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# Question the coherence of dialogical interaction through formalization

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# Question the coherence of dialogical interaction through formalization

Linguistique textuelle, linguistique de corpus

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Maxime Amblard

10 avril 2018



Introduction

SLAM

Corpus Tagging

Toward a formal treatment

Perspectives

## Introduction

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1. Report on natural language phenomena through formal frameworks
2. Thought and language disorders

- Semantics

# Summary

- Semantics
- Compositionality (Frege)

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- Logical approaches (Montague)



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- Cognitive reality, conceptual reality ? ...

# Can we understand madness ?

The SLAM project - Schizophrenia and Language : Analyse and Modelling



# SLAM

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- Linguistic studies of mental diseases (CHAIKA 1974) and (FROMKIN 1975)
- Pragmatic discontinuities in performing verbal interaction (TROGNON et MUSIOL 1996)
- Discontinuities **definitive** (MUSIOL 2009) : pathological use of discourse planning for patients with schizophrenia (paranoid)

The project aims to systematize the study of pathological conversations under interdisciplinary approaches

- Building of a linguistic resource on mental pathology

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The project aims to systematize the **study of pathological conversations** under **interdisciplinary approaches**

- Building of a linguistic resource on mental pathology
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- Epistemological and philosophical studies (norm, madness, rationality)
- Identify these purposes with :
  - formal models
  - NLP methods and tools

- Corpus
- Formalization
- Epistemology

- Corpus
  - organize the interviews
  - transcription and tagging
  - analyse different linguistic levels
- Formalization
  
- Epistemology

- Corpus
- Formalization
  - question the cognitive reality of semantico-pragmatic models,
  - automatically identify unusual uses of the language
- Epistemology



- Corpus
- Formalization
- Epistemology
  - question the normative concepts of rationality and logicity
  - study interpretation under linguistic interaction, and the status of implicit norms

## Discontinuity example

- B124 OH OUAIS (↑) ET PIS COMPLIQUÉ (↓) ET C'EST VRAIMENT TRÈS TRÈS COMPLIQUÉ (→) LA POLITIQUE C'EST QUELQUE CHOSE QUAND ON S'EN OCCUPE FAUT ÊTRE GAGNANT PARCE QU'AUTREMENT QUAND ON EST PERDANT C'EST FINI QUOI (↓)  
Oh yeah (↑) and complicated (↑) and it's really very very complicated (→) politics, it's really something when you get into it, have to win or else when you lose, well, you're finished (↓)
- A125 OUI  
Yes
- B126 J. C. D. EST MORT, L. EST MORT, P. EST MORT EUH (...)  
JCD is dead, L is dead, P is dead uh (...)
- A127 ILS SONT MORTS PARCE QU'ILS ONT PERDU À VOTRE AVIS (↑)  
So you think they're dead because they lost (↑)
- B128 NON ILS GAGNAIENT MAIS SI ILS SONT MORTS, C'EST LA MALADIE QUOI C'EST C'EST (→)  
No they won but if they're dead, it's their disease well it's it's (→)
- A129 OUAIS C'EST PARCE QU'ILS ÉTAIENT MALADES, C'EST PAS PARCE QU'ILS FAISAIENT DE LA POLITIQUE (↑)  
Yeah it's because they had a disease, it's not because they were in politics (↑)
- B130 SI ENFIN (→)  
Yes I mean (→)
- A131 SI VOUS PENSEZ QUE C'EST PARCE QU'ILS FAISAIENT DE LA POLITIQUE (↑)  
Yes you think it's because they were in politics (↑)
- B132 OUI TIENS OUI IL Y A AUSSI C. QUI A ACCOMPLI UN MEURTRE LÀ (→) IL ÉTAIT PRÉSENT LUI AUSSI QUI EST À B. MAIS ENFIN (→) C'EST ENCORE À CAUSE DE LA POLITIQUE ÇA  
Yes, so well yeah there was C too who committed murder, uh huh (→) he was there too, the one in B but well (→) it, that, it's because of politics again

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## Conversation example (english only)

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(→) **politics**, it's really something when you get into it, **have to win** or else  
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B128 No they won but if they're dead, it's **their disease** well it's it's (→)

A129 Yeah it's because they had a disease, it's not because they were in  
politics (↑)

B130 Yes I mean (→)

A131 Yes you think it's because they were in politics (↑)

B132 Yes, so well yeah there was **C too who committed murder**, uh huh (→)  
he was there too, the one in B but well (→) it, that, it's because of politics  
again

The schizophrenic switches twice from a theme to another one :

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- politic death (symbolic)
- death (literal)

## Discontinuity example

The schizophrenic switches twice from a theme to another one :

- politic death (symbolic)
- death (literal)

The two themes are related but they express two different realities.

## A relatively large corpus

	La Rochelle			Lyon			Total
	♂	♀	tot	♂	♀	tot	
Schizophrenics	15	3	18	22	9	31	49
Controls	15	8	23	4	4	8	31
Total	30	11	41	26	13	39	80



## A relatively large corpus

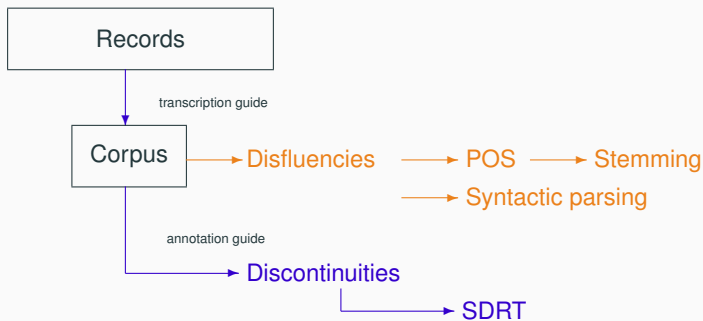
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31 575 speeches / 375 000 words

	La Rochelle				Lyon			
	# speeches		# words		# speeches		# words	
S	3 863	11 145	46 859	119 762	4 062	4 433	66 725	79 081
T	7 282		72 903		12 356			
P + S	3 819	11 517	30 293	138 571	4 098	4 480	33 686	37 842
P + T	7 698		108 278		4 156			
Total	22 662		258 333		8 913		116 923	

- A lot of administrative steps :
  - CPP of the area of the medical institution (including a finalise description of the all protocol)
  - CNIL
- Data should not be use for/against the patient
- Patient involvement (significant loss of participation >55%)
- Heavy protocol

- Interview(s) (hand transcription with a guide)
- Neuro-cognitive tests :
  - Wechsler Adult Intelligence Scale-III (IQ)
  - California Verbal Learning Test (strategy and cognitive abilities)
  - Trail Making Test (deprecation of cognitive flexibility and inhibition)
- Oculomotor behavior (double Eye-Trackers)
- Brain activity (EEG)



# Talking with patient with schizophrenia

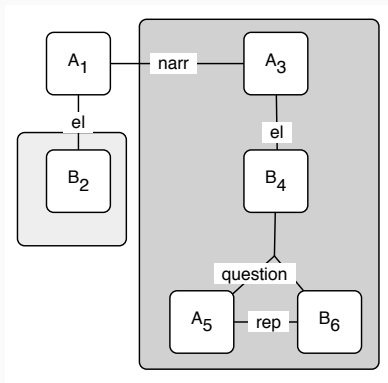
[AMR TALN 2011] [AMR Evol. Psychiatrique 2012] [AMR congrès de linguistique romane 2013]  
[AMR Dialogue, Rationality and Formalism Springer 2014] [AMR Philosophie et langage 31 2014]

Two interlocutors, thus two (spontaneous) views on the exchange.

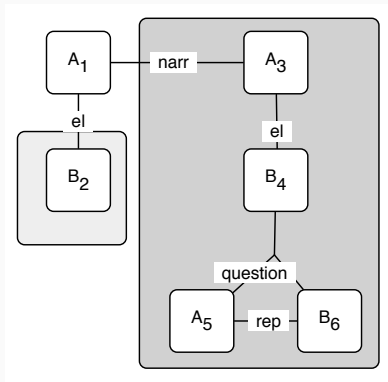
Discourse interpretation by	
<b>normal subject</b> (3 <sup>rd</sup> person)	<b>Schizophrenic</b> (1 <sup>st</sup> person)
<b>hypothesis</b> : pragmatic correctness ↓ semantics incorrectness	pragmatic incorrectness ↑ <b>hypothesis</b> : semantic correctness
contradictory contents : <i>look</i> like a contradiction	coherent content : <i>possibility of interpretation</i>

⇒ The representation *need more* than logical semantics

Use of SDRT + thematic boxes (grey ones)



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They are thematic islands

## Two conjectures

- Schizophrenics are **logically consistent**.



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- Schizophrenics are **logically consistent**.  
Hence discontinuities appear in the process which produce the representation, thus at the pragmatic level.
  
- Underspecification (ambiguity) plays a central role  
*Slogan* : “A choice is never a definitive one !”  
Phonological, morphological, lexical, discourse, ...

# SDRT [Asher & Lascarides 2003] (in 1 minutes ... (!!!))

Guy experienced a lovely evening last night

Elaboration

He had a fantastic meal

Elaboration

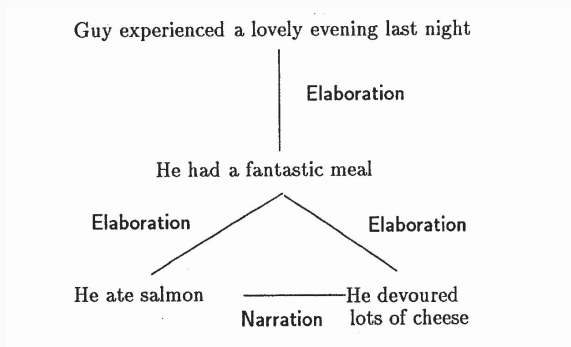
Elaboration

He ate salmon

Narration

He devoured  
lots of cheese

# SDRT [Asher & Lascarides 2003] (in 1 minutes ... (!!!))



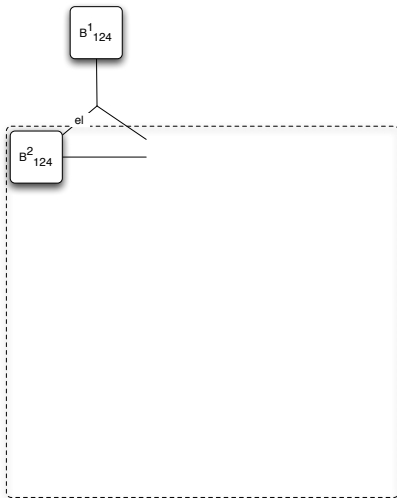
Constraints on attachment : right frontier rule

“He found **it** really marvelous”

(B124) Oh ouais (↑) et pis compliqué (↓) et c'est vraiment très très compliqué (→)

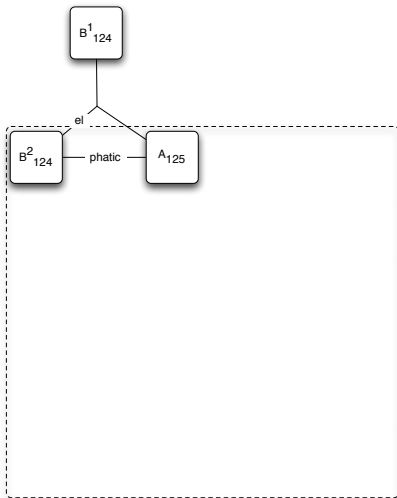
B<sup>1</sup><sub>124</sub>

la politique c'est quelque chose quand on s'en occupe faut être gagnant parce qu'autrement quand on est perdant c'est fini quoi (↓)

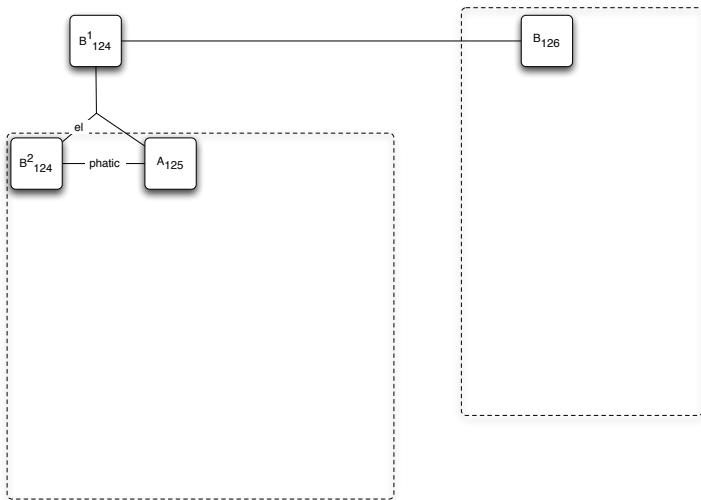




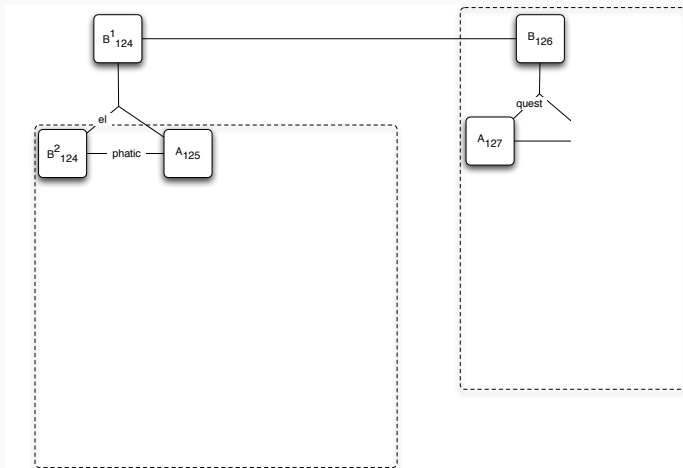
(A125) Oui



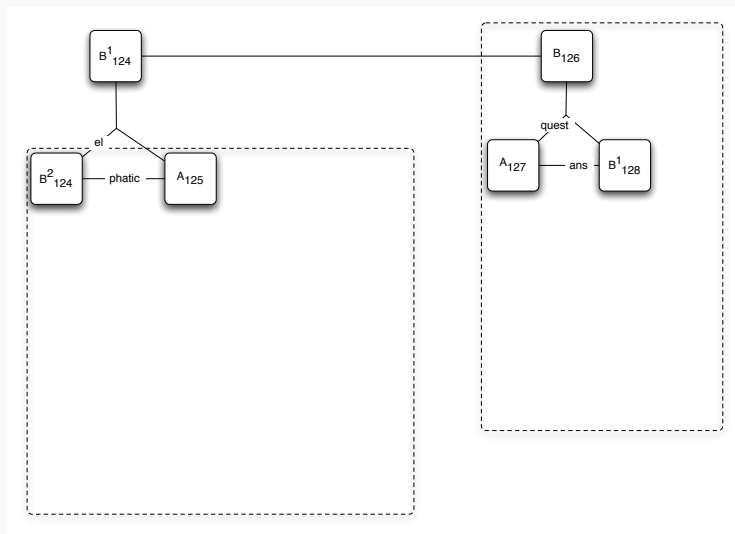
(B126) J. C. D. est mort, L. est mort, P. est mort euh (...)



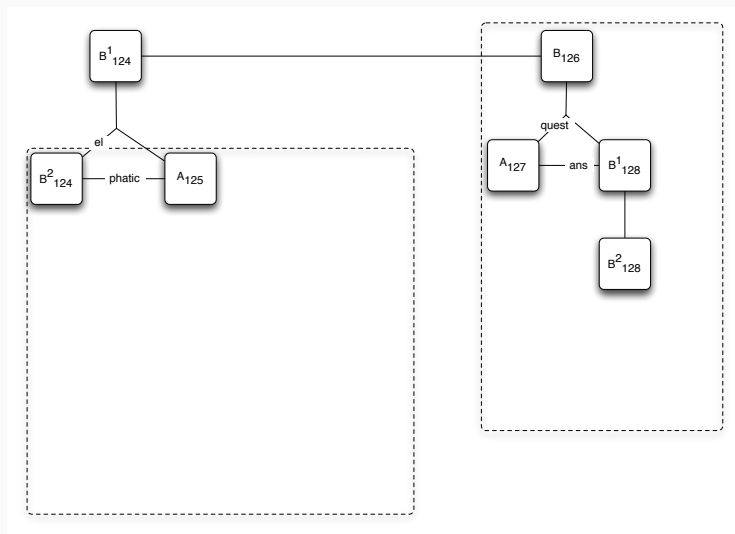
(A127) Ils sont morts parce qu'ils ont perdu à votre avis (↑)



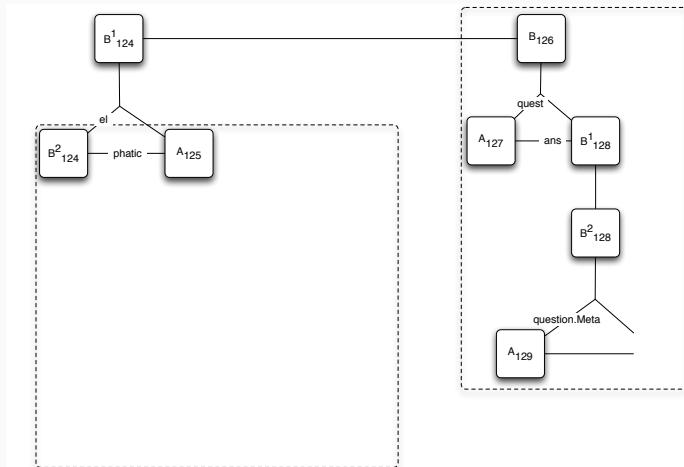
(B128) Non ils gagnaient mais si ils sont morts, c'est la maladie quoi c'est c'est (→)



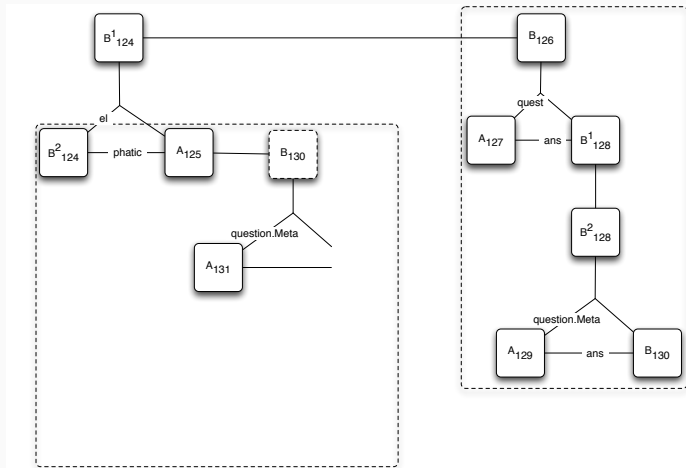
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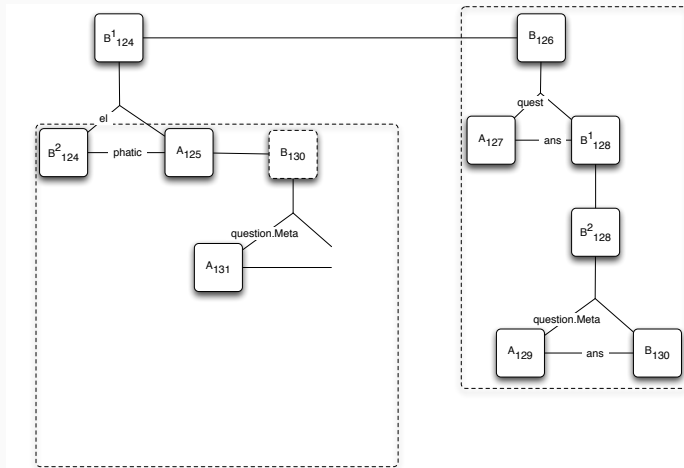
(A129) Ouais c'est parce qu'ils étaient malades, c'est pas parce qu'ils faisaient de la politique (↑)



(B130) Si enfin ( $\rightarrow$ )

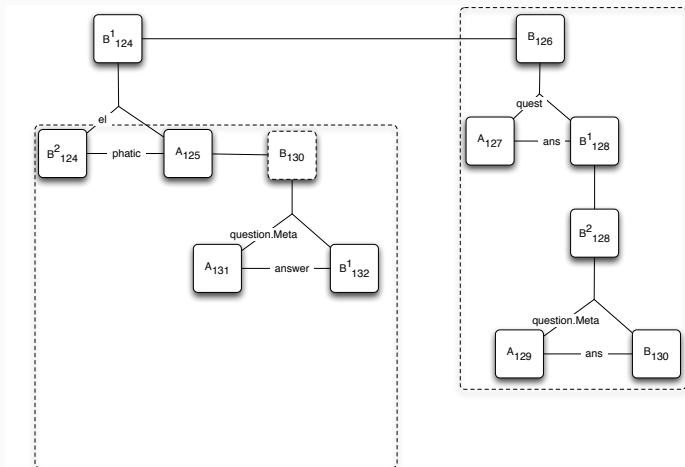


(A131) Si vous pensez que c'est parce qu'ils faisaient de la politique (↑)

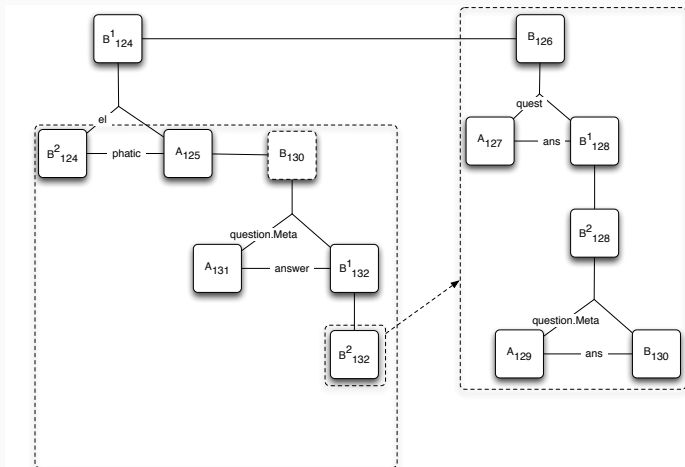




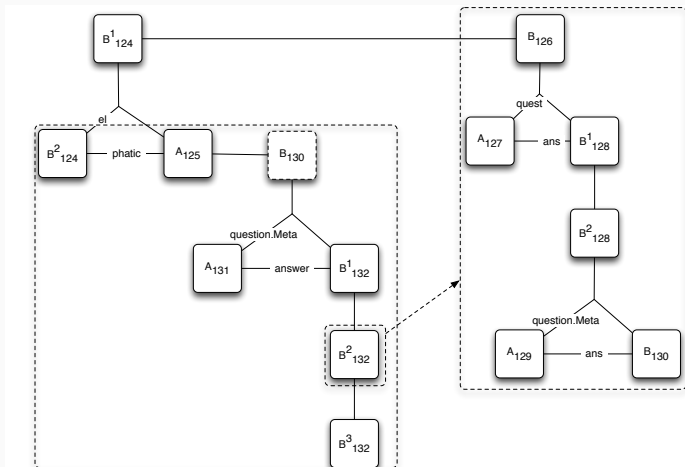
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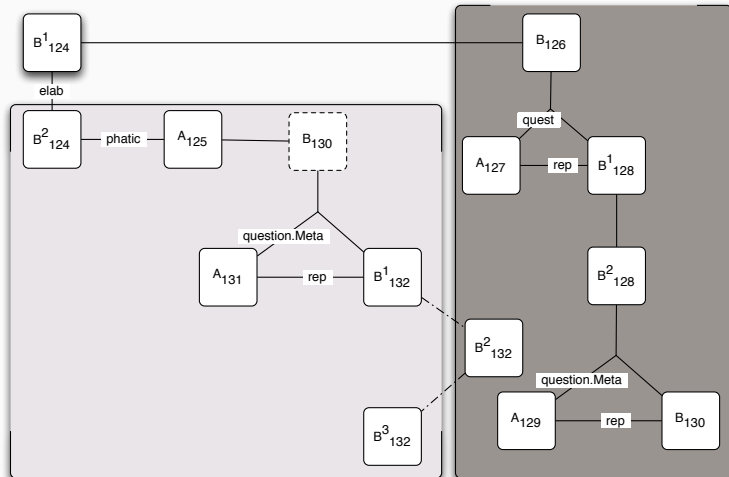
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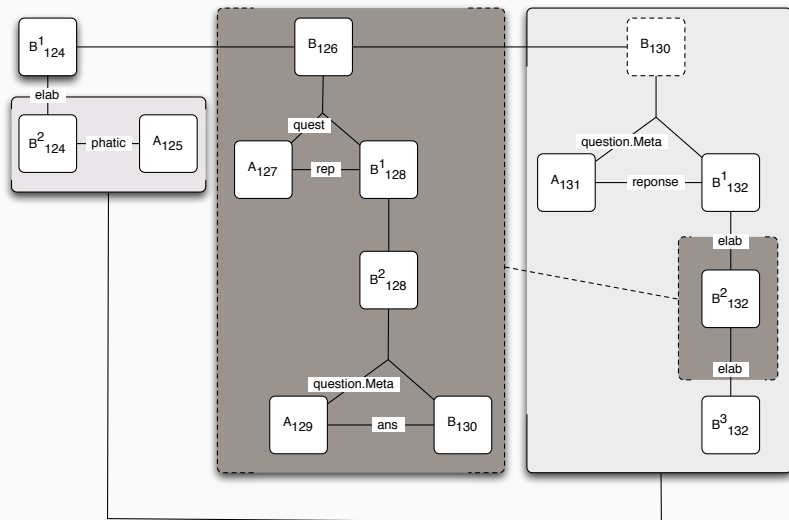
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# Patient understanding



# Psychologist understanding



## Rise without attachement 1/2

G82 l'an dernier euh (→) j'savais pas comment faire j'étais perdue et pourtant j'avais pris mes médicaments j'suis dans un état vous voyez même ma bouche elle est sèche j'suis dans un triste état

I didn't know what to do. I was lost.

V83 Vous êtes quand même bien (↑)

G84 J pense que ma tête est bien mais on croirait à moitié (↓) la moitié qui va et la moitié qui va pas j'ai l'impression de ça vous voyez (↑)

V85 D'accord

G86 Ou alors c'est la conscience peut être la conscience est ce que c'est ça (↑)

V87 Vous savez ça arrive à tout le monde d'avoir des moments biens et des moments où on est perdu

Everybody is lost at times.

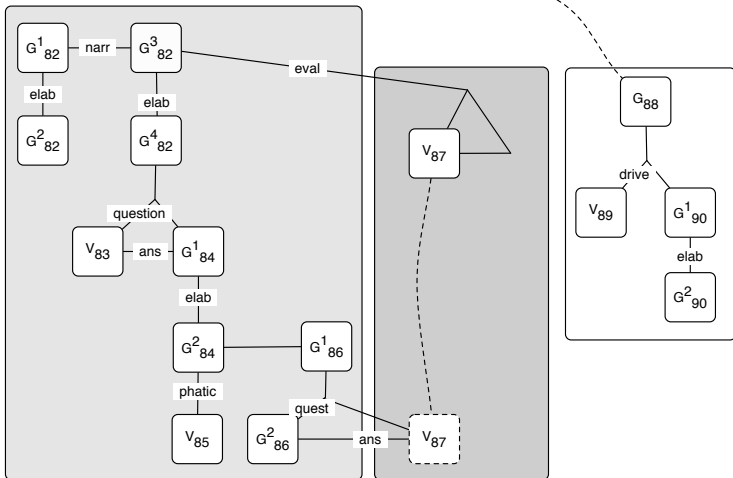
G88 Oui j'ai peur de perdre tout le monde

Yes I am afraid I lose everybody.

V89 Mais ils vont plutôt bien vos enfants (↑)

G90 Ils ont l'air ils ont l'air mais ils ont des allergies ils ont (→) mon petit fils il s'est cassé le bras à l'école tout ça

## Rise without attachement 2/2



## Corpus Tagging

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SLAMtk (python)

- Limit human actions :
  - Disfluencies, *Distagger* (CONSTANT et DISTER 2010)
  - POS and lemmas, *MElt* (DENIS et SAGOT 2009)

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Why ?

- Study conventionnal vs pathological uses
- rebuild more consistent speeches (syntactically)

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Results :

- Patients with schizophrenia produce slightly more disfluencies
- But they have no specific behavior for POS / lemmas

f-score : 95,5 %, precision : 95,3 %, recall : 95,8 % (CONSTANT et DISTER 2010)

## 1. 'euh'

(1) *moi ça m'est presque plus euh difficile et euh anti-naturel de parler*

## 2. Repeat

(2) *j' arrive à être à être concentrée quand il faut faire quelque chose*

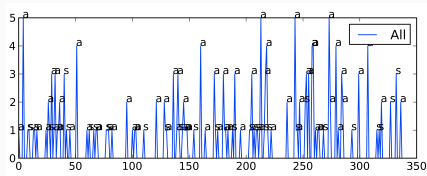
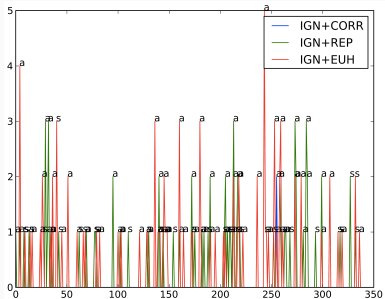
## 3. self-corrections

(3) *enfin je sais pas trop le les termes*

## 4. starters

(4) *pis progressivement vous av- pouvez travailler sur votre concentration*

## Distribution of disfluencies in an interview



## Results (% of disfluencies)

	S	C	S+C	P+S	P+C	P
	Corpus Lyon					
by speeches	0,5417	0,5589	0,545	0,1400	0,1513	0,1424
by words	0,032	0,0168	0,0288	0,0144	0,0138	0,0142
	Corpus La Rochelle					
by speeches	0,7117	0,484	0,5842	0,3338	0,7369	0,5599
by words	0,0595	0,0468	0,0524	0,0421	0,0496	0,0463

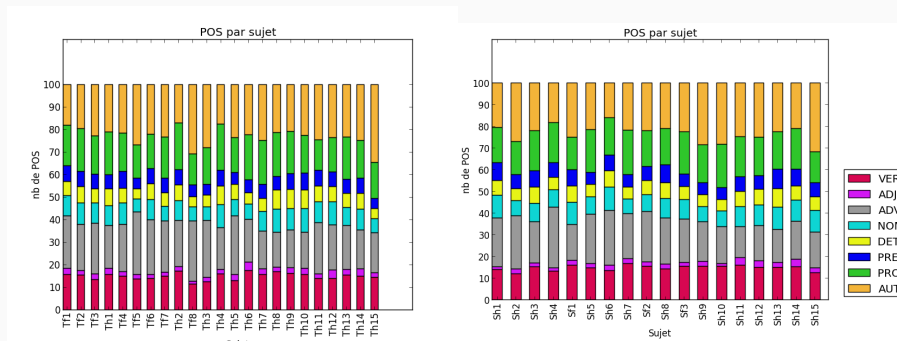
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Corpus La Rochelle						
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by words	0,0595	0,0468	0,0524	0,0421	0,0496	0,0463

	corpus Ville1	corpus Ville2
S and Psy	10,6806923083	19,4197596818
C and Psy	0,422898291704	3,23530253756
S and C	10,2827554261	16,0376100956

Significance :  $> 1,96$

Repartition of POS tagging for controls (on the left) and patients with schizophrenia (on the right)





	La Rochelle		Lyon									
	FR	TR	FR	TR	♂		♀		With med.		Without	
					FR	TR	FR	TR	FR	TR	FR	TR
T	0,04	0,68	0,11	0,73	0,15	0,76	0,14	0,74				
S	0,05	0,69	0,06	0,70	0,07	0,72	0,08	0,71	0,06	0,71	0,10	0,72
P	0,02	0,64	0,06	0,68								

FR : ratio of the number of lemmas to the total number of forms

(T)TR : ratio of the number of lemmas to the total number of different forms (types)

- Differences between sub-corpus (different transcriptions)
- Differences in age and IQ
- Patients under medicine

Organization of 3 human annotation campaigns

- Identification of decisive discontinuities
- SDRT representation

## Organization of 3 human annotation campaigns

- Identification of decisive discontinuities
- SDRT representation

## Results

- Huge difficulties for discontinuities
- Relative consensus for SDRT

## SDRT annotations with Glozz on pretreated texts.

Début

B1 : J'aimerais savoir ce que font les personnes qui sont à l'hôpital

ce que vous faites la journée par exemple...

A2 : Je suis très amoureuse de Florence M.

B3 : De Florence M.

A4 : Oui superbe la...

comment elle s'appelle Florence R.

elle a tué quand même plus de un million de de personnes

B5 : Qui ça ?

A6 : Florence R.

B7 : C'est qui cette dame là ?

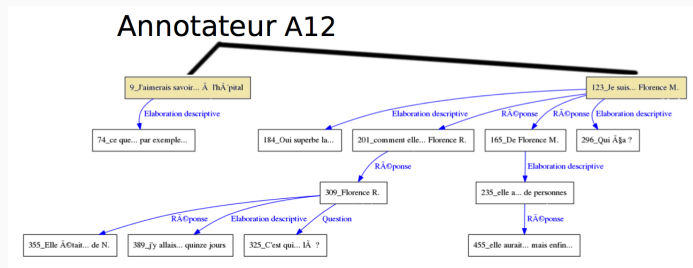
A8 : Elle était psychiatre 40 rue de N.

j'y allais une fois par semaine ou deux fois tous les quinze jours

elle aurait pu me tuer mais enfin...

# Analyse of the annotations (ongoing work)

46 annotators on 3 extracts (+ one training text)



- Impossibility of disidentification
  - Task with a small context : randomise speeches
  - Inability to anonymize the history and the geography
- Patient reality
  - Formal analysis of language = define a standard
  - Deviate = dysfunction
  - But, every speaker is confronted daily with language disorders from healthy people
  - The diagnosis can not suffer from approximations

(REBUSCHI 2015) :

- **Discursive context** that depends on interaction and dynamics of interaction ;
- **Doxatic context** which takes up all the presuppositions, beliefs about the world and the projection of the beliefs of the speakers ;
- **Pragmatic context** that is interpreted by the situation of the interaction (the speaker who says "I" in playing a role does not say "me" to designate himself, but to designate the individual he plays) ;
- **Material and social context** in which the idea is to consider both the framework of interactions and all the influences which build it.



## **Toward a formal treatment**

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- **Type Theoretic Dynamic Logic (TTDL)** (DE GROOTE 2006) :  
montagovian framework, with dynamicity which add continuation in  $\lambda$ -calculus

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$$\llbracket s \rrbracket = o$$

# Type Theoretic Dynamic Logic

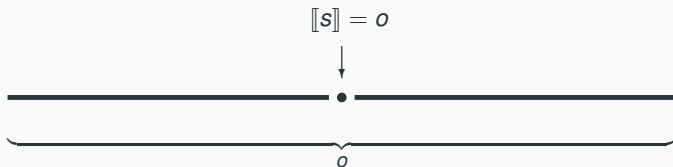
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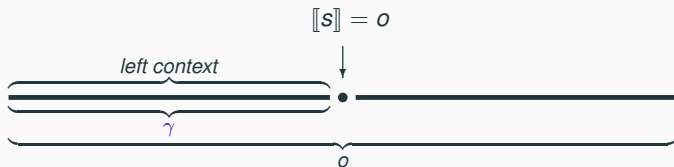
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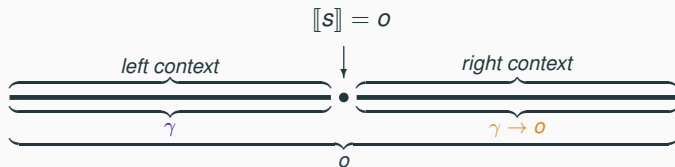
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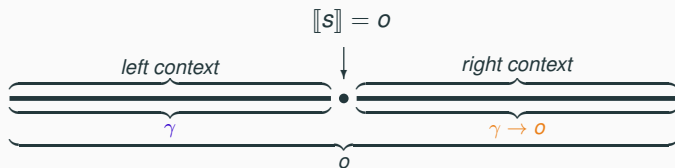
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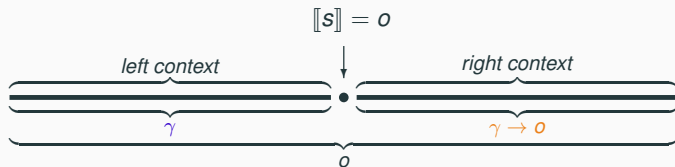
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$$[[s]] = \gamma \rightarrow (\gamma \rightarrow o) \rightarrow o$$

$$\lambda e\phi.\exists x. \text{candidate}(x) \wedge \phi(x :: e)$$

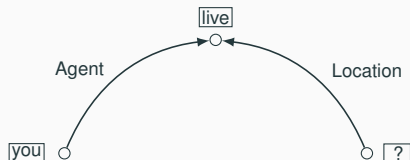
Processing dialogue : **access to subparts** of the interaction for **update**.

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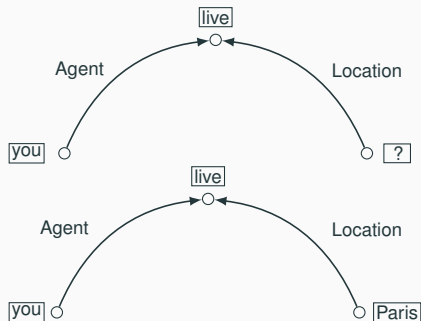


# Frame Semantics

Processing dialogue : **access to subparts** of the interaction for **update**.

**A<sub>1</sub>** Where do you live ?

**B<sub>2</sub>** In Paris.



Use of :

- TTDL for compositionality
- Frame Semantics for representation of the content

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- TTDL for compositionality
- Frame Semantics for representation of the content
- Ongoing work : defining such a framework and apply it to the SLAM corpus



## Features extraction

- a feature  $v$
- type of frames :  $\gamma$

$$find_v : \gamma \rightarrow v \times (v \rightarrow \gamma)$$

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$$find_v : \gamma \rightarrow v \times (v \rightarrow \gamma)$$

Example :

$$\llbracket A_1 \rrbracket = \begin{bmatrix} LIVE \\ Ag: A \\ Loc: Paris \end{bmatrix}$$

$find_{Loc}$  to  $A_1$  :

$$(Paris, \lambda l. \begin{bmatrix} LIVE \\ Ag: A \\ Loc: l \end{bmatrix})$$

*assertion*

$$\llbracket u \rrbracket = \gamma \rightarrow \gamma$$

*question*

$$\llbracket q_v \rrbracket = \gamma \rightarrow v \times (v \rightarrow \gamma)$$

*answer*

$$\llbracket a_v \rrbracket = v \times (v \rightarrow \gamma) \rightarrow \gamma$$

## Example 1/2

**A<sub>1</sub>** I live in Paris.

**B<sub>2</sub>** How long have you been living there ?

**A<sub>3</sub>** For five years.

**A<sub>1</sub>** I live in Paris.

**B<sub>2</sub>** How long have you been living there ?

**A<sub>3</sub>** For five years.

$$\begin{aligned} \llbracket A_1 \cdot^q B_2 \cdot^a A_3 \rrbracket c_e &= \lambda c. \llbracket A_3 \rrbracket \left( \llbracket B_2 \rrbracket (\llbracket A_1 \rrbracket c) \right) c_e \\ &\rightarrow_{\beta} \llbracket A_3 \rrbracket \left( \llbracket B_2 \rrbracket (\llbracket A_1 \rrbracket c_e) \right) \end{aligned}$$

## Example 2/2

$$\llbracket A_1 \rrbracket_{c_e} = \begin{bmatrix} \text{LIVE} \\ \text{Ag: } A \\ \text{Loc: } Paris \end{bmatrix} = \textcircled{1}$$

$$\llbracket B_2 \rrbracket \textcircled{1} = \lambda t. \begin{bmatrix} \text{LIVE} \\ \text{Ag: } A \\ \text{Loc: } Paris \\ \text{Tmp: } t \end{bmatrix} = \textcircled{2}$$

$$\llbracket A_3 \rrbracket \textcircled{2} = \begin{bmatrix} \text{LIVE} \\ \text{Ag: } A \\ \text{Loc: } Paris \\ \text{Tmp: } Five\ years \end{bmatrix}$$

## Perspectives

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- Increase the phenomena analyzed in SLAMt k  
Especially work on syntax and lexical statistics
- Try DDN approaches on the SLAM corpus  
Need more ressources in French
- Deeply study the human annotations of the corpus
- Increase the coverage of the corpus in volume and number of pathologies studied  
Collection of data at the Montperrin Hospital of Aix-En-Provence
- Define remedial help process
- Refine the analysis of dysfunction, opening towards a cognitive interpretation and give more complex context for the interpretation



- Defining robust semantics grammars for TTDL
- Definition of a TTDL for dialogue framework
  - Ongoing work on questions and answers with Maria Boritchev
- (French translation of Fracas)

**Thanks !**

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