ImageCLEFmed

MORPHOSAURUS in ImageCLEFmed 2006:

The effect of subwords on biomedical IR

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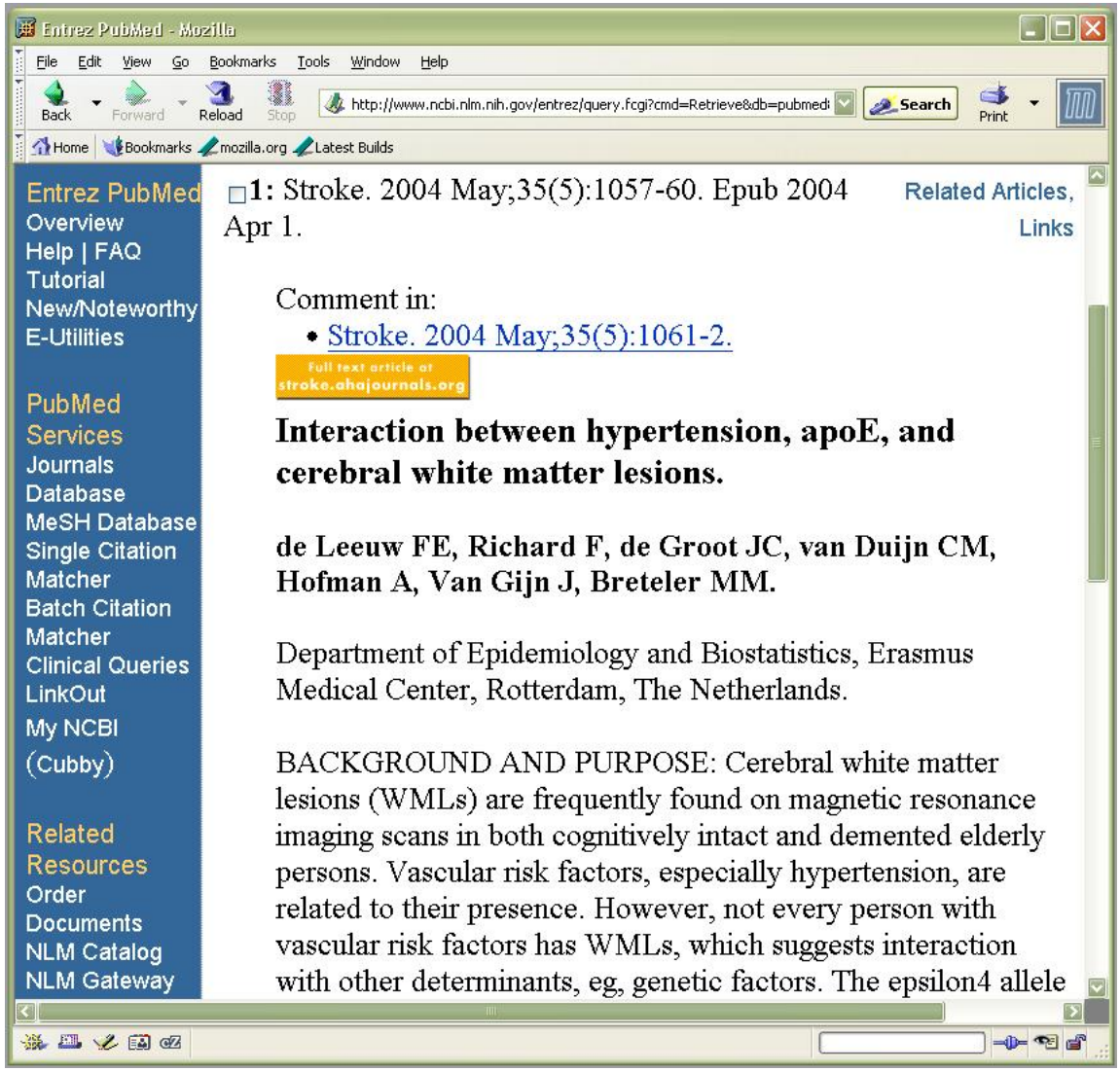
MORPHOSAURUS® MEDICAL SEARCH

UNIVERSITÄTS FREIBURG KLINIKUM

MorphoSaurus

Conventional Search Engines

Korrelation von Hypertonie und Läsion der Weißen Substanz…



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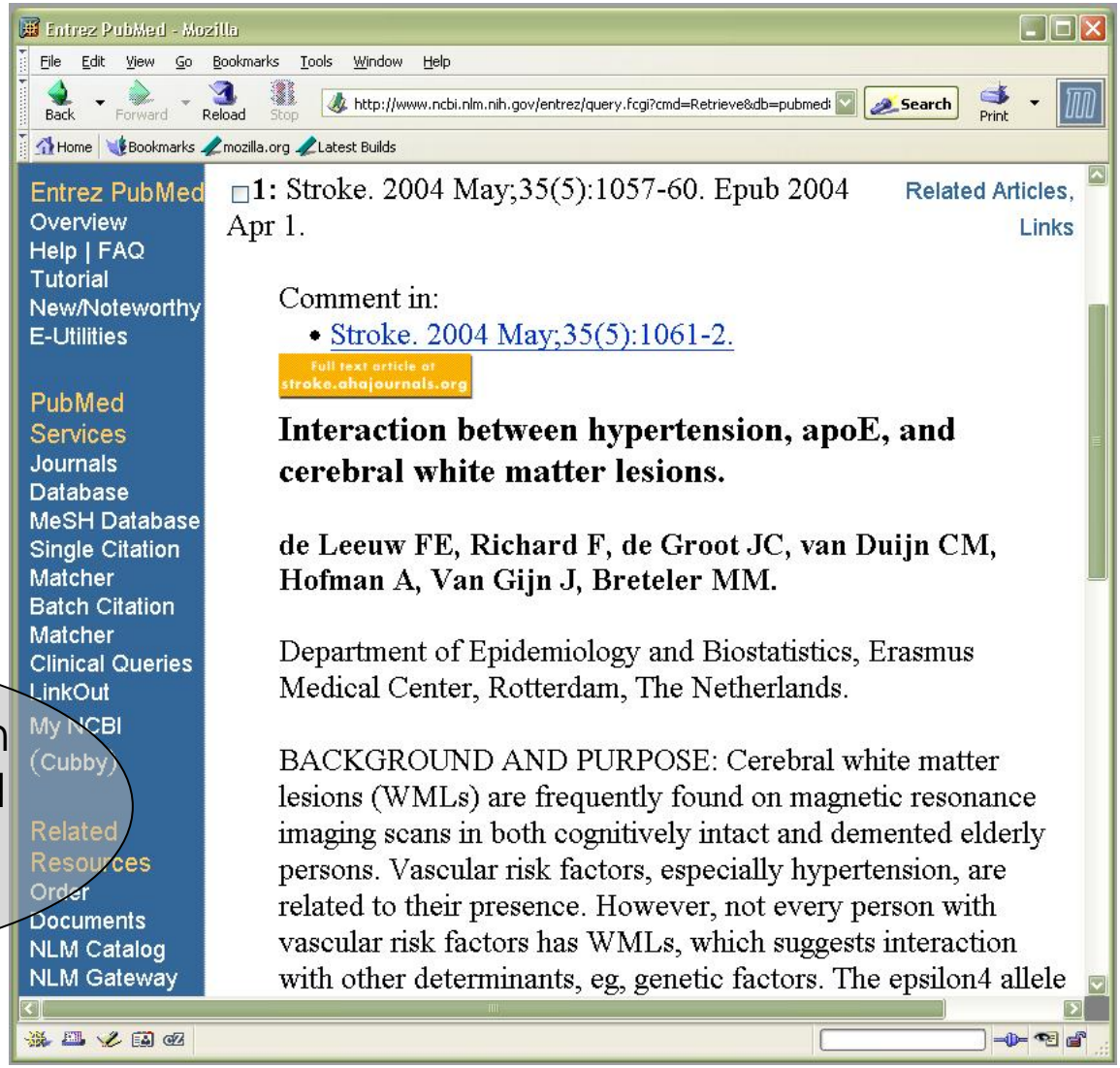
Conventional Search Engines

Korrelation von Hypertonie und Läsion der Weißen Substanz…

"Correlation of high blood pressure and lesion of the white substance"



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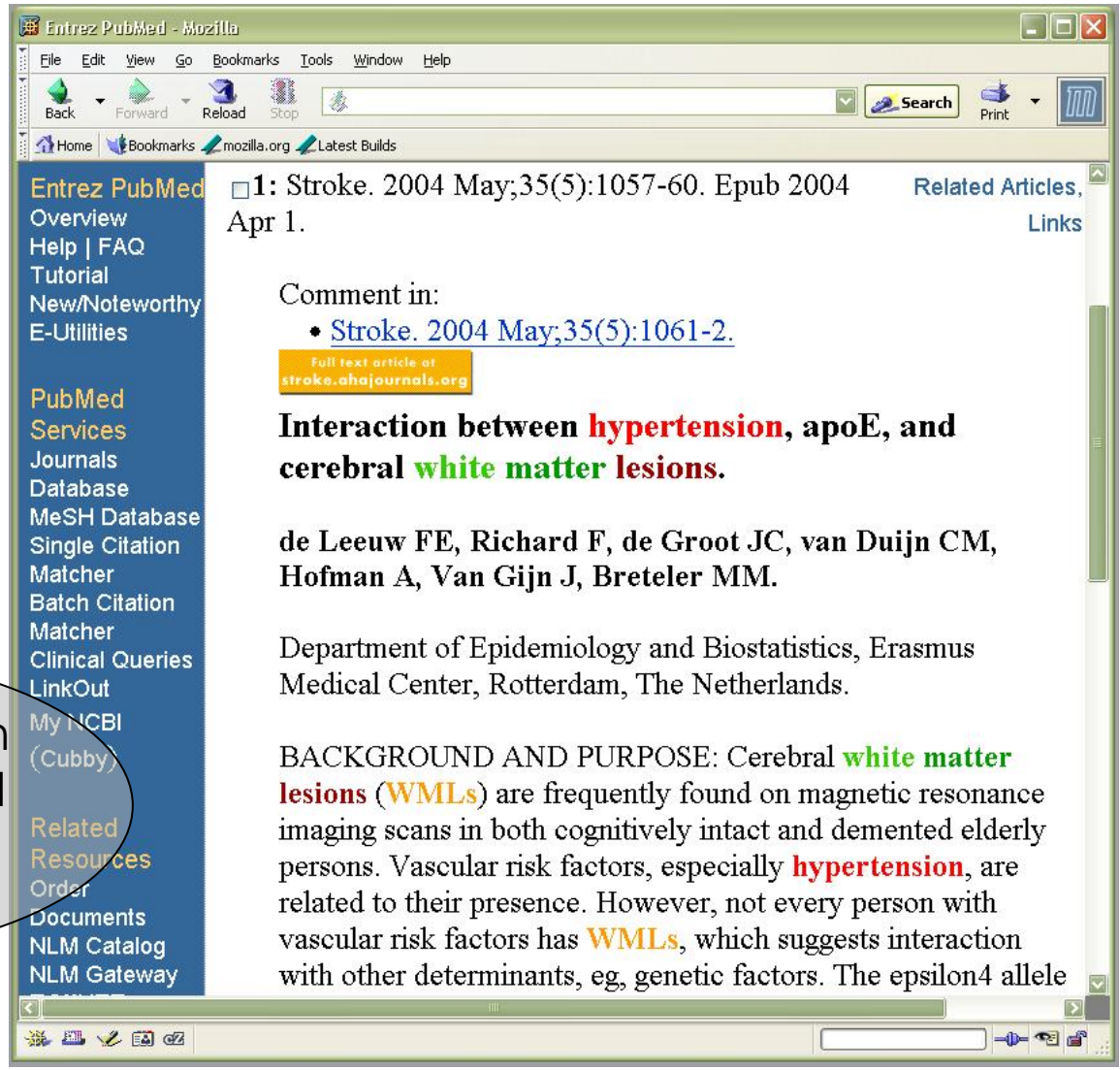

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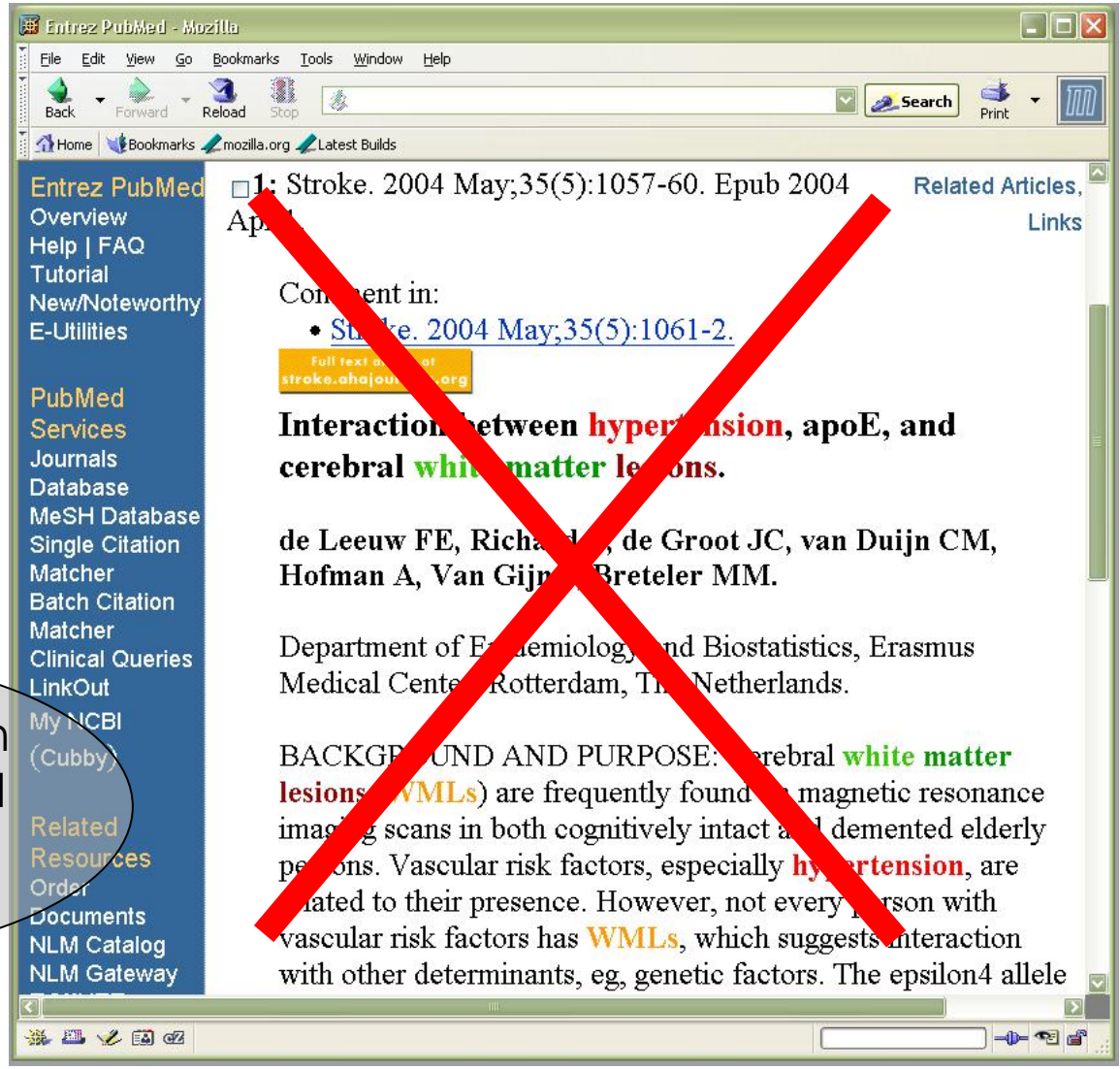

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Linguistic Phenomena

- **Inflection**: leukocytes, appendix – appendices
- **Derivation**: leukocyte → leukocytic
- **Composition**: *para|sympath|ectomy*,
  Magen|schleim|haut|entzünd|ung
- **Acronyms, Abbreviations**: AIDS(en,de)↔SIDA(fr), SARS, OECD
- **Proper Names**: Aspirin ↔ ASS, ...
- **Orthographic Variants**:
  - Kolonkarzinom, Coloncarzinom, Coloncarcinom
  - Oesophagus, Esophagus
- (Multi Word) **Synonyms**:
  - Hypertension ↔ High Blood Pressure
- **Homonyms/Polysemes**: Cold → Common Cold, Low Temperature, Chronic Obstructive Lung Disease

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Domain specific challenges

Biomedical language is characterized by:

- Diverse user groups → **diverse documents**
  - **Telegraphic** style in Electronic Patient Records („58 yo patient c/o pain, o/e NAD“) vs.

    flowery language of pathological reports („size of a ripe peach“)
  - **Laymen** terminology in health portals („inflammation of the gall bladder“) vs.

    Professional terminology in scientific papers („cholecystitis“)
- **Neoclassical compounds** (mix of latin and greek roots)

  („esophagogastroduodenoscopy“)
- **Medical Neologisms / Collocations / Phraseologisms**

  („cardiac muscle bridges“)

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Subwords as smallest units of meaning, whose meaning cannot be derived from smaller meaningful parts:

- Stems: *stomach, gastr, diaphys, vitamin c*
- Prefixes: *anti-, bi-, hyper-*
- Suffixes: *-ary, -ion, -itis*
- Infixes: *-o-, -s-*

Equivalence classes contain synonymous subwords and their translations in a thesaurus:

#derma = { derm, cutis, skin, haut, kutis, pele, cutis, piel, ... }

#inflamm = { inflam, -itic, -itis, entzuend, -itis, -itisch, inflam, flog, inflam, flog, -iolitis, ... }

Two lexical relations between equivalence classes:

- **expandsTo**: #hypertens → #high #blood #pressure
- **senseOf**: #head → {#chief;#caput}

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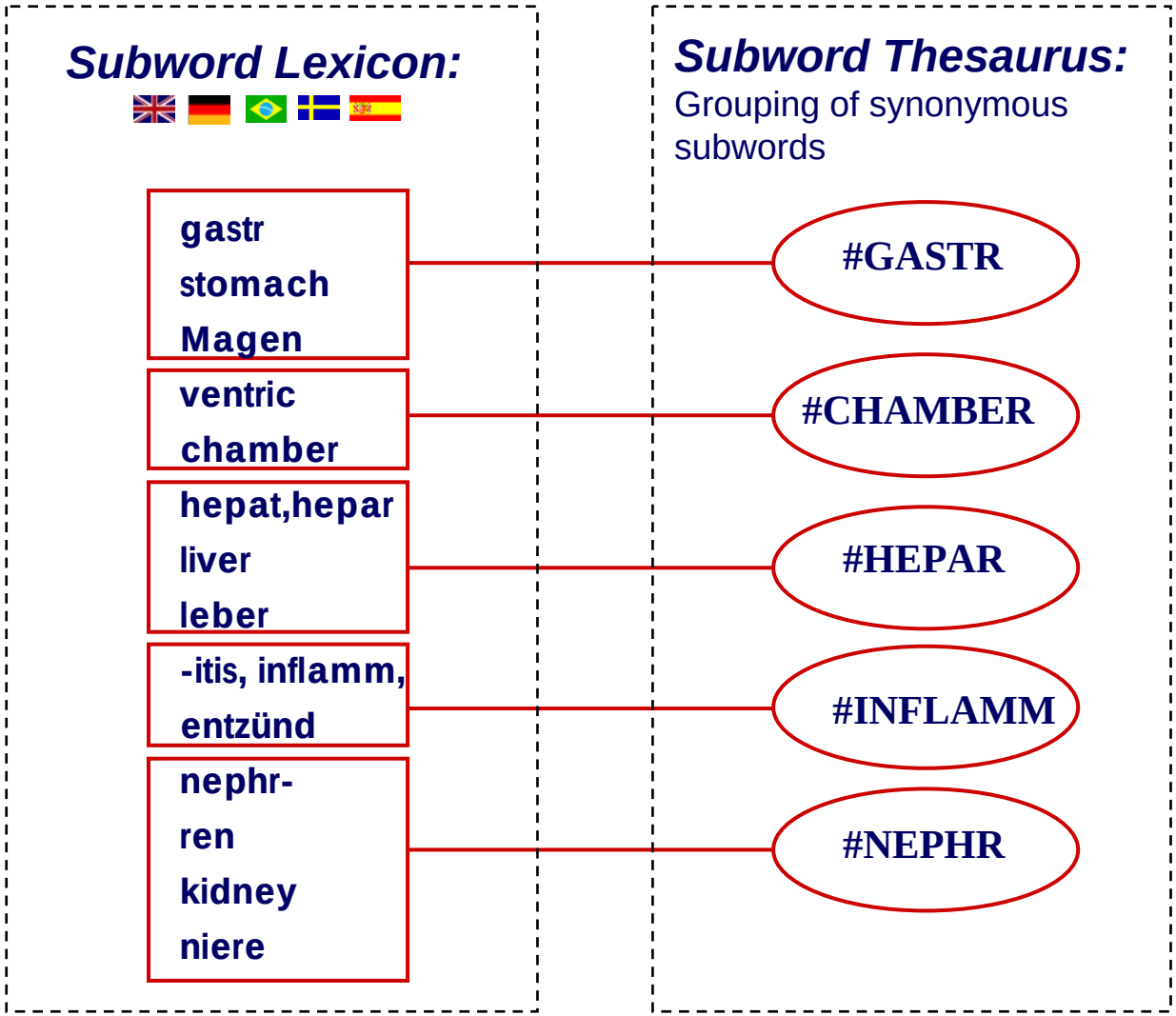
MORPHOSAURUS Lexical Resources



Lexicon statistics

- six languages
- 100,000 subwords
  25,000 (en,de), 15,000 (pt)…
- 20,000 eqClasses
- 500 exandsTo relations
- 1500 senseOf relations

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MORPHOSAURUS Resources

- **Subword-Lexicon:**
  - Organizes subwords in several languages

    (English, German, Portuguese, Spanish, French, Swedish)

- **Subword-Thesaurus:**
  - Contains equivalence classes, groups synonymous subwords (within and between languages)

- **Subword-Segmenter:**
  - Extraction of Subwords and Assignment of *Equivalence Classes*

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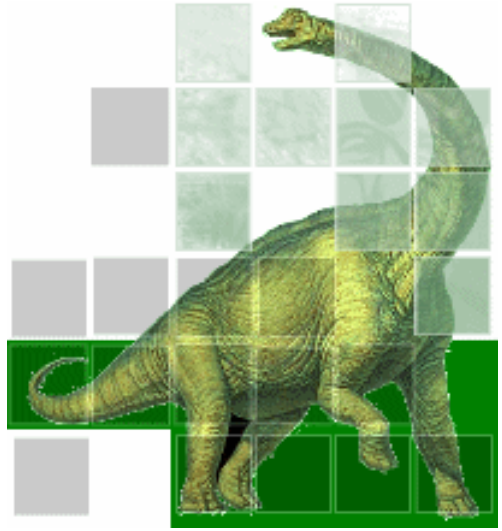

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Example

High TSH values suggest the diagnosis of primary hypo-thyroidism ...
Erhöhte TSH-Werte erlauben die Diagnose einer primären Schilddrüsenunterfunktion ...

Original

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Example

Original		Orthografic Normalisation
High TSH values suggest the diagnosis of primary hypo-thyroidism ...	**Orthografic Normalisation** →	high tsh values suggest the diagnosis of primary hypo-thyroidism ...
Erhöhte TSH-Werte erlauben die Diagnose einer primären Schilddrüsenunterfunktion ...	***Orthografic Rules***	erhoehte tsh werte erlauben die diagnose einer primaeren schilddruesenunterfunktion ...

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Example

Original
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Orthografic Normalisation

Orthografic Rules

high tsh values suggest the diagnosis of primary hypo-thyroidism ...
erhoehte tsh werte erlauben die diagnose einer primaeren schilddruesenunterfunktion ...

Segmenter
Subword Lexicon

high tsh value s **suggest** the **diagnos** is of **primar** y **hypo thyroid** ism
er **hoeh** te **tsh wert** e **erlaub** en die **diagnos** e einer **primaer** en **schilddruese** n **unter funktion**

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Example

Original	Orthografic Normalisation	Orthografic Rules	Segmenter Subword Lexicon
High TSH values suggest the diagnosis of primary hypo-thyroidism ...			high tsh values suggest the diagnosis of primary hypo-thyroidism ...
Erhöhte TSH-Werte erlauben die Diagnose einer primären Schilddrüsenunterfunktion ...			erhoehte tsh werte erlauben die diagnose einer primaeren schilddruesenunterfunktion ...

Interlingua	Semantic Normalisation	Subword Thesaurus	Segmenter Subword Lexicon
#up tsh #value #suggest #diagnost #primar #hypo #thyre			**high tsh value** s **suggest** the **diagnos** is of **primar** y **hypo thyroid** ism
#up tsh #value #permit #diagnost #primar #thyre #hypo #function			er **hoeh** te **tsh wert** e **erlaub** en die **diagnos** e einer **primaer** en **schilddrues** en **unter funktion**

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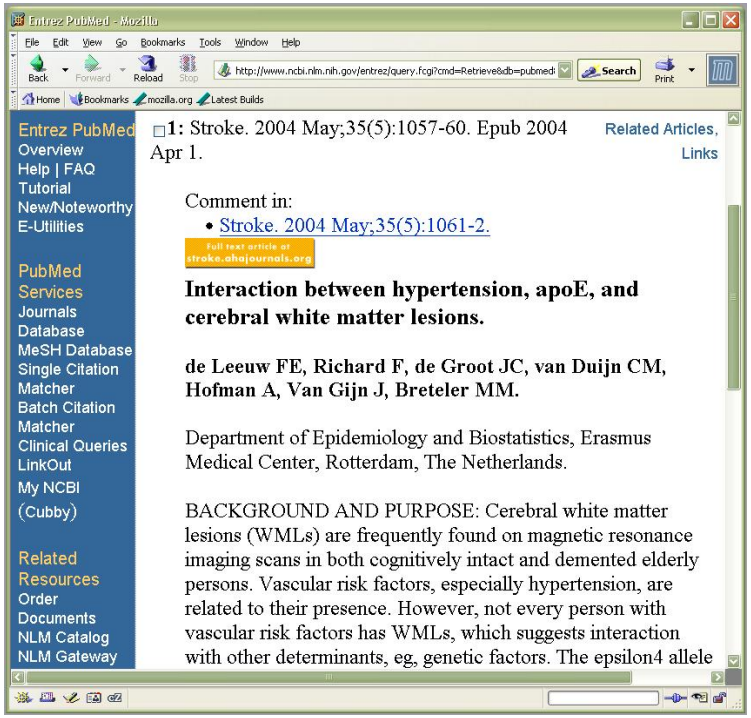
MORPHOSAURUS Search



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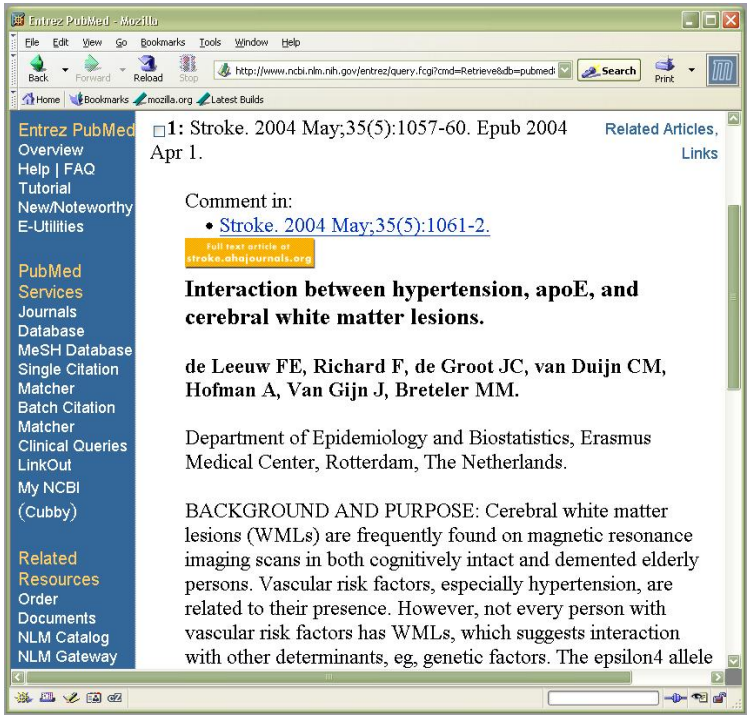

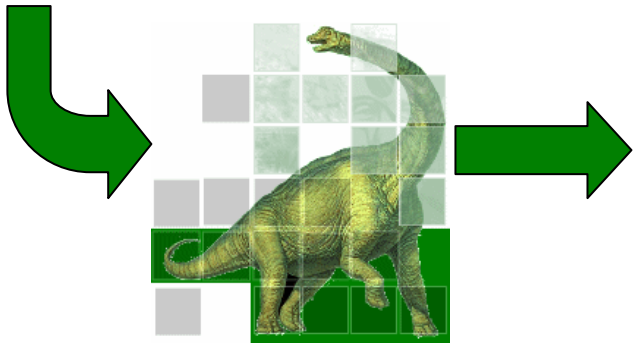

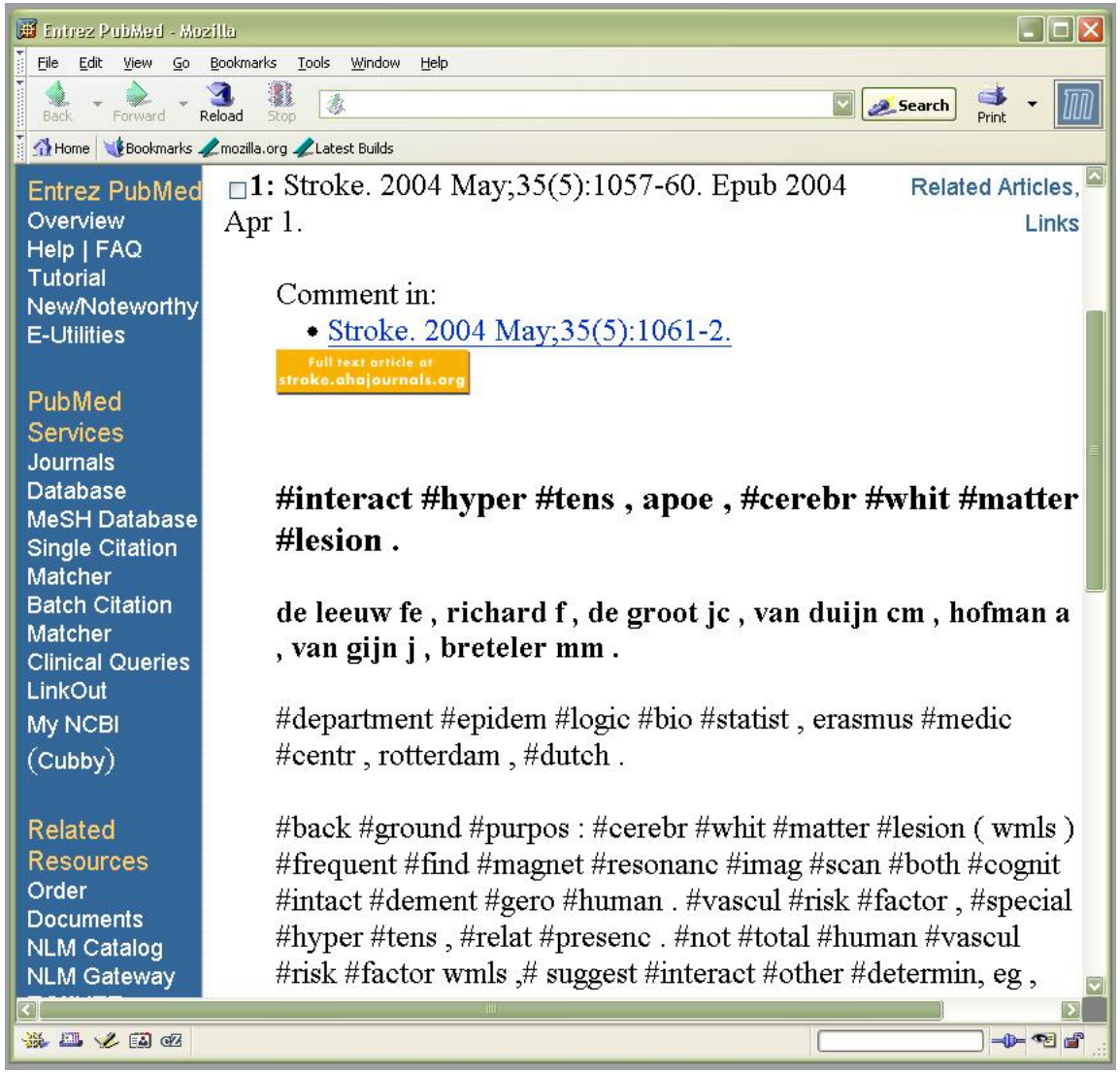

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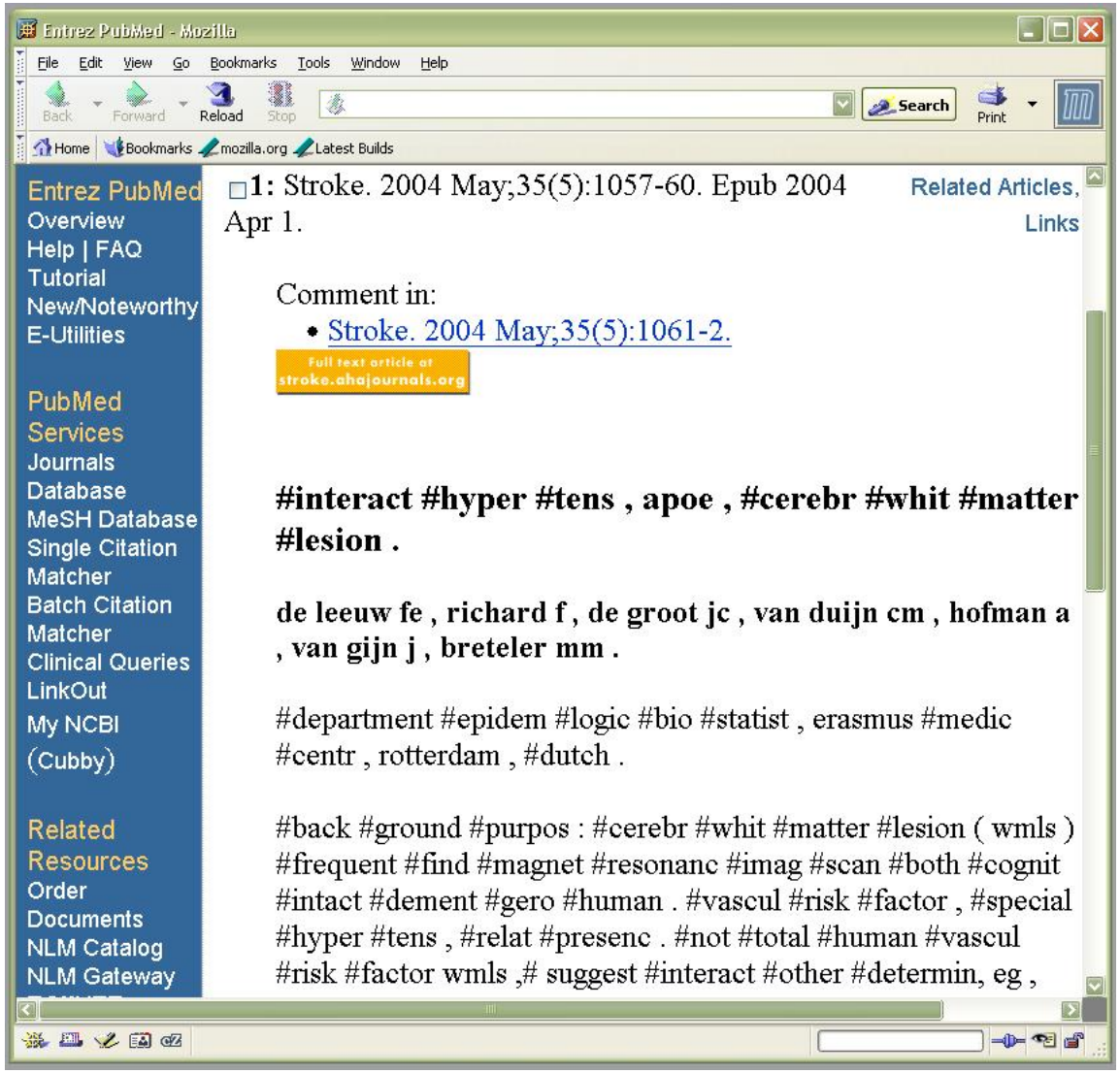

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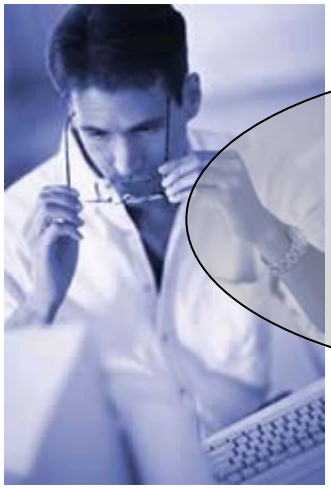
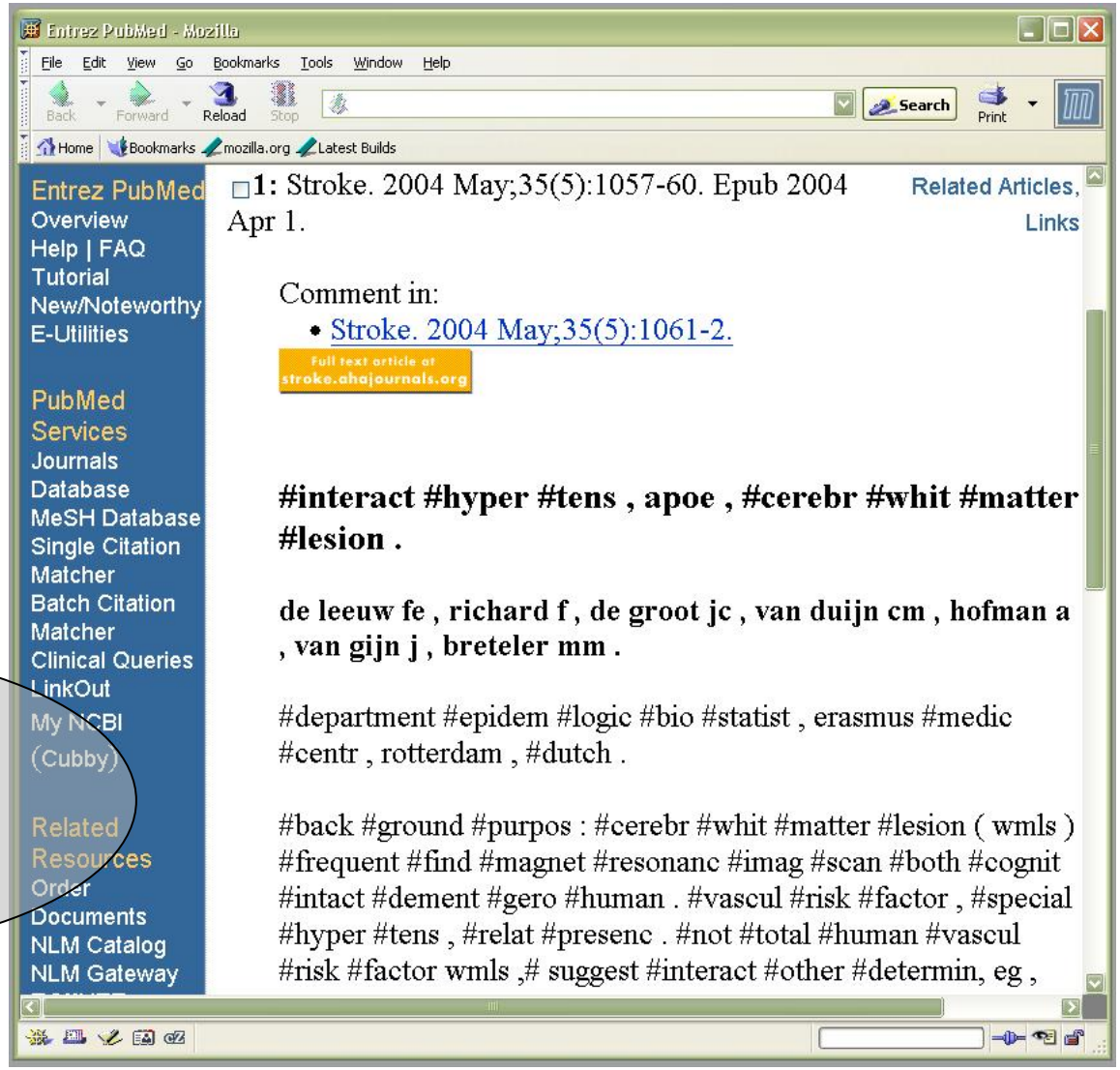


#correl #hyper #tens #lesion #whit #matter



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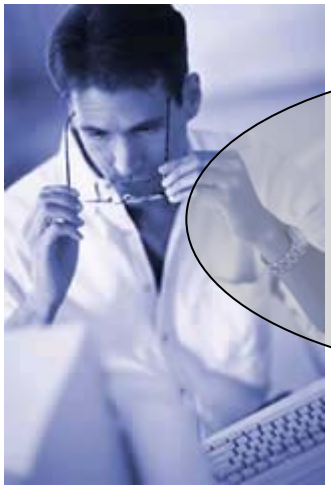

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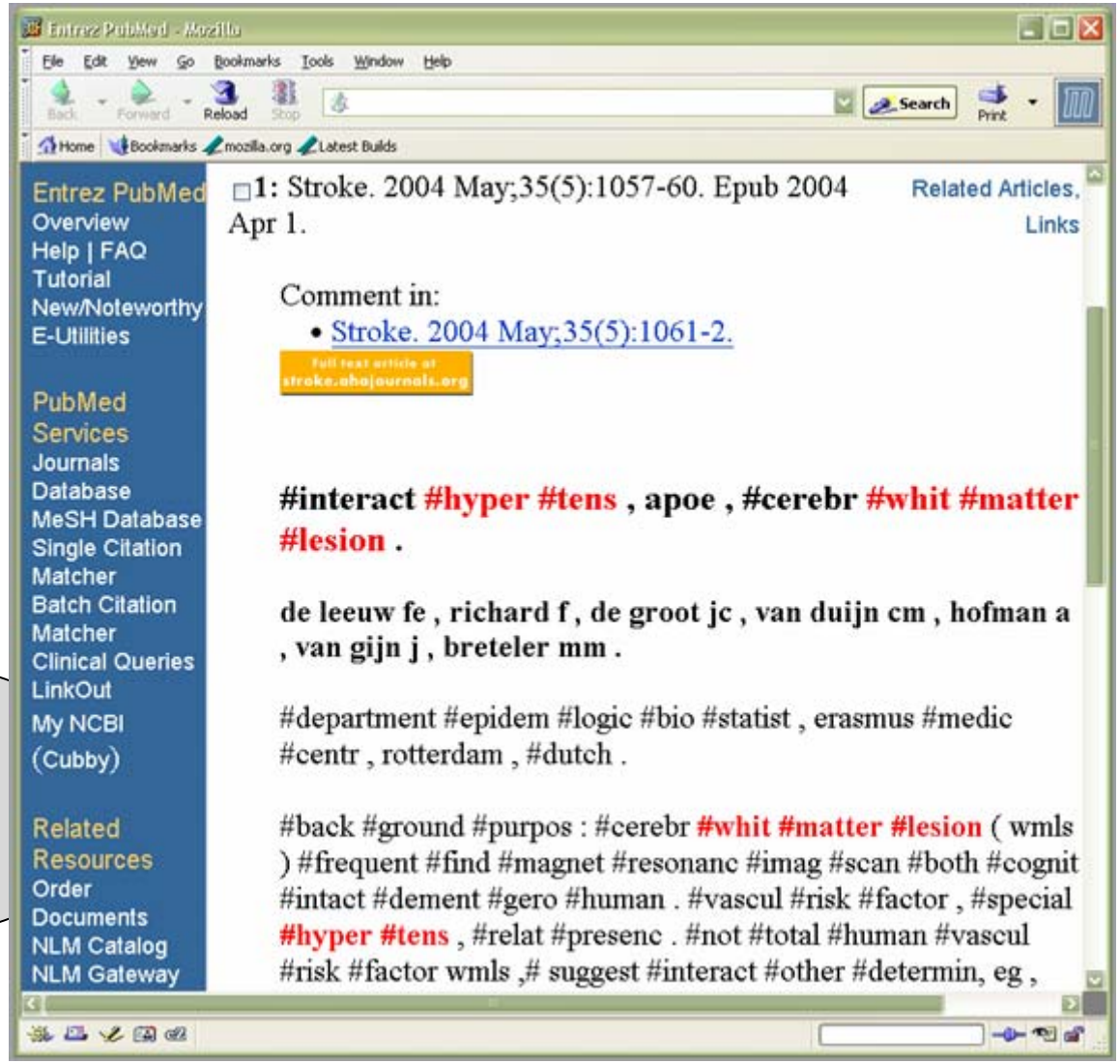

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Evaluation

- **ImageCLEFmed 2006 Corpus**
  - 4 Subsets (CasImage, MIR, PEIR, PathoPic)
  - 40,708 English, 7805 German, 1899 French documents
  - 30 Queries in all three languages
- Search Engine: **Apache Lucene**
- Image Retrieval Tool: **GIFT (the GNU Image-Finding Tool)**
- **Text Only Scenarios**

Mono-Lingual Test Runs (English Subset)
- Original (Baseline)
- Stemming (Porter)
- Subwords
- Original + Stemming
- Original + Subwords

Cross-Lingual Test Runs
- Original (En-En, De-De, Fr-Fr)
- Subwords (En – All)
- Subwords (De – All)
- Subwords (Fr – All)

- **Text + Image Scenarios:** combining above scenarios with GIFT results

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Monolingual Results

Text Only

Scenario	Original (Baseline)	Stemming (Porter)		Subwords		Orginal + Stemming		Original + Subwords	
map	**0.1625**	**0.1482**	**91%**	**0.1297**	**80%**	0.1732	106%	**0.1792**	**110%**
top2avg	0.3778	0.3669	97%	0.3175	84%	0.4146	110%	**0.4525**	**120%**
P5	**0.4867**	**0.4667**	**96%**	**0.4867**	**100%**	0.5133	106%	**0.5933**	**122%**
P20	0.3600	0.4000	111%	0.3550	99%	0.4017	112%	**0.4500**	**125%**

Findings:

- neither Stemming nor Subword Search alone performed as good as Original Search regarding MAP
- Combination of Original and Subword Search increases precision values up to 25%

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Multilingual Results

Text Only

Scenario	Orig-All-All	Orig-En-En		Subwords-En-All		Subwords-De-All		Subwords-Fr-All	
map	**0.1068**	**0.1625**	**152%**	**0.1366**	**128%**	**0.1439**	**135%**	**0.0734**	**69%**
top2avg	0.2881	0.3778	131%	**0.3970**	**138%**	**0.3751**	**130%**	0.2028	70%
P5	0.3200	0.4867	152%	**0.4200**	**131%**	**0.4000**	**125%**	0.3103	97%
P20	0.2600	0.3600	138%	**0.3467**	**133%**	**0.3383**	**130%**	0.2293	88%

Findings:

- Baseline Search on the whole document collection performs much worse than on the English Subset
- Subword Search in English and German performs clearly better than the baseline (original)
- German Subword Search performs (almost) as good as the English Subword Search

Text + Image

- Image results provided by GIFT (the GNU Image-Finding Tool)
- Several merging algorithm were tested → All performed worse than *Text Only* results

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Conclusion/Outlook

- Mono- and Cross-Language Text Retrieval based on a sophisticated **interlingual layer**
- Can be combined with **any search engine**
- Mono-Lingual: **Combination of original and subword search remarkably boosts performance (up to 25%)**
- Cross-Lingual: **Subword approach clearly outperforms baseline, German as good as English**
- **Mean map values, good top-5(20)-precision values**
- A capable combination with Image Retrieval Tools is due

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