Pro-TEXT: Annotated Corpus of Keystroke Logs

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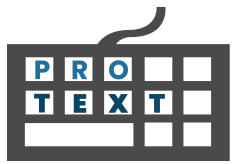

Dynamics of the Writing Process

Evolution of a text:

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Dynamics of the Writing Process

Keystroke logs: recordings of the writing process executed through a keyboard using dedicated software (Leijten and Van Waes, 2006; Strömqvist and Malmsten, 1998; Carl, 2012)

- Character additions, deletions, substitutions
- Behavioural information (pause length, production speed)
- $\rightarrow$ Study of writing itself and of underlying cognitive processes

Linguistic annotation?

- Available for English and Dutch as part of Inputlog (Leijten et al., 2015)
- Remains rare, typically POS-tagging (Serbina et al., 2015; Carl et al., 2011)
- Highly relevant, cf. (Serbina et al., 2017)

Outline

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Pro-TEXT Project: Scope and Goals

Pro-TEXT: linguistic analysis of the textualization process, i.e. the real-time progressive construction of a text

- Funded by the French National Research Agency (ANR-18-CE23-0024-01)
- Interdisciplinary project:
  - **psycholinguistic experiments**: T. Olive, S. Bouriga, D. Chesnet, C. Perret, J. Pylouster and C. Bordes (CERCA, Poitiers University)
  - **linguistic description**: G. Cislaru, S. Fleury, F. Lefeuvre, D. Legallois, A. Boyer, Q. Feltgen and A. Miletic (CLESTHIA, Paris 3 University); C. Benzitoun and M. Dargnat (ATILF, Lorraine University); S. Vandaele (University of Montreal)
  - **machine learning modelling**: G. Cabanes, T. Charnois, N. Grozavu, J. Le Roux, P. Rastin, N. Rogovschi and N. Tomeh (LIPN, Paris 13 University)

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$\rightarrow$ Produce a corpus suitable for this type of research

Outline

Pro-TEXT Corpus

Collected Pro-TEXT Corpus:

Subcorpus	Texts	Words	Writers	Genre
Academic	26	70464	MA students	mini-thesis in linguistics
Professional	10	34504	social workers	reports on child protection
Experimental	165	63533	BA students	essays on different subjects
Children	183	20306	pupils (3^{rd}-6^{th} grade)	narrative texts and essays
Translation	38	13682	BA students	EN-FR translation of medical texts and original texts in FR
Total	422	202489	-	-

Recorded using Inputlog (Leijten and Van Waes, 2006) and Scriptlog (Strömqvist and Malmsten, 1998)

Outline

General Annotation Principles

Goal: maximize the utility of the corpus while respecting time constraints

- French Treebank tagsets (POS tags and dependency syntax) (Candito et al., 2009)
- Using automatic pre-annotation to facilitate work of human annotators
- Manual validation to ensure annotation quality
- Agile annotation (Voormann and Gut, 2008) to ensure manual annotation coherence
- Annotating **all** produced content (not only final texts)
  - $\rightarrow$ intermediate versions of each text

Intermediate Versions of a Text

Intermediate versions:

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afin d'aborder un projet songé par l'Université **de Poitiers** → **v5**
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afin d'aborder un projet songé par ~~l'Université de Poitiers~~ → **v6**
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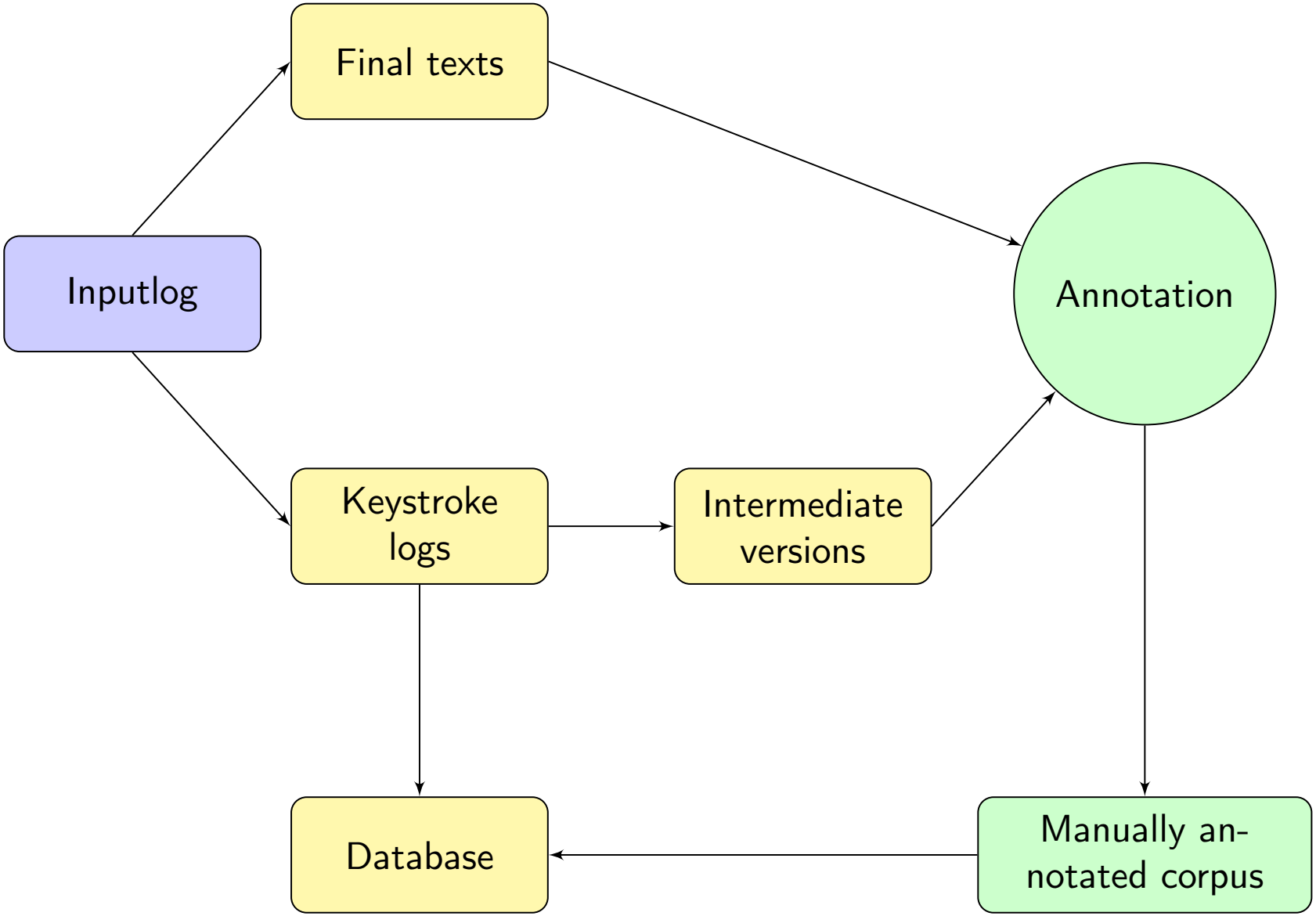
Annotation Workflow



Data Formats

Annotated intermediate versions:

- CoNLL format:

```
#text_version_id=0
#sentence_id=1
1       C'      ce      CLS     CLS     _       2       suj_impers      _       1=C__True|2='__True|
2       etait   être    V       P       _       0       root    _       3=e__True|4=t__True|5=a__True|6=i__True|7=t__True
3       en      en      P       _       _       2       p_obj   _       9=e__True|10=n__True|
4       décembre        décembre        NC      NC      _       3       prep    _       12=d__True|13=é__True|14=c__True|1
5       je      je      CLS     ADJ     _       0       x       _       21=j__True|22=e__True|
212     connaisser      _       VINF    VINF            0       _       _       24=c__True|25=o__True|26=n__True|27=n__Tru
7       ce      ce      DET     DET     _       8       det     _       35=c__True|36=e__True|
8       garçon  garçon  NC      NC      _       0       x       _       38=g__True|39=a__True|40=r__True|41=ç__True|42=o_
9       depuis  depuis  P       P       _       0       x       _       45=d__True|46=e__True|47=p__True|48=u__True|49=i_
10      la      le      DET     DET     _       11      det     _       52=l__True|53=a__True|
11      marenelle       maternelle      NC      ADJ     _       9       prep    _       55=m__True|56=a__True|57=r__True|5
12      il      il      CLS     CLS     _       0       x       _       65=i__True|66=l__True|
213     etea    _       ADV     ADV             0       _       _       68=e__True|69=t__False|70=e__False|71=a__False|

#text_version_id=1
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1       C'      ce      CLS     CLS     _       2       suj_impers      _       1=C__True|2='__True|
2       etait   être    V       P       _       0       root    _       3=e__True|4=t__True|5=a__True|6=i__True|7=t__True
3       en      en      P       _       _       2       p_obj   _       9=e__True|10=n__True|
4       décembre        décembre        NC      NC      _       3       prep    _       12=d__True|13=é__True|14=c__True|1
5       je      je      CLS     ADJ     _       0       x       _       21=j__True|22=e__True|
212     connaisser      _       VINF    VINF            0       _       _       24=c__True|25=o__True|26=n__True|27=n__Tru
7       ce      ce      DET     DET     _       8       det     _       35=c__True|36=e__True|
8       garçon  garçon  NC      NC      _       0       x       _       38=g__True|39=a__True|40=r__True|41=ç__True|42=o_
9       depuis  depuis  P       P       _       0       x       _       45=d__True|46=e__True|47=p__True|48=u__True|49=i_
10      la      le      DET     DET     _       11      det     _       52=l__True|53=a__True|
11      marenelle       maternelle      NC      ADJ     _       9       prep    _       55=m__True|56=a__True|57=r__True|5
12      il      il      CLS     CLS     _       0       x       _       65=i__True|66=l__True|
214     e       _       ADV     ADV             0       _       ***     68=e__True|
```

Data Formats

Annotated database:

- database-like CSV format:

n_event	st_time	end_time	pause	event	pos	doc_len	op	type_op	charID	tokenID	token	lemma	POS	XPOS	ms	governor	function	charStatus	tokenStatus	sentence_id
1	144098	144597		C	0	0	1	keyboard	1	-1=1|0=1|1=1|2	-1=C'|0=C'|1=C	-1=ce|0=ce|1=c	-1=CLS|0=CLS	-1=CLS|0=CLS	-1=_|0=_|1=_|2	-1=2|0=2|1=2|2	-1=suj_impers|	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
2	146235	146313	1638	'	1	1	1	keyboard	2	-1=1|0=1|1=1|2	-1=C'|0=C'|1=C	-1=ce|0=ce|1=c	-1=CLS|0=CLS	-1=CLS|0=CLS	-1=_|0=_|1=_|2	-1=2|0=2|1=2|2	-1=suj_impers|	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
3	146641	146719	328	e	2	2	1	keyboard	3	-1=2|0=2|1=2|2	-1=etait|0=etait	-1=être|0=être|	-1=V|0=V|1=V|	-1=P|0=P|1=P|	-1=_|0=_|1=_|2	-1=0|0=0|1=0|2	-1=root|0=root|	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
4	146922	146984	203	t	3	3	1	keyboard	4	-1=2|0=2|1=2|2	-1=etait|0=etait	-1=être|0=être|	-1=V|0=V|1=V|	-1=P|0=P|1=P|	-1=_|0=_|1=_|2	-1=0|0=0|1=0|2	-1=root|0=root|	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
5	147358	147421	374	a	4	4	1	keyboard	5	-1=2|0=2|1=2|2	-1=etait|0=etait	-1=être|0=être|	-1=V|0=V|1=V|	-1=P|0=P|1=P|	-1=_|0=_|1=_|2	-1=0|0=0|1=0|2	-1=root|0=root|	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
6	147577	147702	156	i	5	5	1	keyboard	6	-1=2|0=2|1=2|2	-1=etait|0=etait	-1=être|0=être|	-1=V|0=V|1=V|	-1=P|0=P|1=P|	-1=_|0=_|1=_|2	-1=0|0=0|1=0|2	-1=root|0=root|	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
7	147904	147982	202	t	6	6	1	keyboard	7	-1=2|0=2|1=2|2	-1=etait|0=etait	-1=être|0=être|	-1=V|0=V|1=V|	-1=P|0=P|1=P|	-1=_|0=_|1=_|2	-1=0|0=0|1=0|2	-1=root|0=root|	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
8	148372	148497	390	␣	7	7	1	keyboard	8	na	na	na	na	na	na	na	na	True	na	na
9	150868	150993	2371	e	8	8	1	keyboard	9	-1=3|0=3|1=3|2	-1=en|0=en|1=e	-1=en|0=en|1=e	-1=P|0=P|1=P|	-1=_|0=_|1=_|2	-1=_|0=_|1=_|2	-1=2|0=2|1=2|2	-1=p_obj|0=p_o	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
10	151102	151196	109	n	9	9	1	keyboard	10	-1=3|0=3|1=3|2	-1=en|0=en|1=e	-1=en|0=en|1=e	-1=P|0=P|1=P|	-1=_|0=_|1=_|2	-1=_|0=_|1=_|2	-1=2|0=2|1=2|2	-1=p_obj|0=p_o	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
11	151321	151414	125	␣	10	10	1	keyboard	11	na	na	na	na	na	na	na	na	True	na	na
12	151758	151836	344	d	11	11	1	keyboard	12	-1=4|0=4|1=4|2	-1=décembre|0	-1=décembre|0	-1=NC|0=NC|1	-1=NC|0=NC|1	-1=_|0=_|1=_|2	-1=3|0=3|1=3|2	-1=prep|0=prep	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
13	152959	153052	1123	é	12	12	1	keyboard	13	-1=4|0=4|1=4|2	-1=décembre|0	-1=décembre|0	-1=NC|0=NC|1	-1=NC|0=NC|1	-1=_|0=_|1=_|2	-1=3|0=3|1=3|2	-1=prep|0=prep	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
14	153364	153427	312	c	13	13	1	keyboard	14	-1=4|0=4|1=4|2	-1=décembre|0	-1=décembre|0	-1=NC|0=NC|1	-1=NC|0=NC|1	-1=_|0=_|1=_|2	-1=3|0=3|1=3|2	-1=prep|0=prep	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
15	153739	153817	312	e	14	14	1	keyboard	15	-1=4|0=4|1=4|2	-1=décembre|0	-1=décembre|0	-1=NC|0=NC|1	-1=NC|0=NC|1	-1=_|0=_|1=_|2	-1=3|0=3|1=3|2	-1=prep|0=prep	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
16	154456	154612	639	m	15	15	1	keyboard	16	-1=4|0=4|1=4|2	-1=décembre|0	-1=décembre|0	-1=NC|0=NC|1	-1=NC|0=NC|1	-1=_|0=_|1=_|2	-1=3|0=3|1=3|2	-1=prep|0=prep	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
17	157795	157920	3183	b	16	16	1	keyboard	17	-1=4|0=4|1=4|2	-1=décembre|0	-1=décembre|0	-1=NC|0=NC|1	-1=NC|0=NC|1	-1=_|0=_|1=_|2	-1=3|0=3|1=3|2	-1=prep|0=prep	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
18	158200	158263	280	r	17	17	1	keyboard	18	-1=4|0=4|1=4|2	-1=décembre|0	-1=décembre|0	-1=NC|0=NC|1	-1=NC|0=NC|1	-1=_|0=_|1=_|2	-1=3|0=3|1=3|2	-1=prep|0=prep	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
19	158419	158481	156	e	18	18	1	keyboard	19	-1=4|0=4|1=4|2	-1=décembre|0	-1=décembre|0	-1=NC|0=NC|1	-1=NC|0=NC|1	-1=_|0=_|1=_|2	-1=3|0=3|1=3|2	-1=prep|0=prep	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
20	159121	159246	640	␣	19	19	1	keyboard	20	na	na	na	na	na	na	na	na	True	na	na
21	165345	165470	6099	j	20	20	1	keyboard	21	-1=5|0=5|1=5|2	-1=je|0=je|1=je	-1=je|0=je|1=je	-1=CLS|0=CLS	-1=ADJ|0=ADJ	-1=_|0=_|1=_|2	-1=6|0=0|1=0|2	-1=suj|0=x|1=x	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
22	165642	165720	172	e	21	21	1	keyboard	22	-1=5|0=5|1=5|2	-1=je|0=je|1=je	-1=je|0=je|1=je	-1=CLS|0=CLS	-1=ADJ|0=ADJ	-1=_|0=_|1=_|2	-1=6|0=0|1=0|2	-1=suj|0=x|1=x	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
23	165938	166032	218	␣	22	22	1	keyboard	23	na	na	na	na	na	na	na	na	True	na	na
24	166250	166344	218	c	23	23	1	keyboard	24	-1=6|0=212|1=1	-1=connaissais	-1=connaître|0	-1=V|0=VINF|1	-1=V|0=VINF|1	-1=_|0=|1=|2=|	-1=0|0=0|1=0|2	-1=root|0=_|1=	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
25	166749	166843	405	o	24	24	1	keyboard	25	-1=6|0=212|1=1	-1=connaissais	-1=connaître|0	-1=V|0=VINF|1	-1=V|0=VINF|1	-1=_|0=|1=|2=|	-1=0|0=0|1=0|2	-1=root|0=_|1=	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
26	167092	167186	249	n	25	25	1	keyboard	26	-1=6|0=212|1=1	-1=connaissais	-1=connaître|0	-1=V|0=VINF|1	-1=V|0=VINF|1	-1=_|0=|1=|2=|	-1=0|0=0|1=0|2	-1=root|0=_|1=	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
27	167514	167592	328	n	26	26	1	keyboard	27	-1=6|0=212|1=1	-1=connaissais	-1=connaître|0	-1=V|0=VINF|1	-1=V|0=VINF|1	-1=_|0=|1=|2=|	-1=0|0=0|1=0|2	-1=root|0=_|1=	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
28	167794	167872	202	a	27	27	1	keyboard	28	-1=6|0=212|1=1	-1=connaissais	-1=connaître|0	-1=V|0=VINF|1	-1=V|0=VINF|1	-1=_|0=|1=|2=|	-1=0|0=0|1=0|2	-1=root|0=_|1=	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
29	168808	168949	936	i	28	28	1	keyboard	29	-1=6|0=212|1=1	-1=connaissais	-1=connaître|0	-1=V|0=VINF|1	-1=V|0=VINF|1	-1=_|0=|1=|2=|	-1=0|0=0|1=0|2	-1=root|0=_|1=	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
30	170275	170368	1326	s	29	29	1	keyboard	30	-1=6|0=212|1=1	-1=connaissais	-1=connaître|0	-1=V|0=VINF|1	-1=V|0=VINF|1	-1=_|0=|1=|2=|	-1=0|0=0|1=0|2	-1=root|0=_|1=	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
31	171070	171164	702	s	30	30	1	keyboard	31	-1=6|0=212|1=1	-1=connaissais	-1=connaître|0	-1=V|0=VINF|1	-1=V|0=VINF|1	-1=_|0=|1=|2=|	-1=0|0=0|1=0|2	-1=root|0=_|1=	True	-1=_|0=_|1=_|2	-1=1|0=1|1=1|2
32	171414	171507	250	e	31	31	1	keyboard	32	0=212|1=212|2	0=connaisserl	0=_|1=_|2=_|3	0=VINF|1=VIN	0=VINF|1=VIN	0=|1=|2=|3=|4	0=0|1=0|2=0|3	0=_|1=_|2=_|3	False	0=_|1=_|2=_|3	0=1|1=1|2=1|3=
33	171663	171757	156	r	32	32	1	keyboard	33	0=212|1=212|2	0=connaisserl	0=_|1=_|2=_|3	0=VINF|1=VIN	0=VINF|1=VIN	0=|1=|2=|3=|4	0=0|1=0|2=0|3	0=_|1=_|2=_|3	False	0=_|1=_|2=_|3	0=1|1=1|2=1|3=
34	171928	172022	171	␣	33	33	1	keyboard	34	na	na	na	na	na	na	na	na	True	na	na

Outline

Results

Annotated Final Texts:

Subcorpus	Texts	Sentences	Tokens	Tok/sent	Lemmas	Types
Children	120	440	11873	27.0	1171	224
Experimental	15	149	5719	38.4	1024	1428
Translation	10	149	3675	24.7	626	887
Academic	2	474	8879	18.7	1523	2013
Professional	0	0	0	0	0	0
TOTAL	147	1212	30146	24.9	3062	5184

Results

Annotated Intermediate Versions:

48 texts

	Sentences	Tokens	Lemmas	Types
Final texts	71	4319	632	1074
Intermediate versions	4621	128518	693	1767

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Outline

Future Work

Corpus annotation:

- Complete the annotation of intermediate versions
- Expand the annotation of the whole corpus: bootstrapping?

Corpus analysis:

- Linguistic profiling of writing bursts
- Relationship between linguistic structure and pauses
- Behaviour of syntactic dependencies with respect to behavioural factors
- Modelling interactions between behavioural and linguistic information using machine learning techniques

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