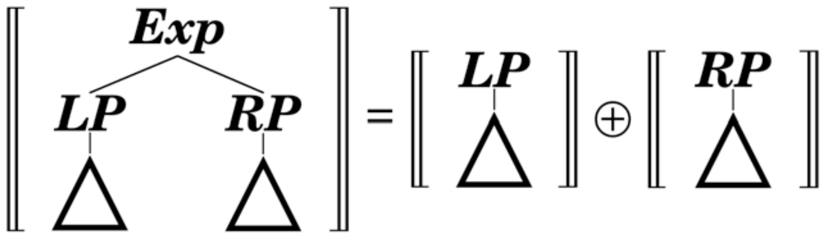
Substitution Principle

If two non-sentential expressions of the same category have the same meaning, either may replace the other in all positions within any sentence without thereby affecting the truth conditions of that sentence.

Principle of Compositionality

The meaning of a complex expression functionally depends on the meanings of its immediate parts and the way in which they are combined:

(8)



- Meaning as communicative function

- *Extension*: [contribution to] reference
- *Intension*: [contribution to] informational content
- …

- Basic Carnapian extensions — Carnap (1947)

(a) ⟦**Vienna**⟧= Vienna — ⟦***proper name***⟧= bearer

(b) ⟦**the largest city in Austria**⟧= Vienna — ⟦***definite description***⟧= descriptee

(c) ⟦**city**⟧= {London, Paris, Rome, Vienna, Frankfurt,…} = $\{x \mid x$ is a city$\}$
⟦***count noun***⟧= set of representatives

(d) ⟦**snore**⟧= $\{x \mid x$ snores$\}$ — ⟦***intransitive verb***⟧= set of satisfiers

(e) ⟦**meet**⟧= $\{(x,y) \mid x$ meets $y\}$ — ⟦***transitive verb***⟧= set of satisfier pairs

(f) ⟦**show**⟧= $\{(x,y,z) \mid x$ shows y to $z\}$ — ⟦***ditransitive verb***⟧= set of satisfier triples

(g) ⟦**shows Angie**⟧= $\{(x,y) \mid x$ shows y to Angie$\}$ — ⟦***2-place predicate***⟧= set of satisfier pairs

(h) ⟦**shows Angie Disneyland**⟧= $\{(x) \mid x$ shows Disneyland to Angie$\}$

= $\{x \mid x$ shows Disneyland to Angie$\}$ — ⟦***1-place predicate***⟧= set of satisfiers

☞ *Parallelism between valency and type of extension* — Frege (1891)

The extension of an n-place predicate is a set of n-tuples.

E.g. ⟦**Donald shows Angie Disneyland**⟧= {() | Donald shows Disneyland to Angie}

= the set of objects of the form '( )' such that Donald shows Disneyland to Angie, i.e.:

$$[\![\textbf{Donald shows Angie Disneyland}]\!] = \begin{cases} \{()\}, \text{ if Donald does show Disneyland to Angie} \\ (), \text{ otherwise} \end{cases}$$

NB: ( ) = Ø = 0; hence {( )} = {Ø} = {0} = 1!

☞ *Frege's Generalization* — Frege (1892)

The extension of a sentence ***S*** is its truth value, i.e. 1 if ***S*** is true and 0 if ***S*** is false.

• <u>Basic Fregean extensions</u> — Frege (1892)

(i) ⟦**Vienna**⟧= Vienna — ⟦***proper name***⟧= bearer

(j) ⟦**the largest city in Austria**⟧= Vienna — ⟦***definite description***⟧= descriptee

(k) ⟦**Ludwig was born in Vienna** ⟧= ⊢ Wittgenstein was born in Vienna ⊣ = 1 *)

≠ ⟦**Rudolf was born in Vienna** ⟧= ⊢ Carnap was born in Vienna ⊣ = 0

⟦***Sentence***⟧ = truth value

*) Notation: ⊢ … ⊣ := the truth value that is 1 iff …

• <u>Derived extensions</u> — Frege (1891)

(9a) — Zimmermann (2012)

From:

⟦***Exp***⟧ √

⟦***LP***⟧ ? ⟦***RP***⟧ √

… to:

⟦***Exp***⟧ √

⟦***LP***⟧ √ ⟦***RP***⟧ √

(b) ⟦***LP***⟧(⟦***RP***⟧) = ⟦***Exp***⟧

(c) ⟦***LP***⟧ = {(⟦***RP***⟧,⟦***Exp***⟧) | ***Exp*** = ***LP*** + ***RP***}

• <u>Deriving (Carnapian) quantifier extensions</u>

(10a)

⟦**Nobody sleeps**⟧ √ — ⟦**Nobody talks**⟧ √ — ⟦**Nobody listens**⟧ √

⟦**nobody**⟧ ? ⟦**sleeps**⟧ √ — ⟦**nobody**⟧ ? ⟦**talks**⟧ √ — ⟦**nobody**⟧ ? ⟦**listens**⟧ √

(b) ⟦**nobody**⟧(⟦**sleeps**⟧) = ⟦**nobody sleeps**⟧ ⇒ ⟦**nobody**⟧(S) = 1 — S: sleepers

⟦**nobody**⟧(⟦**talks**⟧) = ⟦**nobody talks**⟧ ⇒ ⟦**nobody**⟧(T) = 0 — T: talkers

⟦**nobody**⟧(⟦**listens**⟧) = ⟦**nobody listens**⟧ ⇒ ⟦**nobody**⟧(L) = 1 — L: hearers

(c) ⟦**nobody**⟧ = {(S,1), (T,0), (L,1),…}

= {(Y, ⊢⟦**person**⟧ ∩ Y = Ø ⊣ | Y is a (possible) predicate extension}

= λY. ⊢ ⟦**person**⟧ ∩ Y = Ø ⊣

(11a)

⟦**no boy**⟧ √ — ⟦**no girl**⟧ √ — ⟦**no chair**⟧ √

⟦**no**⟧ ? ⟦**boy**⟧ √ — ⟦**no**⟧ ? ⟦**girl**⟧ √ — ⟦**no**⟧ ? ⟦**chair**⟧ √

(b) ⟦**no**⟧(⟦**boy**⟧) = λY. ⊢ B ∩ Y= Ø ⊣ — B: boys

⟦**no**⟧(⟦**girl**⟧) = λY. ⊢ G ∩ Y = Ø ⊣ — G: girls

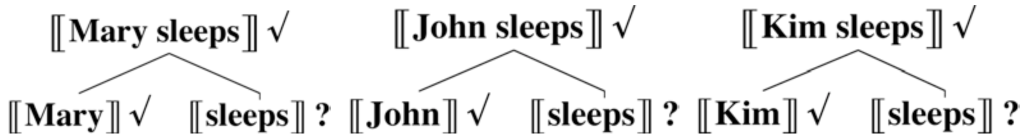
⟦**no**⟧(⟦**city**⟧) = λY. ⊢ C ∩ Y = Ø ⊣ — C: cities

(c) ⟦**no**⟧ = λX. λY. ⊢ X ∩ Y = Ø ⊣

(12) ⟦**every**⟧ = $\lambda X.\ \lambda Y.\vdash X \subseteq Y\ \dashv$
⟦**some**⟧ = $\lambda X.\ \lambda Y.\vdash X \cap Y \neq \emptyset \dashv$
⟦**one**⟧ = $\lambda X.\ \lambda Y.\vdash |X \cap Y| = 1 \dashv$ $|Z|$: # of elements of Z (cardinality)
⟦**most**⟧ = $\lambda X.\ \lambda Y.\vdash\ |X \cap Y| > |X \setminus Y|\ \dashv$

- Deriving Fregean predicate extensions

(13a)



(b) ⟦**sleeps**⟧(⟦**Mary**⟧) =⟦**Mary sleeps**⟧ ⇒ ⟦**sleeps**⟧(Mary) = 1
⟦**sleeps**⟧(⟦**John**⟧) =⟦**John sleeps**⟧ ⇒ ⟦**sleeps**⟧(John) = 0
⟦**sleeps**⟧(⟦**Kim**⟧) =⟦**Kim sleeps**⟧ ⇒ ⟦**sleeps**⟧(Kim) = 0

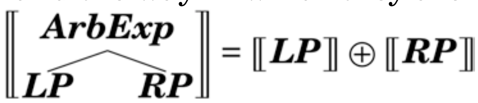
(c) ⟦**sleeps**⟧ = {(Mary,1), (John,0), (Kim,1),…} ≃ {Mary, John, Kim}
= $\{(x, \vdash x$ sleeps $\dashv\ |\ x$ is a (possible) name extension$\} \dashv$
= $\lambda x. \vdash x$ sleeps $\dashv$

- Montagovian term extensions

(14a)⟦$\mathbf{Bill}_M$⟧ = $\lambda X. \vdash$ Bill $\in X \dashv$ = Bill* *cf.* Montague (1970a)
(b) ⟦$\mathbf{the}_R$⟧ = $\lambda X.\ \lambda Y. \vdash\ |X| = 1\ \&\ X \subseteq Y \dashv$ *cf.* Russell (1905)

☞ *Extensional compositionality*

The <u>extension</u> of a complex expression functionally depends on the intensions of its immediate parts and the way in which they are combined:



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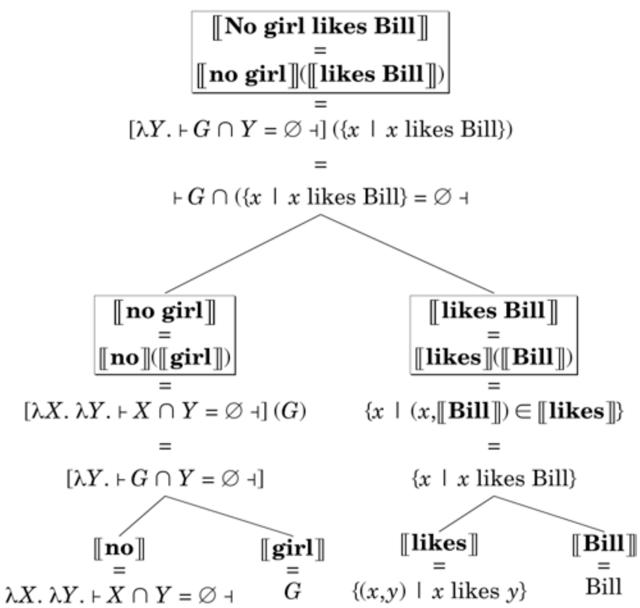

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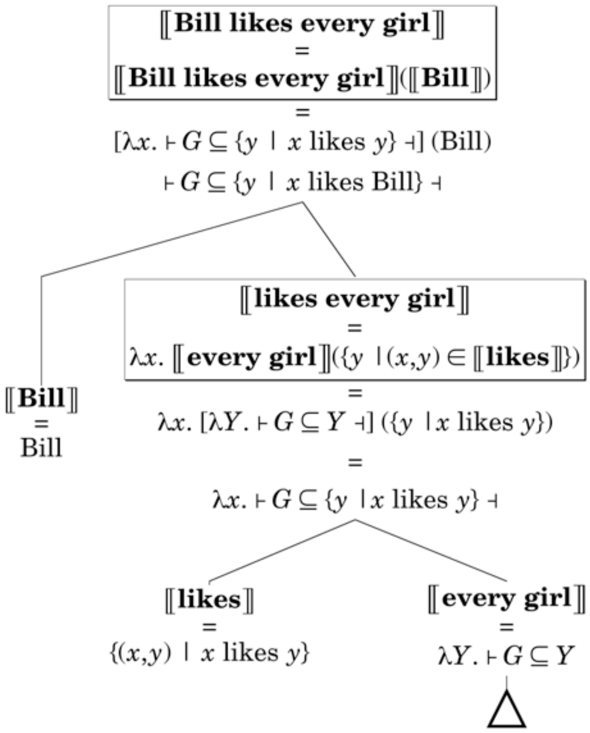


- Extensional types U: domain of individuals

(17a) $A\ [\subseteq \boldsymbol{U}] \simeq \lambda x.\ \vdash\ x \in A\ \dashv$ *characteristic function* (*of A rel. to U*)

(b) $R\ [\subseteq \boldsymbol{U}^2] \simeq \lambda x.\ \lambda y.\ \vdash\ (x,y) \in R\ \dashv\ \simeq \lambda y.\ \lambda x.\ \vdash\ (x,y) \in R\ \dashv$

(c) $R\ [\subseteq \boldsymbol{U}^3] \simeq \lambda z.\ \lambda y.\ \lambda x.\ \vdash\ (x,y,z) \in R\ \dashv$ *Currying* (German: *Schönfinkelei*)

(18) x is of type $\boldsymbol{e} \Leftrightarrow x \in U$;

u is of type $\boldsymbol{t} \Leftrightarrow u \in \{0,1\}$;

f is of type $(a,b) \Leftrightarrow f$: $\{x \mid x$ is of type $a\} \rightarrow \{y \mid y$ is of type $b\}$

(19) *Extensions and their types*

Category	*Example*	*Extension*	*Type*
Name	**Vienna**	Vienna $[\in U]$	***e***
Description	**the capital of Austria**	Vienna $[\in U]$	***e***
Noun	**city**	$C\ [\subseteq \boldsymbol{U}]$	***et***
1-place predicate	**sleep**	$S\ [\subseteq \boldsymbol{U}]$	***et***
2-place predicate	**eat**	$\subseteq \boldsymbol{U} \times \boldsymbol{U}$	***et***
3-place predicate	**give**	$\subseteq \boldsymbol{U} \times \boldsymbol{U} \times \boldsymbol{U}$	***e(et)***
Sentence	**It's raining**	0 $[\in \{0,1\}]$	***t***
Quantified NP	**everybody**	$\lambda Y.\ \vdash [\![\textbf{person}]\!] \subseteq Y\ \dashv$	***(et)t***
Determiner	**no**	$\lambda X.\ \lambda Y.\ \vdash X \cap Y = \emptyset\ \dashv$	***(et)((et)t)***

3. Frege-Carnap intensions

- Logical Space as a model of content

(20a) 4 fair coins are tossed.
(b) At least one of the 4 tossed coins lands heads up.
(c) At least one of the 4 tossed coins lands heads down.
(d) Exactly 2 of the 4 tossed coins land heads up.
(e) Exactly 2 of the 4 tossed coins land heads down.

☞ *Carnap's Content* Carnap (1947)

The *proposition* expressed by a sentence is the set of possible cases of which that sentence is true.

(21a) 4 coins were tossed when John coughed.
(b) 4 coins were tossed and no one coughed.

☞ *Wittgenstein's Paradise* Wittgenstein (1921)

All (and only the) maximally specific cases (possible worlds) are members of a set $\boldsymbol{W}$ (aka *Logical Space*).

- From propositions to intensions

(22) $p\ [\subseteq \boldsymbol{W}] \simeq \lambda w.\ \vdash\ w \in p\ \dashv$ characteristic function (of p rel. to $\boldsymbol{W}$)

(23) The *intension of* an expression is its extension relative to Logical Space:
$[\![\boldsymbol{E}]\!]: \boldsymbol{W} \rightarrow \{x \mid x \text{ is of the “appropriate” type}\}$

- Intensional types

☞ *Montagovian types* Montague (1970a)

x is of type $\boldsymbol{e} \Leftrightarrow x \in U$;

u is of type $\boldsymbol{t} \Leftrightarrow u \in \{0,1\}$;

f is of type $(a,b) \Leftrightarrow f: \{x \mid x \text{ is of type } a\} \rightarrow \{y \mid y \text{ is of type } b\}$

g is of type $(\boldsymbol{s},c) \Leftrightarrow g: \boldsymbol{W} \rightarrow \{y \mid y \text{ is of type } c\}$

☞ *Two-sorted types* “Gallin (1975)”

x is of type $\boldsymbol{e} \Leftrightarrow x \in U$;

u is of type $\boldsymbol{t} \Leftrightarrow u \in \{0,1\}$;

w is of type $\boldsymbol{s} \Leftrightarrow w \in \boldsymbol{W}$;

f is of type $(a,b) \Leftrightarrow f: \{x \mid x \text{ is of type } a\} \rightarrow \{y \mid y \text{ is of type } b\}$

- Notation

$[\![\boldsymbol{Exp}]\!]^{w} = [\![\boldsymbol{Exp}]\!](w)$

☞ *Intensional compositionality*

The intension of a complex expression functionally depends on the intensions of its immediate parts and the way in which they are combined:

$$\left[\!\left[\begin{array}{c} \textbf{\textit{ArbExp}} \\ \textbf{\textit{LP}} \quad \textbf{\textit{RP}} \end{array} \right]\!\right] = [\![\textbf{\textit{LP}}]\!] \oplus [\![\textbf{\textit{RP}}]\!]$$

☞ *Pointwise calculation of intensions*

$$[\![\textbf{John loves Mary}]\!] = \lambda w.\, [\![\textbf{John loves Mary}]\!]^{w}$$

$$= \lambda w. [\![\textbf{loves Mary}]\!]^{w}([\![\textbf{John}]\!]^{w})$$

$$= \ldots$$

$$\lambda w.\, \lambda x^{e}.\, \vdash \text{in } w, \text{ John loves Mary} \dashv$$

$$[\![\textbf{John}]\!]^{w} = \text{John}$$

$$[\![\textbf{loves Mary}]\!]^{w} = [\![\textbf{loves}]\!]^{w}([\![\textbf{Mary}]\!]^{w}) = \lambda x^{e}.\, \vdash \text{in } w, x \text{ loves Mary} \dashv$$

$$[\![\textbf{loves}]\!]^{w} = \lambda y^{e}.\, \lambda x^{e}.\, \vdash \text{in } w, x \text{ loves } y \dashv$$

$$[\![\textbf{Mary}]\!]^{w} = \text{Mary}$$

4. Intensional constructions

- Substitution failure

(24) Fritz thinks that Hamburg is larger than Cologne.
Hamburg is larger than Cologne.
Pfäffingen is larger than Breitenholz.

∵ Fritz thinks that Pfäffingen is larger than Breitenholz.

(25a)

$$[\![\textbf{thinks that Hamburg is larger than Cologne}]\!]^{w^*}$$
$$=$$
$$[\![\textbf{thinks}]\!]^{w^*} \oplus [\![\textbf{Hamburg is larger than Cologne}]\!]^{w^*}$$
$$=$$
$$\boxed{[\![\textbf{thinks}]\!]^{w^*} \oplus 1}$$
$$[\![\textbf{thinks}]\!]^{w^*} \qquad [\![\textbf{Hamburg is larger than Cologne}]\!]^{w^*} = 1$$

(b)

$$[\![\textbf{thinks that Pfäffingen is larger than Breitenholz}]\!]^{w^*}$$
$$=$$
$$[\![\textbf{thinks}]\!]^{w^*} \oplus [\![\textbf{Pfäffingen is larger than Breitenholz}]\!]^{w^*}$$
$$=$$
$$\boxed{[\![\textbf{thinks}]\!]^{w^*} \oplus 1}$$
$$[\![\textbf{thinks}]\!]^{w^*} \qquad [\![\textbf{Pfäffingen is larger than Breitenholz}]\!]^{w^*} = 1$$

- Ersatz extensions

(26a)

$$[\![\textbf{thinks that Hamburg is larger than Cologne}]\!]^{w^*} \surd$$
$$=$$
$$[\![\textbf{thinks}]\!]^{w^*} \oplus [\![\textbf{Hamburg is larger than Cologne}]\!]$$
$$=$$
$$\boxed{[\![\textbf{thinks}]\!]^{w^*} \oplus \mathbf{p}}$$
$$[\![\textbf{thinks}]\!]^{w^*} \textbf{?} \qquad [\![\textbf{Hamburg is larger than Cologne}]\!] = \mathbf{p} \quad \surd$$

(b)

$$[\![\textbf{thinks that Pfäffingen is larger than Breitenholz}]\!]^{w^*} \surd$$
$$=$$
$$[\![\textbf{thinks}]\!]^{w^*} \oplus [\![\textbf{Pfäffingen is larger than Breitenholz}]\!]$$
$$=$$
$$\boxed{[\![\textbf{thinks}]\!]^{w^*} \oplus \mathbf{q}}$$
$$[\![\textbf{thinks}]\!]^{w^*} \textbf{?} \qquad [\![\textbf{Pfäffingen is larger than Breitenholz}]\!] = \mathbf{q} \quad \surd$$

(27) $[\![\textbf{think}]\!]^{w^*}(\mathbf{p}) \neq [\![\textbf{think}]\!]^{w^*}(\mathbf{q})$

☞ *Fregean Laziness* — Larson (2002)

Substitution problems are solved by trading extensions for intensions.

(28a) **Jones thinks that Hesperus is Phosphorus.** — Frege (1892)

word	*type*
think	***~~t(et)~~ (<u>s</u>t)(et)***

(b) **Jones is an alleged murderer.** — Montague (1970b)

alleged	***~~(et)(et)~~ (<u>s</u>(et))(et)***

(c) **Jones is attentively eating every apple.** — Montague (1973)

attentively	***~~(et)(et)~~ (<u>s</u>(et))(et)***

… ⇒ **Jones is eating every apple.**

(P1) $(\forall w)\,(\forall P)\,[[\![\textbf{attentively}]\!]^{w}(P)(x) \leq P_w(x)]$ — $\leq$ ≈ mat. impl.

… ⇔ **Every apple is such that Jones is attentively eating it.** — Engesser (1980)

(P2) $(\forall w)\,(\forall R)\,(\forall Q)\,(\forall x)$

$$[[\![\textbf{attentively}]\!]^{w}(R \oplus Q)(x) = (Q_w y)[\![\textbf{attentively}]\!]^{w}\,(\lambda w'.\, \lambda x.\, R_{w'}(x,y))\,(x)]$$

⊕: combination of intensions of transitive verb and its quantificational object

😥 (P1) & (P2) ⇒ $[\![\textbf{attentively}]\!] = \lambda w.\, \lambda P.\, P_w$ — Zimmermann (1987; 1993a)

⇒ (Fregean) laziness does not (always) pay.

(d) **Jones seeks a unicorn.** — Montague (1970a)

seek	***~~e(et)~~ (<u>s</u>e)(et)*** — Montague (1973), only for verbs like *raise*

(29) *More expressions (of more types)*

Category	*Example*	*Extension*	*Type*
Attitude verb	**think**	$\subseteq \boldsymbol{U} \times \wp \boldsymbol{W}$	***(st)(et)***
Connective	**or**	$\lambda u^{t}.\, \lambda v^{t}.\, u{+}v - (uv)$	***t(tt)***

☞ *Fregean Compositionality* — Frege (1892)

The extension of a complex expression functionally depends on the extensions or intensions of its immediate parts and the way in which they are combined:

$$\left[\!\!\left[\begin{array}{c}\textbf{\textit{ExtExp}}\\ \textbf{\textit{LP}}\quad\textbf{\textit{RP}}\end{array}\right]\!\!\right]^{w} = [\![\textbf{\textit{LP}}]\!]^{w} \oplus [\![\textbf{\textit{RP}}]\!]^{w}$$

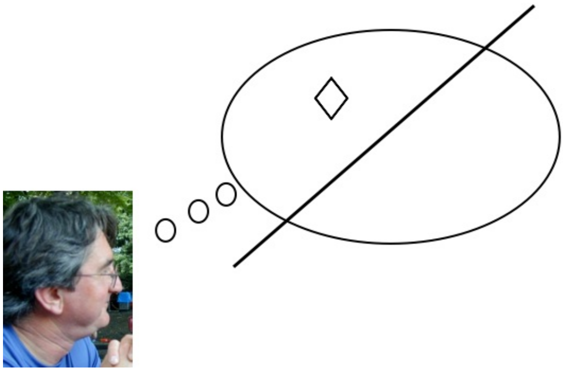
or:

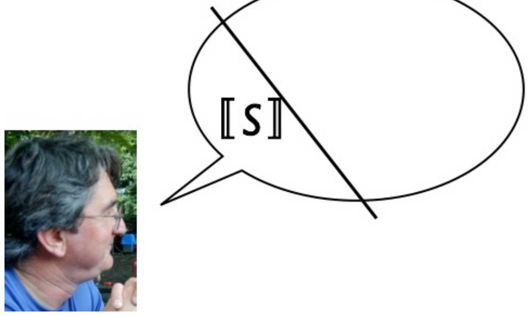
$$\left[\!\!\left[\begin{array}{c}\textbf{\textit{IntExp}}\\ \textbf{\textit{LP}}\quad\textbf{\textit{RP}}\end{array}\right]\!\!\right]^{w} = [\![\textbf{\textit{LP}}]\!]^{w} \oplus [\![\textbf{\textit{RP}}]\!]$$

5. Attitude reports

- Modelling cognitive states in Logical Space — Hintikka (1962, 1969)

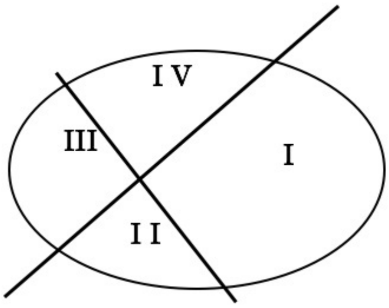
(30a) Fritz in w^* … (b)





S **= Hamburg is larger than Cologne**

(31)



I: $\boldsymbol{W} \setminus (\Diamond \cup [\![\boldsymbol{S}]\!])$; II: $[\![\boldsymbol{S}]\!] \setminus \Diamond$; III: $\Diamond \cap [\![\boldsymbol{S}]\!]$; IV: $\Diamond \setminus [\![\boldsymbol{S}]\!]$

(32) ⟦**Fritz thinks that Hamburg is larger than Cologne**⟧$^{w^*} = 1$

⇔ $\neg (\exists w \in \Diamond)\ [\![\boldsymbol{S}]\!](w) = 0$

⇔ $(\forall w \in \Diamond)\ [\![\boldsymbol{S}]\!](w) = 1$ ⇔ IV = Ø

(33) $\Diamond$ depends on

… attitude subject (Fritz)

… world of evaluation: w^*

… lexical meaning of verb: **think**

⇒ $\Diamond = \boldsymbol{Dox}(\text{Fritz})(w^*) \subseteq \boldsymbol{W}$

≈ ***Dox*** is of type ***e(s(st))*** (dependent) accessibility relation

(34a) ⟦**think**⟧ $= \lambda w^*.\ \lambda p^{st}.\ \lambda x^{e}.\ \vdash (\forall w)\ \boldsymbol{Dox}(x)(w^*)(w) \leq p(w) \dashv$ — $\leq$ ≈ mat. impl.

(b) ⟦**know**⟧ $= \lambda w^*.\ \lambda p^{st}.\ \lambda x^{e}.\ \vdash (\forall w)\ \boldsymbol{Epi}(x)(w^*)(w) \leq p(w) \dashv$

(c) ⟦**want**⟧ $= \lambda w^*.\ \lambda p^{st}.\ \lambda x^{e}.\ \vdash (\forall w)\ \boldsymbol{Bou}(x)(w^*)(w) \leq p(w) \dashv$

… …

(35)

⟦Fritz thinks that Hamburg is larger than Cologne⟧^{w*}
=
⟦thinks that Hamburg is larger than Cologne⟧^{w*}(**⟦Fritz⟧**^{w*})
=
…
$\vdash (\forall w)\ \boldsymbol{Dox}(\text{Fritz})(w^*)(w) \leq \mathbf{p}(w) \dashv$

⟦Fritz⟧^{w*}
=
Fritz

⟦thinks that Hamburg is larger than Cologne⟧^{w*}
=
⟦thinks⟧^{w*}(**⟦Hamburg is larger than Cologne⟧**)
=
$[\lambda p^{st}.\ \lambda x^{e}.\ \vdash (\forall w)\ \boldsymbol{Dox}(x)(w^*)(w) \leq p(w) \dashv](\mathbf{p})$
=
$\lambda x^{e}.\ \vdash (\forall w)\ \boldsymbol{Dox}(x)(w^*)(w) \leq \mathbf{p}(w) \dashv$

⟦thinks⟧^{w*}
=
$\lambda p^{st}.\ \lambda x^{e}.\ \vdash (\forall w)\ \boldsymbol{Dox}(x)(w^*)(w) \leq p(w) \dashv$

⟦Hamburg is larger than Cologne⟧
=
$\mathbf{p}$

(36a) # **Fritz knows that Breitenholz is larger than Pfäffingen.**

(b) $(\forall w^*)\ (\forall p^{st})\ (\forall x^{e})[\![\mathbf{know}]\!]^{w^*}(p)(x) \leq p(w^*)$

(c) $(\forall w^*)\ (\forall x^{e})\ \boldsymbol{Epi}(x)(w^*)(w^*) = 1$

(37a) # **Fritz knows that Rome is in Italy, but he doesn't think so.**

(b) $(\forall w^*)\ (\forall p^{st})\ (\forall x^{e})[\![\mathbf{know}]\!]^{w^*}(p)(x) \leq [\![\mathbf{think}]\!]^{w^*}(p)(x)$

(c) $(\forall w^*)\ (\forall w)\ (\forall x^{e})\ \boldsymbol{Dox}(x)(w^*)(w) \leq \boldsymbol{Epi}(x)(w^*)(w)$

(38a) * **Fritz wants that Fritz meets Eike.**

(b) **Fritz wants to meet Eike.**

(c) $[\![\mathbf{want}]\!] = \lambda w^*.\ \lambda P^{s(et)}.\ \lambda x^{e}.\ \vdash (\forall w)\ \boldsymbol{Bou}(x)(w^*)(w) \leq P(w)(x) \dashv$

(39)

$$[\![\textbf{Fritz wants to meet Eike}]\!]^{w^*}$$
$$=$$
$$[\![\textbf{wants to meet Eike}]\!]^{w^*}([\![\textbf{Fritz}]\!]^{w^*})$$
$$=$$
$$[\lambda x^{e}.\ \vdash (\forall w)\ \textbf{\textit{Bou}}(x)(w^*)(w) \leq \vdash \text{in } w,\ x \text{ meets Eike} \dashv \dashv]\ (\text{Fritz})$$
$$=$$
$$\vdash (\forall w)\ \textbf{\textit{Bou}}(\text{Fritz})(w^*)(w) \leq \vdash \text{in } w, \text{ Fritz meets Eike} \dashv \dashv$$

Left daughter:

$$[\![\textbf{Fritz}]\!]^{w^*}$$
$$=$$
$$\text{Fritz}$$

Right daughter:

$$\boxed{[\![\textbf{wants to meet Eike}]\!]^{w^*} = \lambda x^{e}.\ [\![\textbf{want}]\!]^{w^*}(\ \lambda w.\ [\![\textbf{meet Eike}]\!](w)(x)\ )\ (x)}$$
$$=$$
$$\lambda x^{e}.\ [\lambda p^{st}.\ \lambda x^{e}.\ \vdash (\forall w)\ \textbf{\textit{Bou}}(x)(w^*)(w) \leq p(w) \dashv](\ \lambda w.\ [\boxed{\lambda w}.\ \lambda x^{e}.\ \vdash \text{in } w,\ x \text{ meets Eike} \dashv]\ \boxed{(w)}\ (x)\ )\ (x)$$
$$=$$
$$\lambda x^{e}.\ [\lambda p^{st}.\ \lambda x^{e}.\ \vdash (\forall w)\ \textbf{\textit{Bou}}(x)(w^*)(w) \leq p(w) \dashv](\ \lambda w.\ [\boxed{\lambda x^{e}}.\ \vdash \text{in } w,\ x \text{ meets Eike} \dashv]\ (\boxed{x})\ )\ (x)$$
$$=$$
$$\lambda x^{e}.\ [\lambda p^{st}.\ \lambda x^{e}.\ \vdash (\forall w)\ \textbf{\textit{Bou}}(x)(w^*)(w) \leq p(w) \dashv](\ \lambda w.\ \vdash \text{in } w,\ x \text{ meets Eike} \dashv)\ (x)$$
$$=$$
$$\lambda x^{e}.\ [\boxed{\lambda y^{e}}.\ \vdash (\forall w)\ \textbf{\textit{Bou}}(y)(w^*)(w) \leq [\lambda w.\ \vdash \text{in } w,\ x \text{ meets Eike} \dashv](w) \dashv]\ \boxed{(x)}$$
$$=$$
$$\lambda x^{e}.\ \vdash (\forall w)\ \textbf{\textit{Bou}}(x)(w^*)(w) \leq [\boxed{\lambda w}.\ \vdash \text{in } w,\ x \text{ meets Eike} \dashv]\ \boxed{(w)} \dashv$$
$$=$$
$$\lambda x^{e}.\ \vdash (\forall w)\ \textbf{\textit{Bou}}(x)(w^*)(w) \leq \vdash \text{in } w,\ x \text{ meets Eike} \dashv \dashv$$

Its left daughter:

$$[\![\textbf{want}]\!]^{w^*}$$
$$=$$
$$[\lambda p^{st}.\ \lambda x^{e}.\ \vdash (\forall w)\ \textbf{\textit{Bou}}(x)(w^*)(w) \leq p(w) \dashv]$$

Its right daughter:

$$[\![\textbf{meet Eike}]\!]$$
$$=$$
$$\lambda w.\ [\![\textbf{meet Eike}]\!]^{w}$$
$$=$$
$$\ldots$$
$$\lambda w.\ \lambda x^{e}.\ \vdash \text{in } w,\ x \text{ meets Eike} \dashv$$
$$\triangle$$

6. Unspecific Objects

- <u>Paraphrases</u> Quine (1956)

(40a) **John is looking for a sweater.**

(b) **John wants to find a sweater.**

(41a) **Mary owes me a horse.**

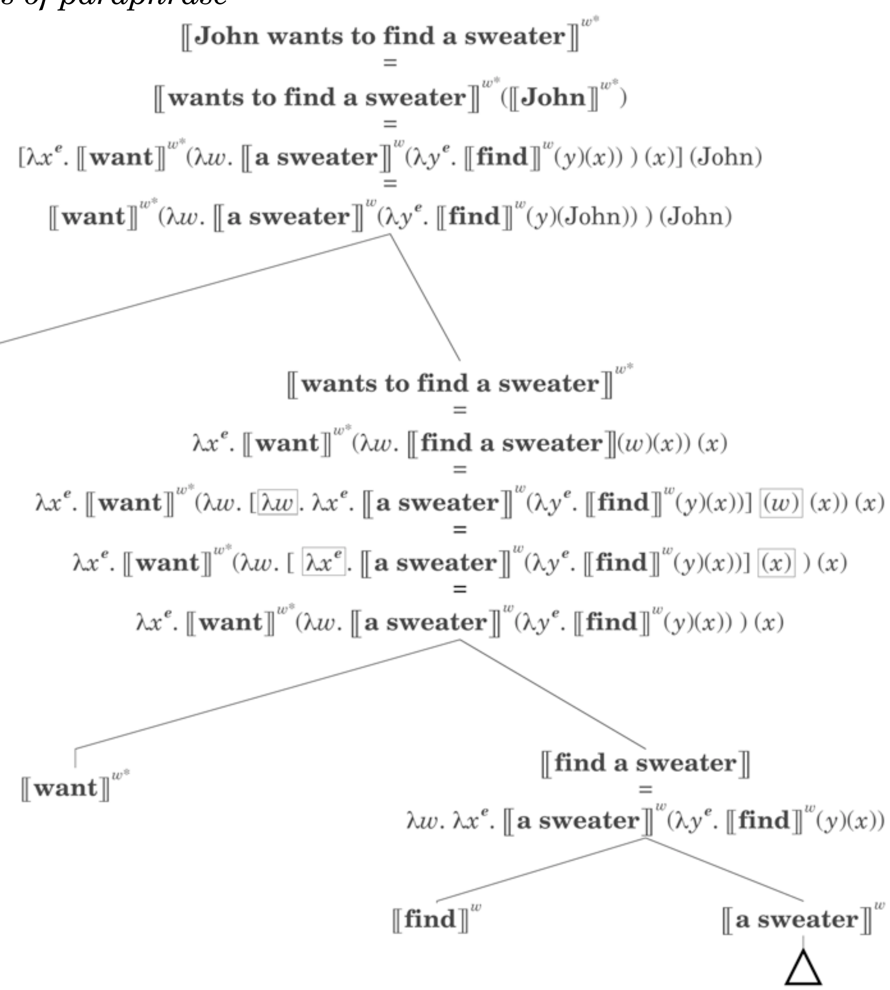
(b) **Mary is obliged to give me a horse.**

(42a) **This horse resembles a unicorn.**

(b) **This horse could (almost) be a unicorn.**

- <u>Relational analyses</u>

(43a) *Analysis of paraphrase*



(b) *Dissection*

$\lambda x^{\boldsymbol{e}}.\ [\![\textbf{want}]\!]^{w^*}(\lambda w.\ [\![\textbf{a sweater}]\!]^{w^*}(w)(\lambda y^{\boldsymbol{e}}.\ [\![\textbf{find}]\!]^{w^*}(w)(y)(x)))(x)$

$=\quad \lambda x^{\boldsymbol{e}}.\ \boldsymbol{W}(\lambda w.\ \boldsymbol{S}(w)(\lambda y^{\boldsymbol{e}}.\ \boldsymbol{F}(w)(y)(x)))(x)$

$=\quad [\lambda Q^{\boldsymbol{s((et)t)}}.\ \lambda x^{\boldsymbol{e}}.\ \boldsymbol{W}(\lambda w.\ Q(w)\ (\lambda y^{\boldsymbol{e}}.\ \boldsymbol{F}(y)(x)))(x)]\ (\boldsymbol{S})$

(c) *Simplification*

$[\![\textbf{look-for}]\!]^{w^*}$

$= \lambda Q^{\boldsymbol{s((et)t)}}.\ \lambda x^{\boldsymbol{e}}.\ \boldsymbol{W}(\lambda w.\ Q(w)\ (\lambda y^{\boldsymbol{e}}.\ \boldsymbol{F}(y)(x)))\ (x)$

$= \lambda Q^{\boldsymbol{s((et)t)}}.\ \lambda x^{\boldsymbol{e}}.\ [\![\textbf{want}]\!]^{w^*}(\lambda w.\ Q(w)\ (\lambda y^{\boldsymbol{e}}.[\![\textbf{find}]\!]^{w}(y)(x)))\ (x)$

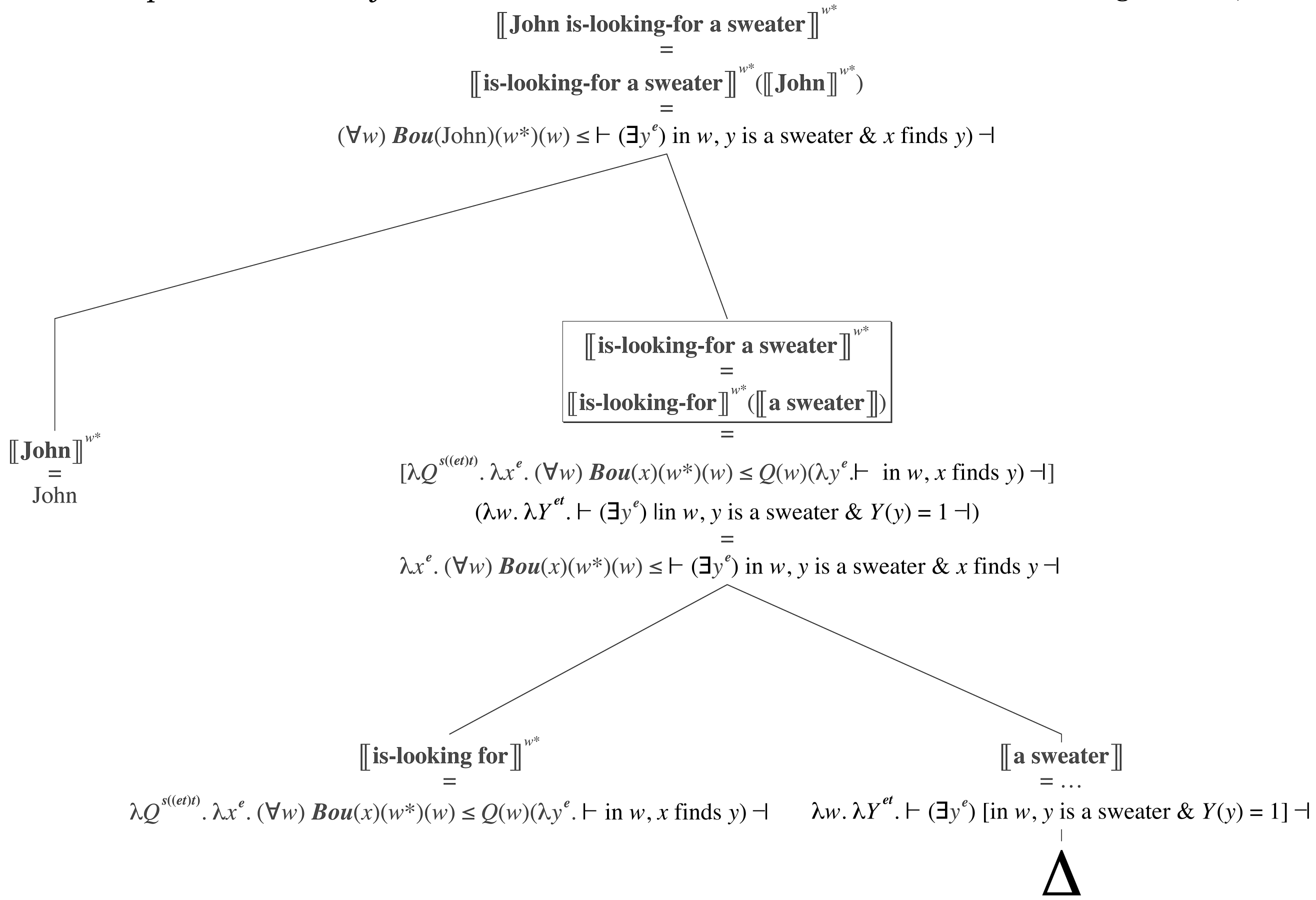
$= \lambda Q^{\boldsymbol{s((et)t)}}.\ \lambda x^{\boldsymbol{e}}.\ [\ \lambda p^{\boldsymbol{st}}.\ \lambda x^{\boldsymbol{e}}.\ \vdash (\forall w)\ \boldsymbol{Bou}(x)(w^*)(w) \leq p(w) \dashv]$
$(\lambda w.\ Q(w)\ (\lambda y^{\boldsymbol{e}}.[\lambda w.\lambda y^{\boldsymbol{e}}.\ \lambda x^{\boldsymbol{e}}.\ \vdash \text{in } w, x \text{ finds } y \dashv](w)(y)(x)))\ (x)$

$= \lambda Q^{\boldsymbol{s((et)t)}}.\ \lambda x^{\boldsymbol{e}}.\ [\ \lambda p^{\boldsymbol{st}}.\ \lambda x^{\boldsymbol{e}}.\ \vdash (\forall w)\ \boldsymbol{Bou}(x)(w^*)(w) \leq p(w) \dashv]$
$(\lambda w.\ Q(w)\ (\lambda y^{\boldsymbol{e}}.\ \vdash \text{in } w, x \text{ finds } y \dashv))\ (x)$

$= \lambda Q^{\boldsymbol{s((et)t)}}.\ \lambda x^{\boldsymbol{e}}.\ [\ \lambda p^{\boldsymbol{st}}.\ \lambda z^{\boldsymbol{e}}.\ \vdash (\forall w)\ \boldsymbol{Bou}(z)(w^*)(w) \leq p(w) \dashv]$
$(\lambda w.\ Q(w)\ (\lambda y^{\boldsymbol{e}}.\ \vdash \text{in } w, x \text{ finds } y \dashv))\ (x)$

$= \lambda Q^{\boldsymbol{s((et)t)}}.\ \lambda x^{\boldsymbol{e}}.\ \vdash (\forall w)\ \boldsymbol{Bou}(x)(w^*)(w) \leq Q(w)\ (\lambda y^{\boldsymbol{e}}.\ \vdash \text{in } w, x \text{ finds } y \dashv) \dashv$

(d) *Compositional analysis* Montague (1969; 1970)



(44a) **John is looking for most unicorns.**

(b) $(\forall w)\ \boldsymbol{Bou}(x)(w^*)(w) \leq \vdash \text{in } w, \#(\text{unicorns } x \text{ finds}) > \#(\text{unicorns } x \text{ doesn't find}) \dashv)$

(c) **John wants to find most unicorns.**

(45a) **John is looking for each unicorn.**

(b) $(\forall w)\ \boldsymbol{Bou}(x)(w^*)(w) \leq \vdash \text{in } w, \text{John finds each unicorn} \dashv)$

(c) **John wants to find each unicorn.**

(46a) **John is looking for no unicorn.**

(b) $(\forall w)\ \boldsymbol{Bou}(x)(w^*)(w) \leq \vdash$ in w, John doesn't find a unicorn $\dashv$)

(c) **John wants to find no unicorn.**

(47a) An intension Q of type $\boldsymbol{s((et)t)}$ is *existential* iff

$$Q = \lambda w.\ \lambda Y^{\boldsymbol{et}}.\ \vdash (\exists x)\ [P(w)(x) = Y(x) = 1] \dashv$$

for some intension P of ('property') type $\boldsymbol{s(et)}$.

(b) $\lambda P^{\boldsymbol{s(et)}}.\ \lambda w.\ \lambda Y^{\boldsymbol{et}}.\ \vdash (\exists x)\ [P(w)(x) = Y(x) = 1] \dashv$ Lerner & Zimmermann (1981: 148)

is a one-one mapping (called A) whose inverse (called BE) is: Partee (1987)

$\lambda Q^{\boldsymbol{s((et)t)}}.\ \lambda w.\ \lambda x^{\boldsymbol{e}}.\ Q(\lambda y^{\boldsymbol{e}}.\ \vdash x = y \dashv)$.

(48) ⟦**look-for**⟧(w^*) Zimmermann (1993)

$= \lambda P^{\boldsymbol{s(et)}}.\ \lambda x^{\boldsymbol{e}}.\ \vdash (\forall w)\ \boldsymbol{Bou}(x)(w^*)(w) \leq \vdash (\exists y^{\boldsymbol{e}})$ in w, $P(y) = 1$ & x finds $y \dashv$

- Relational readings

(49) **I owe you a horse.** Buridanus (1350)

(50) **John is looking for Mary.**

Mary is an Austrian student.

∴ **John is looking for an Austrian student.**

(51a)

⟦**John is-looking-for Mary**$_M$⟧^{w*}

=

⟦**is-looking-for Mary**$_M$⟧^{w*}(⟦**John**⟧^{w*})

=

$(\forall w)\ \boldsymbol{Bou}(\text{John})(w^*)(w) \leq \vdash$ in w, John finds Mary $\dashv$

⟦**John**⟧^{w*}

=

John

⟦**is-looking-for Mary**$_M$⟧^{w*}

=

⟦**is-looking-for**⟧^{w*}(⟦**Mary**$_M$⟧)

=

$[\lambda Q^{s((et)t)}.\ \lambda x^e.\ (\forall w)\ \boldsymbol{Bou}(x)(w^*)(w) \leq Q(w)(\lambda y^e.\ \vdash$ in w, x finds Mary$) \dashv](\lambda w.\ \lambda Y^{et}.\ Y(\text{Mary}))$

=

$\lambda x^e.\ (\forall w)\ \boldsymbol{Bou}(x)(w^*)(w) \leq \vdash$ in w, x finds Mary $\dashv$

⟦**is-looking for**⟧^{w*}

$\lambda Q^{s((et)t)}.\ \lambda x^e.\ (\forall w)\ \boldsymbol{Bou}(x)(w^*)(w) \leq Q(w)(\lambda y^e.\ \vdash$ in w, x finds $y) \dashv$

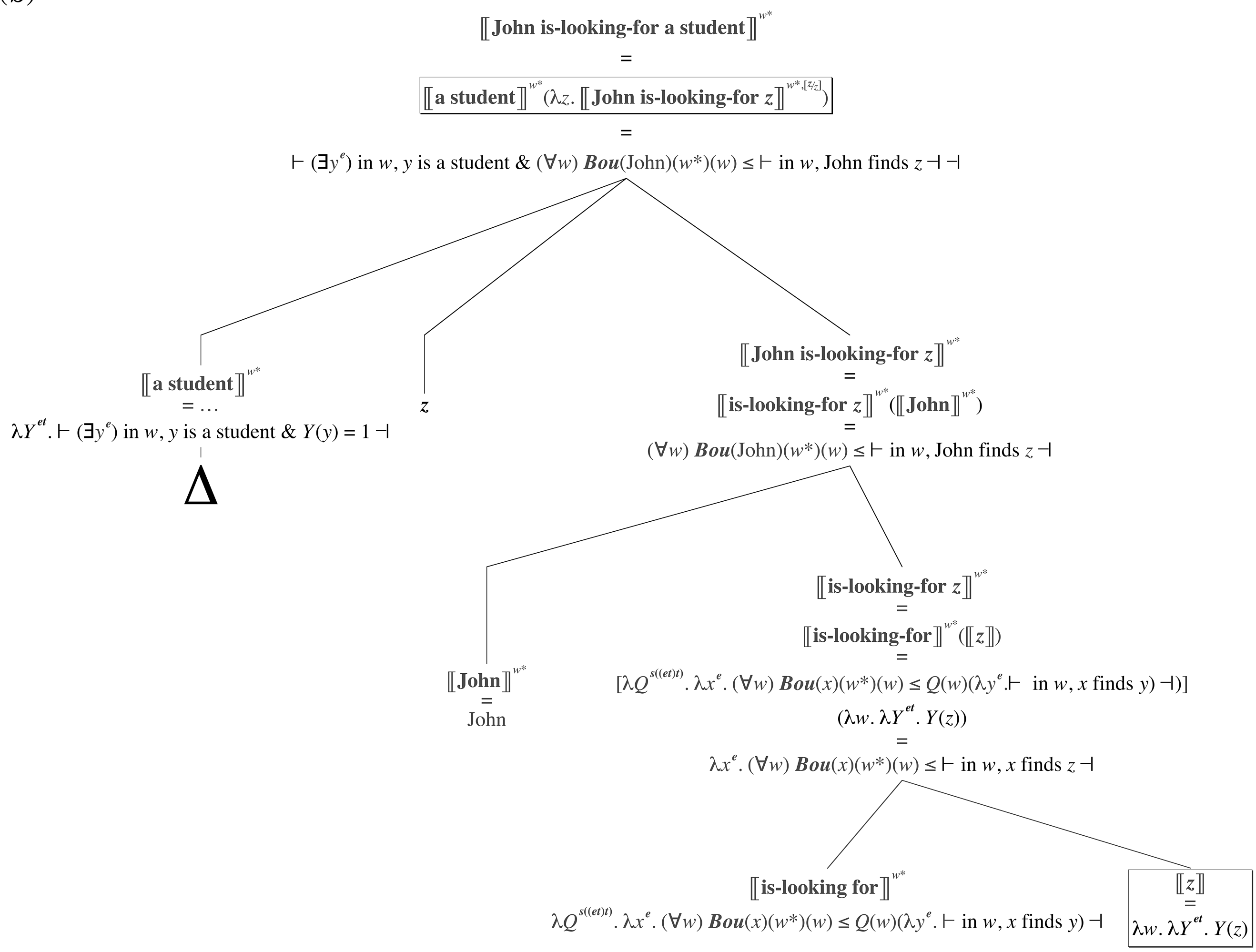
⟦**Mary**$_M$⟧

=

$\lambda w.\ \lambda Y^{et}.\ Y(\text{Mary})$

(a') $(\exists m^{s(e(e))})$ [m is a mode of presentation & $m(w^*)$(John) = Mary & *de re*
$(\forall w)$ $\boldsymbol{Bou}(x)(w^*)(w) \leq \vdash$ in w, John finds $m(w)$(John)] Kaplan (1969)

(b)



- <u>More paraphrases</u>

(52a) **John is looking for a sweater.**
(b) **John wants to find a sweater.**
(c) **John is looking for an intentional sweater.**

(53a) **Mary owes me a horse.**
(b) **Mary is obliged to give me a horse.**
(c) **Mary owes me an arbitrary horse.**

(54a) **Jones hired an assistant.**
(b) **This horse could (almost) be a unicorn.**
(c) **This horse resembles a generic unicorn.**

(55a) **This horse resembles a unicorn.**
(b) **Jones saw to it that someone would become an/his assistant.**
(c) **Jones hired a would-be assistant.**

- Quantificational analyses

(56)

$$\llbracket \textbf{John is-looking-for a sweater} \rrbracket^{w^*}$$
$$=$$
$$\vdash (\exists u^{e^+})\ \llbracket \textbf{sweater}^{+} \rrbracket^{w^*}(u) = \llbracket \textbf{is-looking-for} \rrbracket^{w^*}(u)(\text{John}) = 1 \dashv$$

$$\llbracket \textbf{John} \rrbracket^{w^*} = \text{John}$$

$$\llbracket \textbf{is-looking-for a sweater} \rrbracket^{w^*} = \lambda x^{e}.\ \llbracket \textbf{a sweater} \rrbracket^{w^*}(\lambda u^{e^+}.\ \llbracket \textbf{is-looking-for} \rrbracket^{w^*}(u)(x))$$
$$=$$
$$\lambda x^{e}.\ \vdash (\exists u^{e^+})\ \llbracket \textbf{sweater}^{+} \rrbracket^{w^*}(u) = \llbracket \textbf{is-looking-for} \rrbracket^{w^*}(u)(x) = 1 \dashv$$

$$\llbracket \textbf{is-looking-for} \rrbracket^{w^*} \in \{u \mid u \text{ is of type } \boldsymbol{e^{+}(et)}\}$$

$$\llbracket \boldsymbol{a}^{+} \textbf{ sweater}^{+} \rrbracket^{w^*} = \ldots$$
$$\lambda Y^{e^{+}t}.\ \vdash (\exists u^{e^+})\ \llbracket \textbf{sweater}^{+} \rrbracket^{w^*}(u) = Y(u) = 1 \dashv$$

$$\llbracket \textbf{a}^{+} \rrbracket^{w^*} = \lambda X^{e^{+}t}.\ \lambda Y^{e^{+}t}.\ \vdash (\exists u^{e^+})\ X(u) = Y(u) = 1 \dashv$$

$$\llbracket \textbf{sweater}^{+} \rrbracket^{w^*} \in \{u \mid u \text{ is of type } \boldsymbol{e^{+}t}\}$$

(57a) $\boldsymbol{e^{+}} = \boldsymbol{s(et)}$ Condoravdi *et al.* (2001)

(b) $\llbracket \textbf{sweater}^{+} \rrbracket^{w^*} = \lambda P^{\boldsymbol{s(et)}}.\ \vdash (\forall w)\ (\forall x^{\boldsymbol{e}})\ P \sqsubseteq \llbracket \textbf{sweater} \rrbracket \dashv$

(c) $\llbracket \textbf{look-for} \rrbracket^{w^*}$ Zimmermann (2006): 'exact match'

$= \lambda P^{\boldsymbol{s(et)}}.\ \lambda x^{\boldsymbol{e}}.\ \vdash (\forall w)\ [\boldsymbol{Bou}(x)(w^*)(w) \leftrightarrow (\exists y^{\boldsymbol{e}}) \text{ in } w,\ P(y) = 1\ \&\ x \text{ finds } y] \dashv$

Notation: $P \sqsubseteq Q :\Leftrightarrow (\forall w)\ (\forall x^{\boldsymbol{e}})\ P(w)(x) \leq Q(w)(x)$ sub-concepthood

- Monotonicity

(58a) **John is a looking for a red sweater.**

∴ **John is looking for a sweater.**

(b) **John is looking for a sweater.**

Mary is looking for a book.

∵ **John is looking for something Mary is looking for.**

Intersective construal (for simplicity): $\llbracket \textbf{red sweater} \rrbracket = \llbracket \textbf{sweater} \rrbracket \sqcap \llbracket \textbf{red} \rrbracket$

Notation: $P \sqcap Q := \lambda w.\ \lambda x^{\boldsymbol{e}}.\ P(w)(x) = Q(w)(x) = 1$

(59) *Relational analyses (with lexical decomposition)*

(q) $(\forall w)\ \boldsymbol{Bou}(\text{John})(w^*)(w) \leq \vdash (\exists y^{\boldsymbol{e}})$ in w, y is a sweater & y is red & John finds $y \dashv$

$\Rightarrow$ $(\forall w)\ \boldsymbol{Bou}(\text{John})(w^*)(w) \leq \vdash (\exists y^{\boldsymbol{e}})$ in w, y is a sweater & John finds $y \dashv$

$\Rightarrow$ $(\forall w)\ \boldsymbol{Bou}(\text{John})(w^*)(w) \leq \vdash (\exists y^{\boldsymbol{e}})$ in w, John finds $y \dashv$

$\Leftrightarrow$ $\llbracket$**John is looking for something**$\rrbracket^{w^*} = 1 \ldots$

$\Rightarrow$ $(\exists Q^{\boldsymbol{s((et)t)}})$ $\llbracket$**look-for**$\rrbracket^{w^*}(Q)$(Mary) & $\llbracket$**look-for**$\rrbracket^{w^*}(Q)$(John) $\qquad Q = \llbracket$**something**$\rrbracket^{w^*}$

(p) $[(\forall w)\ \boldsymbol{Bou}(\text{John})(w^*)(w) \leq \vdash (\exists y^{\boldsymbol{e}})$ in w, y is a sweater & John finds $y \dashv$

$\Rightarrow$ $(\forall w)\ \boldsymbol{Bou}(\text{Mary})(w^*)(w) \leq \vdash (\exists y^{\boldsymbol{e}})$ in w, y is a book & Mary finds $y \dashv$

$\Rightarrow$ $(\forall w)\ \boldsymbol{Bou}(\text{Mary})(w^*)(w) \leq \vdash (\exists y^{\boldsymbol{e}})$ in w, Mary finds $y \dashv$

$\Leftrightarrow$ $\llbracket$**John is looking for something**$\rrbracket^{w^*} = 1 \ldots$

$\Rightarrow$ $(\exists P^{\boldsymbol{s(et)}})$ $\llbracket$**look-for**$\rrbracket^{w^*}(P)$(Mary) & $\llbracket$**look-for**$\rrbracket^{w^*}(P)$(John) $\qquad P = \llbracket$**something**$\rrbracket^{w^*}$

(60) *Quantificational analysis (with exact match)*

(a) $(\exists P^{\boldsymbol{s(et)}} \sqsubseteq \llbracket$**sweater**$\rrbracket \sqcap \llbracket$**red**$\rrbracket)(\forall w)[\boldsymbol{Bou}(\text{j})(w^*)(w) \leftrightarrow (\exists y^{\boldsymbol{e}})$ in w, $P(w)(y) = 1$ & j finds $y]$

$\Rightarrow$ $(\exists P^{\boldsymbol{s(et)}} \sqsubseteq \llbracket$**sweater**$\rrbracket)(\forall w)[\boldsymbol{Bou}(\text{j})(w^*)(w) \leftrightarrow (\exists y^{\boldsymbol{e}})$ in w, $P(w)(y) =1$ & j finds $y]$

(b) $[(\exists P^{\boldsymbol{s(et)}} \sqsubseteq \llbracket$**sweater**$\rrbracket)(\forall w)[\boldsymbol{Bou}(\text{j})(w^*)(w) \leftrightarrow (\exists y^{\boldsymbol{e}})$ in w, $P(w)(y) =1$ & j finds $y]$

& $(\exists P^{\boldsymbol{s(et)}} \sqsubseteq \llbracket$**book**$\rrbracket)(\forall w)[\boldsymbol{Bou}(\text{m})(w^*)(w) \leftrightarrow (\exists y^{\boldsymbol{e}})$ in w, $P(w)(y) =1$ & m finds $y]$]

$\not\Rightarrow$ $(\exists P^{\boldsymbol{s(et)}})(\forall w)[\boldsymbol{Bou}(\text{m})(w^*)(w) \leftrightarrow (\exists y^{\boldsymbol{e}})$ in w, $P(w)(y)$ & m finds $y]$

… & $[\boldsymbol{Bou}(\text{j})(w^*)(w) \leftrightarrow (\exists y^{\boldsymbol{e}})$ in w, $P(w)(y) =1$ & j finds $y]$

$\equiv$ $(\exists P^{\boldsymbol{s(et)}})$ $[\llbracket$**look-for**$\rrbracket^{w^*}(P)$(Mary) & $\llbracket$**look-for**$\rrbracket^{w^*}(P)$(John)]

- Unspecificity $\Rightarrow$ Intensionality? Zimmermann (1983; 2001)

(61) **Arnim owns a bottle of 1981 Riesling-Sylvaner.** Rooth (p.c., *anno* 1991)
Riesling-Sylvaner is Müller-Thurgau.
Arnim owns a bottle of 1981 Müller-Thurgau.

(62) **Arnim owns the bottle that Franzis does not own.**

(a) $\llbracket$**the**$\rrbracket^{w^*}(\llbracket$**bottle Franzis doesn't own**$\rrbracket^{w^*})(\lambda y^{\boldsymbol{e}}.\ \llbracket$**own**$\rrbracket^{w^*}(\lambda Y^{\boldsymbol{et}}.\ Y(y))$(Arnim)

$\leq$ $\vdash (\exists y^{\boldsymbol{e}})$ $[\llbracket$**bottle**$\rrbracket^{w^*}(y) = \llbracket$**own**$\rrbracket^{w^*}(\lambda Y^{\boldsymbol{et}}.\ Y(y))(\text{Arnim}) = 1] \dashv$

(b) $\llbracket$**own**$\rrbracket^{w^*}$(Arnim, $\llbracket$**the**$\rrbracket^{w^*}(\llbracket$**bottle Franzis doesn't own**$\rrbracket^{w^*})$)

$\leq$ $\llbracket$**own**$\rrbracket^{w^*}$(Arnim, $\llbracket$**the**$\rrbracket^{w^*}(\llbracket$**unicorn**$\rrbracket^{w^*})$) (in given scenario)

(63a) **Pfäffingen is near a river.** Mador-Haim & Winter (2015)

$\equiv$ $(\exists x^{\boldsymbol{e}})$ $[\llbracket$**river**$\rrbracket\rrbracket^{w^*}(x)$ & $\llbracket$**near**$\rrbracket^{w^*}(\llbracket$**Pfäffingen**$\rrbracket, x)$]

(b) **Breitenholz is far from a river.**

$\equiv$ $(\forall x^{\boldsymbol{e}})$ $[\llbracket$**river**$\rrbracket^{w^*}(x)$ & $\llbracket$**far**$\rrbracket^{w^*}(\llbracket$**Pfäffingen**$\rrbracket, x)$]

- Landscape of intensional verbs

(64)

VERBS OF ...	EXAMPLES
Absence	avoid, lack, omit
Anticipation	allow* (for), anticipate, expect, fear, foresee, plan, wait* (for)
Calculation	calculate, compute, derive
Creation	assemble, bake, build, construct, fabricate, make (these verbs in progressive aspect only)
Depiction	caricature, draw, imagine, portray, sculpt, show, visualize, write* (about)
Desire	hope* (for), hunger* (for), lust* (after), prefer, want
Evaluation	admire, disdain, fear, respect, scorn, worship (verbs whose corresponding noun can fill the gap in the evaluation 'worthy of _' or 'merits_')
Requirement	cry out* (for), demand, deserve, merit, need, require
Search	hunt* (for), look* (for), rummage about* (for), scan* (for), seek
Similarity	imitate, be reminiscent* (of), resemble, simulate
Transaction	buy, order, owe, own, reserve, sell, wager

Forbes (2006: 37)

(65a) **Matt needed some change before the conference.** Partee (1974); Schwarz (2006);
(b) **Matt was looking for some change before the conference.** Moulton (2013)
(66a) **Matt needs most of the small bills that were in the cash-box.**
(b) **Matt is looking for most of the small bills that were in the cash-box.**

(67) Zimmermann (2001: 526)

Existential Impact[5]
From *x Rs an N* infer: *There is at least one N.*

Extensionality[6]
From *x Rs an N*, *Every N is an M*, and *Every M is an N* infer: *x Rs an M.*

Specificity
From *x Rs an N* infer: *Some (specific) individual is Red by x.*

7. General aspects

- Propositionalism — Forbes (2000; 2006); M. Montague (2007)

(P) All (linguistic, mental, perceptual, pictorial,…) content is propositional.

(Q) All intensional contexts are parts of embedded clauses. — Quine (1956)

(68a) **⟦Hesperus is a planet⟧≠ ⟦Phosphorus is a planet⟧** — Frege (1892)

⇒ **⟦Hesperus⟧≠ ⟦Phosphorus⟧** — non-propositional content

(b) **The thirsty man wants beer.** — Meinong (1904): intentional object

(c) **Jones worships a Greek goddess.** — R. Montague (1969) [crediting H. Kamp]

(d) **Lex Luthor fears Superman (but not Clark Kent).** — Forbes (2000)

(e) **Horatio believes that things Horatio doesn't believe in exist.**
Szabó (2003): coherent belief

(e) **John likes chocolate.** — … (partly) explains why …
John wants to have chocolate. — M. Montague (2007)

(f) **The temperature is 90 and it is rising.** — Cf. Partee (2004: 17)

≠> **90 is rising.** — Montague (1973): reference to non-propositional content

(g) **Most screws are missing.**
Zimmermann (2010): quantification over non-propositional content

- Russellian analysis — Russell (1905); Whitehead & Russell (1910); Cresswell (1973)

(69) *Denotations and their types*

Category	*Example*	*Type*
Name	**Vienna**	***e***
Description	**the capital of Austria**	***(e(st))(st)***
Noun	**city**	***e(st)***
1-place predicate	**sleep**	***e(st)***
2-place predicate	**eat**	***e(e(st))***
3-place predicate	**give**	***e(e(e(st)))***
Sentence	**It's raining**	***st***
Quantified NP	**everybody**	***(e(st))(st)***
Determiner	**no**	***(e(st))((e(st))(st)))***
Attitude verb	**think**	***(st)(et)***
Connective	**or**	***(st)((st)(st))***

(70) *How to Russell a Frege-Church* — Kaplan (1975); Liefke (2015)

(a) $\mathcal{R}$(⟦**the capital of Slovenia is larger than Breitenholz**⟧)

= $\mathcal{R}$(⟦**is larger than**⟧)$\mathcal{R}$(⟦**Breitenholz**⟧)($\mathcal{R}$(⟦**the capital of Slovenia**⟧)

(b) $\mathcal{R}$(⟦**the capital of Slovenia**⟧)= $\lambda x^{e}.\ \lambda w.\ x =$⟦**the capital of Slovenia**⟧(w)

(c) $\mathcal{R}$(⟦**Breitenholz**⟧) = $\lambda x^{e}.\ \lambda w.\ x =$⟦**Breitenholz**⟧$(w)$ — [= $\lambda x^{e}.\ \lambda w.\ x =$ Breitenholz]

(d) $\mathcal{R}$(⟦**is larger than**⟧)

= $\lambda P^{e(st)}.\ \lambda Q^{e(st)}.\ \lambda w.\ \vdash (\forall x)\ (\forall y)\ P(x)(w) \times\ Q(x)(w) \leq$ ⟦**is larger than**⟧$(w)(x)(y)$

- <u>Relativity of Reference</u>

(71a) $||\boldsymbol{A}|| = \lambda w.\ [\![\boldsymbol{A}]\!]$, for lexical $\boldsymbol{A}$ Lewis (1974)

(b) $||\boldsymbol{A}\ \boldsymbol{B}|| = \lambda w.\ ||\boldsymbol{A}||(w) \oplus ||\boldsymbol{B}||(w)$, if $[\![\boldsymbol{A}\ \boldsymbol{B}]\!] = [\![\boldsymbol{A}]\!]\oplus[\![\boldsymbol{B}]\!]$

(72a) $[\![$**John thinks it's raining**$]\!]$

= $\mathrm{APP}^{ext}(\mathrm{APP}^{int}([\![$**thinks**$]\!],[\![$**it's raining**$]\!]),[\![$**John**$]\!])$

NB: $\mathrm{APP}^{ext}(A,B) = \lambda w.\ A(w)(B(w))$; $\mathrm{APP}^{int}(A,B) = \lambda w.\ A(w)(B)$

(b) $||$**John thinks it's raining**$||\ (w)$

= $\mathrm{APP}^{ext}(||$ **thinks it's raining**$||(w),||$**John** $||(w))$

= $\mathrm{APP}^{ext}(\mathrm{APP}^{int}(||$ **thinks**$||(w),||$**it's raining**$||(w)),||$**John**$||(w))$

= $\mathrm{APP}^{ext}(\mathrm{APP}^{int}([\![$**thinks**$]\!],[\![$**it's raining**$]\!]),[\![$**John**$]\!])$

= $[\![$**John thinks it's raining**$]\!]$

(73a) $//\boldsymbol{A}// = \pi([\![\boldsymbol{A}]\!])$, for lexical $\boldsymbol{A}$ Putnam (1980)

(b) $//\boldsymbol{A}\ \boldsymbol{B}// = //\boldsymbol{A}// \oplus //\boldsymbol{B}//$, if $[\![\boldsymbol{A}\ \boldsymbol{B}]\!]= [\![\boldsymbol{A}]\!]\oplus[\![\boldsymbol{B}]\!]$

(c) $\pi_{\boldsymbol{e}}$: $\boldsymbol{U}\rightarrow\boldsymbol{U}$ is a (non-trivial) bijection; $\pi_{\boldsymbol{s}}$ and $\pi_{\boldsymbol{t}}$ are identities on $\boldsymbol{W}$ and $\{0,1\}$;

$\pi_{\boldsymbol{ab}}$ maps any f of type $\boldsymbol{ab}$ to $\{(\pi x,\pi y) \mid f(x) = y\}$

(d) $//\boldsymbol{S}// = [\![\boldsymbol{S}]\!]$, for any sentence $\boldsymbol{S}$

… provided that all compositions $\oplus$ are invariant

NB: $\oplus$ is invariant iff $\pi(\oplus) = \oplus$ for all permutations π Tarski (1986); van Benthem (1989)

- *<u>Further topics</u>*

– Externalism Putnam (1975); Burge (1979); Haas-Spohn (1995)

– Lexical meanings and intensions

Zimmermann & Sternefeld (2013: sec. 8.4); Zimmermann (2014: Kap. 5)

– Fregean vs. intensional compositionality

Zimmermann & Sternefeld (2013: sec. 8.6); Zimmermann (t.a.)

– *De re* attitude reports Kaplan (1968); Aloni (2001)

– Generalised *de re* Cresswell & von Stechow (1982); Bäuerle (1983); Zimmermann (t.a.)

– *De se* attitudes Lewis (1979); Schlenker (2011)

– Granularity Cresswell (1985); Stalnaker (1991; 1999)

– Hierarchy of senses Parsons (1981); Zimmermann (t.a.)

– Worlds and models Zimmermann (1999; 2011)

– Verbs of Depiction Forbes (2006: ch. 7); Zimmermann (2016)

References

Aloni, Maria (2001): *Quantification under Conceptual Covers*. University of Amsterdam dissertation.

Bäuerle, Rainer (1983): 'Pragmatisch-semantische Aspekte der NP-Interpretation'. In: M. Faust *et al.* (eds.), *Allgemeine Sprachwissenschaft, Sprachtypologie und Textlinguistik*. Tübingen: Narr. 121–31.

Benthem, Johan van (1989): 'Categorial Grammar and Type Theory'. *Journal of Philosophical Logic* **19** , 115–68.

Burge, Tyler (1979): 'Individualism and the Mental'. *Midwest Studies in Philosophy* **4**, 73–121.

Buridanus, Johannes (1350): *Sophismata*. Ms. Paris. Published as Scott (1977).

Carnap, Rudolf (1947): *Meaning and Necessity*. Chicago/London: University of Chicago Press.
Cresswell, Maxwell J. (1973): *Logics and Languages*. London: Methuen.
– (1985): *Structured Meanings: The Semantics of Propositional Attitudes*. Cambridge, MA: MIT Press.
Cresswell, Maxwell J.; Stechow, Arnim von (1982): '*De Re* Belief Generalized'. *Linguistics and Philosophy* **5** , 503–35.
Condoravdi, Cleo; Crouch, Dick; van den Berg, Martin (2001): 'Preventing Existence'. In: *Proceedings of the international conference on formal ontology in information systems*. Amsterdam: IOS Press, 162–73.
Engesser, Kurt (1980): *Untersuchungen zur Montaguegrammatik*. University of Konstanz dissertation.
Forbes, Graeme (2006): *Attitude Problems. An Essay on Linguistic Intensionality*. Oxford: Clarendon Press.
Frege, Gottlob (1891): *Function und Begriff*. Jena: Pohle. [English translation: 'On Function and Concept'. In: M. Beaney (ed.), *The Frege Reader*. Oxford: Wiley-Blackwell 1997. 130–48]
– (1892): 'Über Sinn und Bedeutung'. *Zeitschrift für Philosophie und philosophische Kritik* (*NF)* **100**, 25–50. [English translation: 'On *Sinn* and *Bedeutung*'. In: M. Beaney (ed.), *The Frege Reader*. Oxford: Wiley-Blackwell 1997. 151–71]
Gallin, Daniel (1975): *Intensional and Higher-order Modal Logic*. Amsterdam: North Holland.
Haas-Spohn, Ulrike (1995): *Versteckte Indexikalität und subjektive Bedeutung*. Berlin: Akademie Verlag.
Hintikka, Jaakko (1962): *Knowledge and Belief*. Ithaca, NY: Cornell University Press.
– (1969): 'Semantics for Propositional Attitudes'. In: J. W. Davis *et al.* (eds.), *Philosophical Logic*. Dordrecht: REidel. 21-45.
Kaplan, David (1968): 'Quantifying in'. *Synthese* **19** (1968), 178–214.
– (1975): 'How to Russell a Frege-Church'. *Journal of Philosophy* **72**, 716–29.
Lerner, Jean-Yves; Zimmermann, Thomas Ede (1981): *Mehrdimensionale Semantik. Die Präsuppositionen und die Kontextabhängigkeit von* nur. Papier No. 50. SFB 99, Universität Konstanz.
Lewis, David K. (1974): ''Tensions'. In: M. K. Munitz & P. K. Unger (eds.), *Semantics and Philosophy*. New York: New York University Press. 49–62.
– (1979): 'Attitudes *de dicto* and *de se*'. *Philosophical Review* **88** (1979), 513–43.
Liefke, Kristina (2015): 'Codability and Robustness in Formal Natural Language Semantics'. In: T. Murata *et al.* (eds.), *New Frontiers in Artificial Intelligence*. New York: Springer. 6–22.
Mador-Haim, Sela; Winter, Yoad (2015): 'Far from obvious: the semantics of local indefinites'. *Linguistics and Philosophy* **38**, 437–476.
Meinong, Alexius (1904): *Über Gegenstandstheorie*. Leipzig: Akademische Druck- und Verlagsanstalt.
Montague, Michelle (2007): 'Against Propositionalism'. *Noûs* **41**, 503–18.
Montague, Richard (1969): 'On the Nature of Certain Philosophical Entities'. *The Monist* **53**, 159–95.
– (1970a): 'Universal Grammar'. *Theoria* **36** (1970), 373–98.
– (1970b): 'English as a Formal Language'. In: B. Visentini (ed.), *Linguaggi nella società e nella tecnica*. Milan: Edizioni di Comunità. 189–223.
Moulton, Keir (2013): 'Raising from the Dead'. *Linguistic Inquiry* **44**, 157–67.
Parsons, Terence (1981): 'Frege's Hierarchies of Indirect Senses and the Paradox of Analysis'. In: P. French *et al.* (eds.), *Midwest Studies in Philosophy VI: The Foundations of Analytic Philosophy*. Minneapolis: University of Minnesota Press. 37–57.
Partee, Barbara (1974): 'Opacity and Scope'. In: M. K. Munitz & P. K. Unger (eds.), *Semantics and Philosophy*. New York: New York University Press. 81–101.
– (1987): 'Noun Phrase Interpretation and Type Shifting Principles'. In: J. Groenendijk *et al.* (eds.), Studies in Discourse Representation Theory and the Theory of Generalized Quantifiers. Dordrecht: Foris. 115–43.
– (2004): 'Reflections of a formal semanticist'. In: *Compositionality in Formal Semantics. Selected Papers by Barbara Partee*. Oxford: Wiley 2004. 1–25.

Putnam, Hilary (1975): 'The meaning of "meaning"'. In: H. Putnam, *Philosophical Papers. Vol. 2: Mind, Language, and Reality*. Cambridge: Cambridge University Press. 215–71.
– (1980): 'Models and Reality', *Journal of Symbolic Logic* **45**, 464–82.
Quine, Willard Van Orman (1956): 'Quantifiers and Propositional Attitudes'. *Journal of Philosophy* **53**, 177–87.
Russell, Bertrand (1905): 'On Denoting'. *Mind* **14**, 479–93.
Schlenker, Philippe (2011): 'Indexicality and De Se reports '. In: K. v. Heusinger *et al.* (eds.), *Semantics. An international Handbook of Natural Language Meaning. Volume 2*. Berlin: de Gruyter. 1561–1604.
Schwarz, Florian. (2006): 'On *Needing* propositions and *Looking* for properties'. In M. Gibson & J. Howell (eds.), *SALT XVI Conference Proceedings*. Ithaca, NY: Cornell University Press. 259–76.
Scott, Theodore Kermit (1977): *Johannes Buridanus. 'Sophismata'. Critical Edition with an Introduction*. Stuttgart: Frommann-Holzboog. [English translation: *Sophisms on Meaning and Truth*. New York: Appleton Century Crofts 1966]
Stalnaker, Robert (1991): 'The Problem of Logical Omniscience, I'. *Synthese* **89** , 425–40.
– (1999): 'The Problem of Logical Omniscience, II'. In: R. Stalnaker (ed.), *Context and Content*. Oxford: Oxford University Press. 255–73.
Szabó, Zoltan G. (2003): 'Believing in Things'. *Philosophy and Phenomenological Research* **LXVI**, 584–611.
Tarski, Alfred (1986): 'What are logical notions?'. *History and Philosophy of Logic* **7**, 143–54.
Whitehead, Alfred North; Russell, Bertrand (1905): *Principia Mathematica. To *56.* Cambridge: Cambridge University Press.
Wittgenstein, Ludwig (1921): 'Logisch-philosophische Abhandlung'. In: W. Ostwald (ed.), *Annalen der Naturphilosophie*, Vol. 14. 185–262 [Revised version, with English translation: *Tractatus logico-philosophicus*. London: Kegan Paul 1922]
Zimmermann, Thomas Ede (1983): 'Notes on a Recent Textbook in Semantics'. *Theoretical Linguistics* **10**, 65–79.
– (1989): 'Intensional Logic and Two-sorted Type Theory'. *Journal of Symbolic Logic* **54**, 65–77.
– (1993): 'On the Proper Treatment of Opacity in Certain Verbs'. *Natural Language Semantics* **1** 149–79.
– (2001): 'Unspecificity and Intensionality'. In: C. Féry & W. Sternefeld (eds.), *Audiatur Vox Sapientiae*. Berlin: de Gruyter. 514–33.
– (2006): 'Monotonicity in opaque verbs'. *Linguistics and Philosophy* **29**, 715–61.
– (1999): 'Meaning Postulates and the Model-Theoretic Approach to Natural Language Semantics'. *Linguistics and Philosophy* **22** (1999), 529–61.
– (2010): 'What it Takes to be Missing '. In: T. Hanneforth & G. Fanselow (eds.), Language and Logos. Berlin: Akademie Verlag. 255–65.
– (2011): 'Model-theoretic semantics'. In: C. Maienborn *et al.* (eds.), *Semantics. An International Handbook of Natural Language Meaning. Volume 1*. Berlin: de Gruyter 2011. 762–801.
– (2012): 'Compositionality problems and how to solve them '. In: M. Werning et al. (eds.), The Oxford Handbook of Compositionality. Oxford: Oxford University Press. 81–106.
– (2014): *Einführung in die Semantik*. Darmstadt: Wissenschaftliche Buchgesellschaft.
– (2016): 'Painting and Opacity'. In: W. Freitag et al. (eds.), *Von Rang und Namen*. Münster: mentis. 425–51.
– (t.a.): 'Fregean Compositionality'. In: D. Ball & B. Rabern (eds.), *The Science of Meaning*. Oxford: Oxford University Press. [Ms. available on request]
– (ms.): 'Representing Intensionality: Variables vs. Parameters'. Submitted. [Ms. available on request]
Zimmermann, Thomas Ede; Sternefeld, Wolfgang (2013): *Introduction to Semantics*. Berlin: de Gruyter.