Canolfan ESRC Centre
dros Ymchwil
i Ddwyieithrwydd
for Research
on Bilingualism

Using constraint grammar in the Bangor Autoglosser to disambiguate multilingual spoken text

Kevin Donnelly and Margaret Deuchar

ESRC Centre for Research on Bilingualism, Bangor, Wales

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BANGOR

Background

The Centre

- ESRC Centre for Research in Bilingualism
- Established January 2007
- Five research themes
- Corpus-based research
- **bilingualism.bangor.ac.uk**

Bangor corpora

	Chats	*Hours*	*Words*	*Date*
Welsh-English (Siarad)	69	40	456k	2009
Welsh-Spanish (Patagonia)	32	20	161k	2011
Spanish-English (Miami)	31	20	126k	2011
	132	**80**	**743k**	

All available under the GPL.

The conversations

- Transcribed using the CLAN format
- **childes.psy.cmu.edu/clan**
- Standard orthography
  - Elisions spelled out for Welsh:
  - **mae'n fawr** (it's big) →**mae (y)n fawr**
- Gloss added
- Free translation in English added

Sample utterances

***SER:** dw@1 i@1 (y)n@1 hopeless@2 efo@1 tynnu@1 llun@1 .
%snd:"deuchar1"_72848_73881
%gls: be.1S.PRES PRON.1S PRT hopeless with take.NONFIN picture
%eng: I'm hopeless at drawing
***MYF:** +< &=laugh . %snd:"deuchar1"_73196_73881
***SER:** dw@1 i@1 (y)n@1 tynnu@1 llun@1 i@1 [/] i@1 (y)r@1 plant@1 <i@1 plant@1> [//] <i@1 (y)r@1> [//] # i@1 er@0 &h Helen@0 a@1 Susanna@0 a@1 +/. %snd:"deuchar1"_73881_79477
%gls: be.1S.PRES PRON.1S PRT take.NONFIN picture for for DET children for children for DET for IM Helen and Susanna and
%eng: I draw a picture for . . . for the children, for, er, Helen and Susanna and . . .

(Siarad corpus, deuchar1)

Utterance format

**SER dw@1 i@1 (y)n@1 hopeless@2 efo@1 tynnu@1 llun@1 . %snd:"deuchar1"_72848_73881*

Speaker	*SER
Utterance	dw@1 i@1 (y)n@1 hopeless@2 efo@1 tynnu@1 llun@1 .
Language tags	1=Welsh, 2=English, 0=undetermined
Audio location	%snd:"deuchar1"_72848_73881
Manual gloss	be.1S.PRES PRON.1S PRT hopeless with take.NONFIN picture

Why?

- Examine how language is actually used
- Differences between spoken language and formal written language
- Sociolinguistic variation – what is used where by whom
- Balance between languages in bilingual usage
- How one language handles lexical items from the other
    - Welsh loan-verbs such as *textio* (to text) behave more like ordinary Welsh verbs the more frequent they are

Glossing

Why gloss?

- Lexemes and part-of-speech (POS) tags:
  - Help non-native speakers parse the conversation
  - Allow further analysis - morphological, syntactic, sociolinguistic
- Difficulties:
  - Time-consuming and tedious
  - Inconsistency and errors (*ychydig* – "a_bit"/"a_little")
  - Tag choice difficult to revise later

Automation

- April 2010
- Explore automation to address difficulties above
- Move towards more granular POS information
- Welsh →Spanish →English
- Accuracy reflects timespend:
  99% for Welsh, and 95% for English.
- Work in progress

Why another wheel?

- CLAN tagging system
  - For 11 languages > 5m speakers
  - Requires one pass for each language
  - Can't mix language context
  - Vocabulary stored in a number of files
  - Disambiguation for only 4 languages
- Toolbox
- No automated system for small languages

Pilot project

- Test project over two weeks:
  - No disambiguation
  - Write out entries from Spanish dictionary
  - **apertium.org**
  - Compare them with MOR output
  - Write out entries from Welsh dictionary
  - **eurfa.org.uk**
- Good results
- Needed a way to disambiguate - enter CG!

Dictionaries

Dictionaries

- Derived from GPL or PD resources
- One database table
- Words, not morphemes
- Easily presented in a spreadsheet
- Easy to update
- Easy to get started

Welsh dictionary

surface	*lemma*	*enlemma*	*pos*	*gender*	*number*	*tense*
bara	bara	bread	n	m	sg	
cathod	cath	cat	n	f	pl	
mynd	mynd	go	v			infin
aeth	mynd	go	v		3s	past
hapus	hapus	happy	adj			
rhywsut	rhywsut	somehow	adv			
heb	heb	without	prep			

Spanish dictionary

surface	*lemma*	*enlemma*	*pos*	*gender*	*number*	*tense*
perro	perro	dog	n	m	sg	
canciones	canción	song	n	f	pl	
empezar	empezar	start	v			infin
empieza	empezar	start	v		23s	pres
empieza	empezar	start	v		2s	imper
rojo	rojo	red	adj	m	sg	
rojas	rojo	red	adj	f	pl	
por	por	for	prep			

English dictionary

surface	*lemma*	*pos*	*number*	*tense*
break	break	sv		infin
broke	break	av		past
broken	break	av		pastpart
car	car	n	sg	
quick	adj			
by	by	prep		
which	which	rel		

breaks, breaking, cars, quickly are derived during lookup

Language differences

- Spanish and Welsh
  - Inflected (Welsh less so than it was)
  - Surface forms give clues about the POS
- English
  - Analytic
  - Homophonous surface forms
  - POS defined by role in the sentence
  - **break**
    - *a clean break* (noun)
    - *break the mould!* (imperative)
    - *to break a habit* (infinitive)
    - *they break everything* (present)

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Import

Import the chat file

- PHP script reads each line into a PostgreSQL database table
- Selects the utterance and discards markers
- Splits the cleaned utterance into words
- Puts them into another database table

Utterance-table fields

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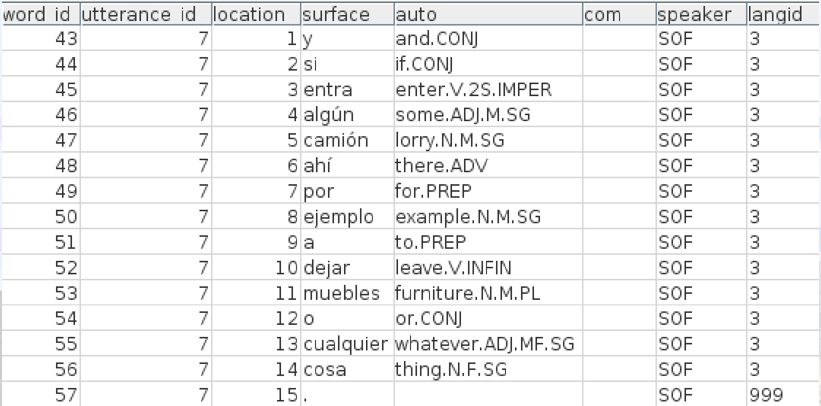
- utterance_id
- filename
- speaker
- surface
- startpoint
- endpoint
- duration
- manual glosses (if present)
- English translation (if present)
- comments (if present)
- precode (if present – marks entire utterances in the least-frequent language)

Word-table fields

- word_id
- utterance_id
- location of the word in the utterance
- surface
- automatic glosses
- manual glosses (if present)
- language id
- speaker
- filename

The words table



word id	utterance id	location	surface	auto	com	speaker	langid
43	7	1	y	and.CONJ		SOF	3
44	7	2	si	if.CONJ		SOF	3
45	7	3	entra	enter.V.2S.IMPER		SOF	3
46	7	4	algún	some.ADJ.M.SG		SOF	3
47	7	5	camión	lorry.N.M.SG		SOF	3
48	7	6	ahí	there.ADV		SOF	3
49	7	7	por	for.PREP		SOF	3
50	7	8	ejemplo	example.N.M.SG		SOF	3
51	7	9	a	to.PREP		SOF	3
52	7	10	dejar	leave.V.INFIN		SOF	3
53	7	11	muebles	furniture.N.M.PL		SOF	3
54	7	12	o	or.CONJ		SOF	3
55	7	13	cualquier	whatever.ADJ.MF.SG		SOF	3
56	7	14	cosa	thing.N.F.SG		SOF	3
57	7	15	.			SOF	999

Lookup

- Each word is looked up against the appropriate dictionary
- Uses the language id assigned to the word
- Writes out all “hits” in the CG input format

Segmentation

- Lookup also does some basic segmentation
- Minimises number of dictionary entries (**break** above)
- Welsh: mutated words are tagged
  - thad →tad (*father*) + am
  - gael →cael (*get*) + am
- Spanish: clitic pronouns are tagged
  - ponerle →poner (*put*) + le[pron.mf.3s]
  - déjanos →dejar (*leave*)+ nos[pron.mf.1p]

English Segmentation

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- Elisions are tagged
    - gonna →go # to.prep
    - we're →we # be.v.pres
- Plurals or verbs (3p sg pres) are tagged
    - breaks →break # pv
- Adjectives or verbs (past or pastpart) are tagged
    - constructed →construct # av
- Adjectives, nouns or verbs (prespart) are tagged
    - thinking →think # asv

Mutation

- **tad** (father)
  - **ei dad** (his father)
  - **ei thad** (her father)
- **marw** (die, dead)
  - **mae o'n marw** (he is dying)
  - **mae o'n farw** (he is dead)
- direct object following a verb
  - **Mi werthodd y ffermwr y mochyn** (The farmer sold the pig)
  - **Mi werthodd y ffermwr fochyn** (The farmer sold a pig)

Welsh before CG

```
"<ddim>"
    "dim"  {96,1} [cy] n m sg :nothing: [208789] + sm
    "dim"  {96,1} [cy] adv :not: [204176] + sm
"<yn>"
    "yn"  {96,2} [cy] stat :stative: [200654]
    "yn"  {96,2} [cy] prep :in: [204430]
    "gan"  {96,2} [cy] prep :with: [196964] + sm
"<gynnar>"
    "cynnar"  {96,3} [cy] adj :early: [209212] + sm
"<iawn>"
    "iawn"  {96,4} [cy] adv :OK: [207540]
    "iawn"  {96,4} [cy] adv :very: [203775]
"<.>"
```

(Miami corpus, sastre1)

Welsh after CG

```
"<ddim>"
    "dim" {96,1} [cy] adv :not: [204176] + sm
"<yn>"
    "yn" {96,2} [cy] stat :stative: [200654]
"<gynnar>"
    "cynnar" {96,3} [cy] adj :early: [209212] + sm
"<iawn>"
    "iawn" {96,4} [cy] adv :very: [203775]
"<.>"
```

(Patagonia corpus, patagonia1)

Spanish before CG

```
"<y>"
    "y"  {122,1} [es] conj :and: [118037]
"<ahora>"
    "ahora"  {122,2} [es] adv :now: [6292]
"<vamos>"
    "ir"  {122,3} [es] v 1p pres :go: [115789]
"<a>"
    "a"  {122,4} [es] prep :to: [1]
"<hacerle>"
    "hacer"  {122,5} [es] v infin :do: [62577] + le[pron.mf.3s]
"<el>"
    "el"  {122,6} [es] det.def m sg :the: [45129]
"<baño>"
    "baño"  {122,7} [es] n m sg :bathroom: [16011]
    "bañar"  {122,7} [es] v 1s pres :bathe: [16010]
"<.>"
```

(Patagonia corpus, patagonia1)

Spanish after CG

```
‘‘<y>"
    "y" {122,1} [es] conj :and: [118037]
"<ahora>"
    "ahora" {122,2} [es] adv :now: [6292]
"<vamos>"
    "ir" {122,3} [es] v 1p pres :go: [115789]
"<a>"
    "a" {122,4} [es] prep :to: [1]
"<hacerle>"
    "hacer" {122,5} [es] v infin :do: [62577] + le[pron.mf.3s]
"<el>"
    "el" {122,6} [es] det.def m sg :the: [45129]
"<baño>"
    "baño" {122,7} [es] n m sg :bathroom: [16011]
"<.>"
```

(Miami corpus, sastre1)

English before CG

```
"<it’s>"
    "it"  {545,1} [en] pron.sub 3s :it: [130342] # gb
"<coming>"
    "come"  {545,2} [en] sv infin :come: [82193] # asv
"<out>"
    "out"  {545,3} [en] adv :out: [157287]
"<on>"
    "on"  {545,4} [en] prep :on: [156077]
"<D_V_D>"
    "D_V_D"  {545,5} [en] name
"<then>"
    "then"  {545,6} [en] adv :then: [208154]
"<.>"
```

(Miami corpus, herring7)

English after CG

```
"<it's>"
    "it" {545,1} [en] pron.sub 3s :it: [130342] # be.v.3s.pres
"<coming>"
    "come" {545,2} [en] v prespart :come: [82193] #
"<out>"
    "out" {545,3} [en] adv :out: [157287]
"<on>"
    "on" {545,4} [en] prep :on: [156077]
"<D_V_D>"
    "D_V_D" {545,5} [en] name
"<then>"
    "then" {545,6} [en] adv :then: [208154]
"<.>"
```

(Miami corpus, herring7)

Multilingual disambiguation

Multiple languages

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- Previous extracts all monolingual
- But easy to use CG for multilingual speech
- Ensure that each “hit” in the input file is tagged for language
- Put all the rules into one grammar file, grouped according to language
- Constrain the rules to act only on one language by including that language’s tag in the rule

▶

▶

▶

Welsh before CG

```
"<cada>"
    "cada"  {79,5} [es] adj mf sg :every: [18541]
"<vez>"
    "vez"  {79,6} [es] n f sg :time: [116758]
"<que>"
    "que"  {79,7} [es] conj :than: [93349]
    "que"  {79,7} [es] conj :that: [93350]
"<nos>"
    "yo"  {79,8} [es] pron.obl mf 1p :us: [80717]
"<vamos>"
    "ir"  {79,9} [es] v 1p pres :go: [115789]
"<camping>"
    "camp"  {79,10} [en] sv infin :camp: [74449] # asv
```

(Miami corpus, sastre1)

- **vamos camping**
- substitute (sv infin asv) (v prespart) ([en] sv infin asv) (-1 ([en] "be") or (:go:));
- tags
-

Welsh before CG

(Miami corpus, sastre1)

Welsh before CG

(Miami corpus, sastre1)

Process

- Read the lines of the chat file into a database table
- Segment each line into words
- Look up the words in a digital dictionary
- Disambiguate using constraint grammar
- Write the results into a gloss tier, using Leipzig schema

Results for Welsh – manual

***ALN:** +" oedd@1 o@1 (y)n@1 edrych@1 fath@1 â@1 cael@1 snog@2 pan@1 wnes@1 i@1 basio@1 !

%gls: be.3S.IMP PRON.3SM PRT look.NONFIN kind with have.NONFIN snog when do.1S.PAST PRON.1S pass.NONFIN

%aut: be.V.3S.IMPERF he.R.M.3S.SPOKEN stative.S look.V.INFIN type.N.M.S.+SM as.C have.V.INFIN snog.V .INFIN when.C do.V.1S.PAST.SPOKEN.+SM I.R.1S pass.V .INFIN.+SM

%eng: it looked like having a snog when I passed!

(Siarad corpus, stammers4)

Results for Welsh

***AVR:** neu dylai bod fi wedi mynd (be)cause@s:en mae (y)n hwyr rŵan .

%aut: or.CY.C ought.CY.V.3S.IMPERF be.CY.V.INFIN I.CY.R.1S after.CY.P go.CY.V.INFIN because.EN.C be.CY.V.3S.PRES stative.CY.S late.CY.A now.CY.B

%eng: or I ought to have gone because it's late now

(Patagonia corpus, patagonia2)

Results for Spanish – MOR

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***LAR:** +” porque tú me apoyas en todo sabes .

%mor: conj|porque=because pro:per|tú=you pro:per|me=me vpres|apoya-2S&PRES=support prep|en=in det:indef|todo-MASC=all co|sabes=you_know^vpres|sabe-2S&PRES=know .

%aut: because.CONJ you.PRN.SUBJ.MF.2S me.PRN.OBJ.MF.1S support.V.2S.PRES on.PREP everything.PRN.M.SG know.V.2S.PRES

%eng: because you support me in everything, you know

(Miami corpus, zeledon14)

Results for Spanish

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***SEB:** ellos@3 mataban@3 a@3 la@3 gente@3 como@3 nosotros@3 .

%aut: they.PRN.SUBJ.M.3P kill.V.3P.IMPERF to.PREP the.DET.DEF.F.SG people.N.F.SG like.PREP we.PRN.SUBJ .M.1P

%eng: they would kill people like us

(Miami corpus, herring7)

Benefits

- Speed: 2 minutes/30-minute conversation
- Consistency: *ychydig* – “a bit”/“a little”
- Handles any number of languages in one pass
- Extensible
- Re-uses existing resources and tools
- Transferable skills

Results

	Welsh	Spanish
Coverage (all words)	88%	96%
Tokens	5224	4827
Correlation (nouns)	82%	85%
Accuracy (nouns)	93%	97%
Nouns	459	380
Files	*stammers4*	*zeledon14*

Drawbacks

- Like MOR, still needs checking!
- Dictionary cleaning can take some time
- Rules take time to write and test

Can we add value to the texts?

Texts

- Check on typos – proof-reading
- Consistent glosses
- More granular analysis
- Global tag changes or enrichment

Accessibility

Accessibility

- Interactive webpages (*siarad.org.uk*)

Accessibility

- Interface to CLAN queries

Data-mining

- Utterance profiling

Data-mining

- Easier or more detailed statistical analysis
- N-gram generation (2- or 3-word collocations)
- Input to statistical machine translation