Universal Quantification as Iterated Conjunction

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Universal Quantification

Classic view: generalized Boolean conjunction

$[\![\text{Every student left}]\!] =$

$$\text{left}\, x_1 \wedge \text{left}\, x_2 \wedge \ldots \wedge \text{left}\, x_k, \quad \text{for } x_1, \ldots, x_k \in \text{student}$$

The Proposal: generalized dynamic conjunction

$[\![\text{Every student left}]\!] =$

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The Empirical Payoff:

- Pair-list readings
- Internal adjectives

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Outline

1. Data on pair-lists and adjectives in English

2. Dynamic conjunction and relation composition

3. Applications of iterated conjunction to data

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Universal quantification and pair-list questions

Matrix pair-list questions only possible with distributive universal quantifiers
(Szabolcsi 1993, 1997; Krifka 2001; a.o.)

(1) Which dish did every boy make?
  a. Pasta
  b. His favorite
  c. ✓ Al (made) pasta, Bill salad, Carl pudding

(2) Which dish did most/several/no boys make?
  a. Pasta
  b. Their favorite
  c. # Al (made) pasta, Bill salad, Carl pudding

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Universal quantification and "functional readings"

Pair-list varieties of functional readings only possible with distributive universal quantifiers

(Chierchia 2001; Schwarz 2001; Schlenker 2006; a.o.)

(3) If each guest brought a certain dish, the party was a sure success

$^{\checkmark}\exists f : \mathsf{guest} \to \mathsf{dish} \,.\, \big(\forall x \in \mathsf{guest} \,.\, \mathsf{brought}\,(f\,x)\,x\big) \Rightarrow \ldots$

(4) If no/three/all the guests brought a certain dish, the party was probably a success

$^{\#}\exists f : \mathsf{guest} \to \mathsf{dish} \,.\, \big(\neg\exists/\exists_3/\forall x \in \mathsf{guest} \,.\, \mathsf{brought}\,(f\,x)\,x\big) \Rightarrow \ldots$

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Universal quantification and internal adjectives

Internal readings of singular adjectives only possible with distributive universal quantifiers

(Carlson 1987; Beck 2000; Brasoveanu 2011; a.o.)

(5) Each guest brought a different/more elaborate dish

$^{\checkmark}\exists f : \mathsf{guest} \xrightarrow{1:1/+} \mathsf{dish} \,.\, \forall x \in \mathsf{guest} \,.\, \mathsf{brought}\,(f\,x)\,x$

(6) No/At least three/Few guests brought a different/more elaborate dish

$^{\#}\exists f : \mathsf{guest} \xrightarrow{1:1/+} \mathsf{dish} \,.\, \neg\exists/\exists_3/\mathsf{Few}\, x \in \mathsf{guest} \,.\, \mathsf{brought}\,(f\,x)\,x$

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A little dynamics

- Propositions in dynamic semantics: relations over “contexts” (here, stacks á la Dekker 1994)
  $[\![\text{John left}]\!] \rightsquigarrow \lambda s\,.\,\{s \cdot \mathsf{j} \mid \mathsf{left}\,\mathsf{j}\}$
- Existentials in dynamic semantics: potential multiplicity of output contexts for any given input
  $[\![\text{A man left}]\!] \rightsquigarrow \lambda s\,.\,\{s \cdot x \mid \mathsf{left}\,x \wedge \mathsf{man}\,x\}$
- Conjunction in dynamic semantics: relation composition
  $[\![\phi\,;\,\psi]\!] \equiv \lambda s\,.\,\bigcup\{[\![\psi]\!]\,s' \mid s' \in [\![\phi]\!]\,s\}$

Iterated conjunction and alternatives

(7) John read a book and Tom read a book

$$\overbrace{\lambda s\,.\left\{ s \cdot \mathsf{j} \cdot x \;\middle|\; \begin{array}{l} \mathsf{book}\, x \\ \mathsf{read}\, x\, \mathsf{j} \end{array} \right\}}^{\text{John read a book}} \;;\; \overbrace{\lambda s\,.\left\{ s \cdot \mathsf{t} \cdot y \;\middle|\; \begin{array}{l} \mathsf{book}\, y \\ \mathsf{read}\, y\, \mathsf{t} \end{array} \right\}}^{\text{Tom read a book}}$$

$$\rightsquigarrow \quad \underbrace{\lambda s\,.\left\{ \begin{array}{r} s \cdot \mathsf{j} \cdot x \\ \cdot\, \mathsf{t} \cdot y \end{array} \;\middle|\; \begin{array}{l} x, y, z, \in \mathsf{book}, \\ \langle \mathsf{j}, x \rangle, \langle \mathsf{t}, y \rangle \in \mathsf{read} \end{array} \right\}}_{\left\{ \begin{array}{lcl} \text{John read } \textit{W\&P} & \text{and} & \text{Tom read } \textit{W\&P} \\ \text{John read } \textit{W\&P} & \text{and} & \text{Tom read } \textit{AK} \\ & \vdots & \\ \text{John read } \textit{AK} & \text{and} & \text{Tom read } \textit{AK} \end{array} \right\}}$$

A set of alternatives pairing John and Tom with books they read

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Universal quantification as iterated conjunction

(8) Every student read a book

$$\overbrace{\lambda s\,.\left\{ s\cdot \mathsf{j}\cdot x \;\middle|\; \begin{array}{l}\text{book}\,x\\ \text{read}\,x\,\mathsf{j}\end{array}\right\}}^{\text{John read a book}} \;;\; \overbrace{\lambda s\,.\left\{ s\cdot \mathsf{t}\cdot y \;\middle|\; \begin{array}{l}\text{book}\,y\\ \text{read}\,y\,\mathsf{t}\end{array}\right\}}^{\text{Tom read a book}} \;;\; \overbrace{\ldots}^{\ldots}$$

$$\rightsquigarrow \quad \underbrace{\lambda s\,.\left\{ \begin{array}{l} s\cdot \mathsf{j}\cdot x\\ \quad\cdot \mathsf{t}\cdot y\cdot\ldots\end{array} \;\middle|\; \begin{array}{l} x, y, z, \in \text{book},\\ \langle \mathsf{j}, x\rangle, \langle \mathsf{t}, y\rangle \in \text{read}\end{array}\right\}}_{\left\{\begin{array}{llll}\text{John read } \textit{W\&P} & \text{and} & \text{Tom read } \textit{W\&P} & \text{and} \ldots\\ \text{John read } \textit{W\&P} & \text{and} & \text{Tom read } \textit{AK} & \text{and} \ldots\\ & & \vdots & \end{array}\right\}}$$

A set of alternatives pairing each student with a book he read

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A set of alternatives pairing each student with a book he read

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Pair-list functional readings

(9) Each guest brought a dish

$$\rightsquigarrow \left\{ \begin{array}{lllll} \text{Al made pasta} & \text{and} & \text{Bill made salad} & \text{and} & \text{Carl made pudding} \\ \text{Al made pasta} & \text{and} & \text{Bill made salad} & \text{and} & \text{Carl made salad} \\ & & \vdots & & \end{array} \right\}$$

Like other sources of nondeterminism — indefinites, disjunctions — these alternatives can take exceptional scope

(Kratzer & Shimoyama 2002; Alonso-Ovalle 2006; Charlow 2014)

(10) If each guest brought a certain dish, the party was a sure success

$\{p \Rightarrow \text{success the.party} \mid p \in [\![(9)]\!]\}$

Internal adjectives

Comparative adjectives are essentially anaphoric
(e.g. Brasoveanu 2011)

(11) John bought a computer.
Mary bought a different/faster computer.

$$[\![\text{different}]\!] \equiv \lambda P x s\,.\, \{s' \mid s' \in P\,x\,s \;\wedge\; x \notin s'\}$$

$$[\![\text{faster}]\!] \equiv \lambda P y s\,.\, \left\{ s' \,\middle|\, \begin{array}{l} s' \in P\,x\,s \\ \text{speed}\,x > \text{max}\{\text{speed}\,v \mid v \in s \;\wedge\; P\,v\,s \neq \emptyset\} \end{array} \right\}$$

Internal adjectives

(12) In 2010, I bought a faster computer

$$\lambda s\,.\,\left\{ s \cdot 2010 \cdot x \;\middle|\; \begin{array}{l} \text{comp}\, x \\ \text{speed}\, x > \max\{\text{speed}\, u \mid \text{comp}\, u \,\wedge\, u \in s\} \end{array} \right\}$$

(13) Every year, I bought a faster computer

⟦In 09, I bought a faster computer⟧ ;

⟦In 10, I bought a faster computer⟧ ;

$$\vdots$$

$$\lambda s\,.\,\left\{ \begin{array}{l} s \cdot 09 \cdot x \\ \quad \cdot 10 \cdot y \\ \quad \cdot 11 \cdot z \\ \quad \cdot \ldots \end{array} \;\middle|\; \begin{array}{l} x, y, z, \cdots \in \text{comp}, \quad \langle \text{j}, x, 09\rangle, \langle \text{j}, y, 10\rangle, \langle \text{j}, z, 11\rangle, \cdots \in \text{bought} \\ \text{speed}\, x > \max\{\text{speed}\, u \mid \text{comp}\, u \,\wedge\, u \in s\} \\ \text{speed}\, y > \max\{\text{speed}\, u \mid \text{comp}\, u \,\wedge\, u \in s \cdot 09 \cdot x\} \\ \text{speed}\, z > \max\{\text{speed}\, u \mid \text{comp}\, u \,\wedge\, u \in s \cdot 09 \cdot x \cdot 10 \cdot y\}, \;\ldots \end{array} \right\}$$

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Conclusion

- Uniform distibution of pair-lists and internal readings accounted for
- No need to resort to choice functions or quantification over pairs
  (Schwarz 2001; Schlenker 2006; Brasoveanu 2011; a.o.)
- Consonant with theories like Szabolcsi 2013 that take universals to be morphosemantically composed of conjunction, and conjunction to be dynamic by default

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Thanks!