Gramática Categorial — Conectivo $\Uparrow$

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- quantificação até agora — dois itens para cada determinante:
  - tod{a/o}
    - sujeito — $(S/(N\backslash S))/N_c : \lambda\Pi.\lambda\Lambda.\forall v.((\Pi\ v) \rightarrow (\Lambda\ v))$
    - obj. dir. — $((S/N)\backslash S)/N_c : \lambda\Pi.\lambda\Lambda.\forall v.((\Pi\ v) \rightarrow (\Lambda\ v))$
  - um(a)
    - sujeito — $(S/(N\backslash S))/N_c : \lambda\Pi.\lambda\Lambda.\exists v.((\Pi\ v) \wedge (\Lambda\ v))$
    - obj. dir. — $((S/N)\backslash S)/N_c : \lambda\Pi.\lambda\Lambda.\exists v.((\Pi\ v) \wedge (\Lambda\ v))$

- quantificação com $\uparrow$?
- ainda precisaria de dois itens para cada determinante:
  - tod{a/o}
    - $(S/(S\uparrow N))/N_c : \lambda\Pi.\lambda\Lambda.\forall\upsilon.((\Pi\ \upsilon) \rightarrow (\Lambda\ \upsilon))$
      (para lacuna no sujeito)
    - $((S\uparrow N)\backslash S)/N_c : \lambda\Pi.\lambda\Lambda.\forall\upsilon.((\Pi\ \upsilon) \rightarrow (\Lambda\ \upsilon))$
      (para lacuna no objeto direto)
  - um(a)
    - $(S/(S\uparrow N))/N_c : \lambda\Pi.\lambda\Lambda.\exists\upsilon.((\Pi\ \upsilon) \wedge (\Lambda\ \upsilon))$
      (para lacuna no sujeito)
    - $((S\uparrow N)\backslash S)/N_c : \lambda\Pi.\lambda\Lambda.\exists\upsilon.((\Pi\ \upsilon) \wedge (\Lambda\ \upsilon))$
      (para lacuna no objeto direto)

- ama com duas hipóteses:

$$\dfrac{[N : x_0]^0 \quad \dfrac{\dfrac{\text{ama}}{(N\backslash S)/N : A}Lex \quad [N : x_1]^1}{N\backslash S : (A\ x_1)}E/}{S : ((A\ x_1)\ x_0)}E\backslash$$

- todo homem para sujeito:

$$\dfrac{\dfrac{\text{todo}}{(S/(S \uparrow N))/N_c : \lambda P.\lambda Q.\forall x.((P\ x) \rightarrow (Q\ x))}Lex \quad \dfrac{\text{homem}}{N_c : H}Lex}{S/(S \uparrow N) : (\lambda P.\lambda Q.\forall x.((P\ x) \rightarrow (Q\ x))\ H) =_{red.\beta} \lambda Q.\forall x.((H\ x) \rightarrow (Q\ x))}E/$$

- uma mulher para objeto direto:

$$\dfrac{\dfrac{\text{uma}}{((S \uparrow N)\backslash S)/N_c : \lambda R.\lambda S.\exists y.((R\ y) \wedge (S\ y))}Lex \qquad \dfrac{\text{mulher}}{N_c : M}Lex}{(S \uparrow N)\backslash S : (\lambda R.\lambda S.\exists y.((R\ y) \wedge (S\ y))\ M) =_{red.\beta} \lambda S.\exists y.((M\ y) \wedge (S\ y))}E/$$

- escopos corretos:
  - universal com escopo sobre existencal

$$
\dfrac{
  \dfrac{\text{todo homem}}{\begin{array}{c}S/(S\uparrow N) :\\ \lambda Q.\forall x.((H\ x) \rightarrow (Q\ x))\end{array}}\,D
  \qquad
  \dfrac{
    \dfrac{
      \dfrac{
        \dfrac{\text{ama}}{S : ((A\ x_1)\ x_0)}\,D
      }{\begin{array}{c}S\uparrow N :\\ \lambda x_1.((A\ x_1)\ x_0)\end{array}}\,I{\uparrow}^1
      \qquad
      \dfrac{\text{uma mulher}}{\begin{array}{c}(S\uparrow N)\backslash S :\\ \lambda S.\exists y.((M\ y) \wedge (S\ y))\end{array}}\,D
    }{\begin{array}{l}S : (\lambda S.\exists y.((M\ y) \wedge (S\ y))\ \lambda x_1.((A\ x_1)\ x_0))\\ \quad =_{red.\beta} \exists y.((M\ y) \wedge (\lambda x_1.((A\ x_1)\ x_0)\ y))\\ \quad =_{red.\beta} \exists y.((M\ y) \wedge ((A\ y)\ x_0))\end{array}}\,E\backslash
  }{S\uparrow N : \lambda x_0.\exists y.((M\ y) \wedge ((A\ y)\ x_0))}\,I{\uparrow}^0
}{\begin{array}{l}S : (\lambda Q.\forall x.((H\ x) \rightarrow (Q\ x))\ \lambda x_0.\exists y.((M\ y) \wedge ((A\ y)\ x_0)))\\ \quad =_{red.\beta} \forall x.((H\ x) \rightarrow (\lambda x_0.\exists y.((M\ y) \wedge ((A\ y)\ x_0))\ x))\\ \quad =_{red.\beta} \forall x.((H\ x) \rightarrow \exists y.((M\ y) \wedge ((A\ y)\ x)))\end{array}}\,E/
$$

– existencial com escopo sobre universal

$$\dfrac{\dfrac{\dfrac{\text{todo homem}}{S/(S\uparrow N) : \lambda Q.\forall x.((H\ x) \rightarrow (Q\ x))}D \quad \dfrac{\dfrac{\text{ama}}{S : ((A\ x_1)\ x_0)}D}{S\uparrow N : \lambda x_0.((A\ x_1)\ x_0)}I{\uparrow}^0}{\begin{array}{l} S : (\lambda Q.\forall x.((H\ x) \rightarrow (Q\ x))\ \lambda x_0.((A\ x_1)\ x_0)) \\ \quad =_{red.\beta} \forall x.((H\ x) \rightarrow (\lambda x_0.((A\ x_1)\ x_0)\ x)) \\ \quad =_{red.\beta} \forall x.((H\ x) \rightarrow ((A\ x_1)\ x)) \end{array}}E/}{S\uparrow N : \lambda x_1.\forall x.((H\ x) \rightarrow ((A\ x_1)\ x))}I{\uparrow}^1 \quad \dfrac{\text{uma mulher}}{(S\uparrow N)\backslash S : \lambda S.\exists y.((M\ y) \wedge (S\ y))}D}{\begin{array}{l} S : (\lambda S.\exists y.((M\ y) \wedge (S\ y))\ \lambda x_1.\forall x.((H\ x) \rightarrow ((A\ x_1)\ x))) \\ \quad =_{red.\beta} \exists y.((M\ y) \wedge (\lambda x_1.\forall x.((H\ x) \rightarrow ((A\ x_1)\ x))\ y)) \\ \quad =_{red.\beta} \exists y.((M\ y) \wedge \forall x.((H\ x) \rightarrow ((A\ y)\ x))) \end{array}}E\backslash$$

- mas também inversão incorreta de argumentos:
  - quem ama seria a mulher, e os homem seriam amados

$$\dfrac{\text{todo homem}}{S/(S\uparrow N) : \lambda Q.\forall x.((H\ x) \to (Q\ x))}\,D \qquad \dfrac{\dfrac{\text{ama}}{S : ((A\ x_1)\ x_0)}\,D}{S\uparrow N : \lambda x_1.((A\ x_1)\ x_0)}\,I{\uparrow}^1 \qquad \dfrac{\text{uma mulher}}{(S\uparrow N)\backslash S : \lambda S.\exists y.((M\ y) \wedge (S\ y))}\,D$$

$$\dfrac{S/(S\uparrow N) : \lambda Q.\forall x.((H\ x) \to (Q\ x)) \qquad S\uparrow N : \lambda x_1.((A\ x_1)\ x_0)}{\begin{array}{l} S : (\lambda Q.\forall x.((H\ x) \to (Q\ x))\ \lambda x_1.((A\ x_1)\ x_0)) \\ \quad =_{red.\beta} \forall x.((H\ x) \to (\lambda x_1.((A\ x_1)\ x_0)\ x)) \\ \quad =_{red.\beta} \forall x.((H\ x) \to ((A\ x)\ x_0)) \end{array}}\,E/$$

$$\dfrac{S : \forall x.((H\ x) \to ((A\ x)\ x_0))}{S\uparrow N : \lambda x_0.\forall x.((H\ x) \to ((A\ x)\ x_0))}\,I{\uparrow}^0$$

$$\dfrac{S\uparrow N : \lambda x_0.\forall x.((H\ x) \to ((A\ x)\ x_0)) \qquad (S\uparrow N)\backslash S : \lambda S.\exists y.((M\ y) \wedge (S\ y))}{\begin{array}{l} S : (\lambda S.\exists y.((M\ y) \wedge (S\ y))\ \lambda x_0.\forall x.((H\ x) \to ((A\ x)\ x_0))) \\ \quad =_{red.\beta} \exists y.((M\ y) \wedge (\lambda x_0.\forall x.((H\ x) \to ((A\ x)\ x_0))\ y)) \\ \quad =_{red.\beta} \exists y.((M\ y) \wedge \forall x.((H\ x) \to ((A\ x)\ y))) \end{array}}\,E\backslash$$

– idem

$$\dfrac{\text{todo homem}}{S/(S \uparrow N) : \lambda Q.\forall x.((H\ x) \to (Q\ x))}\,D \qquad \dfrac{\dfrac{\text{ama}}{S : ((A\ x_1)\ x_0)}\,D}{S \uparrow N : \lambda x_0.((A\ x_1)\ x_0)}\,I{\uparrow}^0 \qquad \dfrac{\text{uma mulher}}{(S \uparrow N)\backslash S : \lambda S.\exists y.((M\ y) \wedge (S\ y))}\,D$$

$$\dfrac{S \uparrow N : \lambda x_0.((A\ x_1)\ x_0) \qquad (S \uparrow N)\backslash S : \lambda S.\exists y.((M\ y) \wedge (S\ y))}{\begin{array}{l} S : (\lambda S.\exists y.((M\ y) \wedge (S\ y))\ \lambda x_0.((A\ x_1)\ x_0)) \\ \quad =_{red.\beta} \exists y.((M\ y) \wedge (\lambda x_0.((A\ x_1)\ x_0)\ y)) \\ \quad =_{red.\beta} \exists y.((M\ y) \wedge ((A\ x_1)\ y)) \end{array}}\,E\backslash$$

$$\dfrac{S : \exists y.((M\ y) \wedge ((A\ x_1)\ y))}{S \uparrow N : \lambda x_1.\exists y.((M\ y) \wedge ((A\ x_1)\ y))}\,I{\uparrow}^1$$

$$\dfrac{S/(S \uparrow N) : \lambda Q.\forall x.((H\ x) \to (Q\ x)) \qquad S \uparrow N : \lambda x_1.\exists y.((M\ y) \wedge ((A\ x_1)\ y))}{\begin{array}{l} S : (\lambda Q.\forall x.((H\ x) \to (Q\ x))\ \lambda x_1.\exists y.((M\ y) \wedge ((A\ x_1)\ y))) \\ \quad =_{red.\beta} \forall x.((H\ x) \to (\lambda x_1.\exists y.((M\ y) \wedge ((A\ x_1)\ y))\ x)) \\ \quad =_{red.\beta} \forall x.((H\ x) \to \exists y.((M\ y) \wedge ((A\ x)\ y))) \end{array}}\,E/$$

- conclusões:
  - é possível estipular uma categoria para os determinantes através do conectivo $\uparrow$
  - que também possibilita análise para os diferentes escopos com a interação dos quantificadores
  - mas ainda continuamos com a necessidade de dois itens lexicais para cada determinante (um quando a lacuna está na posição de sujeito, outro para quando a lacuna está na posição de objeto direto)
  - só que o pior é que, com o conectivo $\uparrow$, encontramos análises que não são compatíveis com o julgamento dos falantes (a gramática sobregera)

1 Um outro novo conectivo

$$
\dfrac{\dfrac{\begin{array}{ccc} \vdots & Y \Uparrow X : \alpha & \vdots \\ \vdots & \overline{}\,{}^{n} & \vdots \\ \vdots & Y : \upsilon & \vdots \\ \vdots & \vdots & \vdots \end{array}}{X : \beta}}{X : (\alpha\ \lambda\upsilon.\beta)}\, E\Uparrow^{n}
$$

[para υ nova na derivação]

[1, p. 225]

- $\langle$tod{a/o}, $(N \Uparrow S)/N_c$, $\lambda\Pi.\lambda\Lambda.\forall\upsilon.((\Pi\ \upsilon) \rightarrow (\Lambda\ \upsilon))\rangle \in Lex$
- $\langle$um(a), $(N \Uparrow S)/N_c$, $\lambda\Pi.\lambda\Lambda.\exists\upsilon.((\Pi\ \upsilon) \wedge (\Lambda\ \upsilon))\rangle \in Lex$

- todo homem

$$\dfrac{\dfrac{\text{todo}}{(N \Uparrow S)/N_c : \lambda P.\lambda Q.\forall x.((P\ x) \rightarrow (Q\ x))}\,Lex \quad \dfrac{\text{homem}}{N_c : H}\,Lex}{\begin{array}{c} N \Uparrow S : (\lambda P.\lambda Q.\forall x.((P\ x) \rightarrow (Q\ x))\ H) \\ =_{red.\beta}\ \lambda Q.\forall x.((H\ x) \rightarrow (Q\ x)) \end{array}}\,E/$$

- uma mulher

$$\dfrac{\dfrac{\text{uma}}{(N \Uparrow S)/N_c : \lambda R.\lambda S.\exists y.((R\ y) \wedge (S\ y))}\,Lex \quad \dfrac{\text{mulher}}{N_c : M}\,Lex}{\begin{array}{c} N \Uparrow S : (\lambda R.\lambda S.\exists y.((R\ y) \wedge (S\ y))\ M) \\ =_{red.\beta}\ \lambda S.\exists y.((M\ y) \wedge (S\ y)) \end{array}}\,E/$$

- quantificador universal com escopo sobre o existencial:

$$\dfrac{\text{todo homem}}{\dfrac{N \Uparrow S : \lambda Q.\forall x.((H\ x) \to (Q\ x))}{N : x_0}{\scriptstyle 0}}{\scriptstyle D}
\qquad
\dfrac{\text{ama}}{(N\backslash S)/N : A}{\scriptstyle D}
\qquad
\dfrac{\text{uma mulher}}{\dfrac{N \Uparrow S : \lambda S.\exists y.((M\ y) \wedge (S\ y))}{N : x_1}{\scriptstyle 1}}{\scriptstyle D}$$

$$\dfrac{(N\backslash S)/N : A \qquad N : x_1}{N\backslash S : (A\ x_1)}\ E/$$

$$\dfrac{N : x_0 \qquad N\backslash S : (A\ x_1)}{S : ((A\ x_1)\ x_0)}\ E\backslash$$

$$\dfrac{S : ((A\ x_1)\ x_0)}{\begin{array}{l} S : (\lambda S.\exists y.((M\ y) \wedge (S\ y))\ \lambda x_1.((A\ x_1)\ x_0)) \\ \quad =_{red.\beta} \exists y.((M\ y) \wedge (\lambda x_1.((A\ x_1)\ x_0)\ y)) \\ \quad =_{red.\beta} \exists y.((M\ y) \wedge ((A\ y)\ x_0)) \end{array}}\ E\Uparrow^1$$

$$\dfrac{S : \exists y.((M\ y) \wedge ((A\ y)\ x_0))}{\begin{array}{l} S : (\lambda Q.\forall x.((H\ x) \to (Q\ x))\ \lambda x_0.\exists y.((M\ y) \wedge ((A\ y)\ x_0))) \\ \quad =_{red.\beta} \forall x.((H\ x) \to (\lambda x_0.\exists y.((M\ y) \wedge ((A\ y)\ x_0))\ x)) \\ \quad =_{red.\beta} \forall x.((H\ x) \to \exists y.((M\ y) \wedge ((A\ y)\ x))) \end{array}}\ E\Uparrow^0$$

- quantificador existencial com escopo sobre o universal:

$$\dfrac{\text{todo homem}}{N \Uparrow S : \lambda Q.\forall x.((H\ x) \to (Q\ x))}\,D \qquad \dfrac{\text{ama}}{(N\backslash S)/N : A}\,D \qquad \dfrac{\text{uma mulher}}{N \Uparrow S : \lambda S.\exists y.((M\ y) \wedge (S\ y))}\,D$$

$$\dfrac{N \Uparrow S : \lambda Q.\forall x.((H\ x) \to (Q\ x))}{N : x_0}\,0 \qquad \dfrac{N \Uparrow S : \lambda S.\exists y.((M\ y) \wedge (S\ y))}{N : x_1}\,1$$

$$\dfrac{(N\backslash S)/N : A \qquad N : x_1}{N\backslash S : (A\ x_1)}\,E/$$

$$\dfrac{N : x_0 \qquad N\backslash S : (A\ x_1)}{S : ((A\ x_1)\ x_0)}\,E\backslash$$

$$\dfrac{S : ((A\ x_1)\ x_0)}{\begin{array}{l} S : (\lambda Q.\forall x.((H\ x) \to (Q\ x))\ \lambda x_0.((A\ x_1)\ x_0)) \\ \quad =_{red.\beta} \forall x.((H\ x) \to (\lambda x_0.((A\ x_1)\ x_0)\ x)) \\ \quad =_{red.\beta} \forall x.((H\ x) \to ((A\ x_1)\ x)) \end{array}}\,E{\Uparrow}^0$$

$$\dfrac{S : \forall x.((H\ x) \to ((A\ x_1)\ x))}{\begin{array}{l} S : (\lambda S.\exists y.((M\ y) \wedge (S\ y))\ \lambda x_1.\forall x.((H\ x) \to ((A\ x_1)\ x))) \\ \quad =_{red.\beta} \exists y.((M\ y) \wedge (\lambda x_1.\forall x.((H\ x) \to ((A\ x_1)\ x))\ y)) \\ \quad =_{red.\beta} \exists y.((M\ y) \wedge \forall x.((H\ x) \to ((A\ y)\ x))) \end{array}}\,E{\Uparrow}^1$$

- conclusões finais:
  - um único item lexical para cada determinante
  - escopos apropriados
  - não sobregera

Referências

[1] Bob Carpenter. *Type-Logical Semantics.* The MIT Press, Cambridge, MA, 1997.