

Creating the first reliable monitor corpus of English: problems, solutions, and insights

Mark Davies Brigham Young University www.americancorpus.org

Related corpora [corpus.byu.edu]



- Corpus del español (100m, 1200s-1900s) [NEH]
- Corpus do português (45m, 1300s-1900s) [NEH]
- British National Corpus* (100m words, 1980s-1993)
- TIME Magazine (100m words, 1923-2006)
- (2008) Corpus of Contemporary American English (~400 million words, balanced, 1990-present)
- (2010) Corpus of Historical American English (300m words, balanced, c1810 current) [NEH]

Monitor corpora



- (Lexical) When (and perhaps why, as a result) have the following words increased most in usage: globalization, adolescent, insurgent, same-sex, upscale, old-school, wirelessly, online, and the verbs mentor, morph, download, freak out, and splurge?
- (Lexical) What are the fifty verbs, nouns, and adjectives that have increased the most in usage during the past five years?
- (Morphological) Is the "scandal" suffix –gate (Watergate, zippergate, Irangate) increasing or decreasing in usage since the 1990s?
- (**Syntactic**) Are the grammatical constructions "end up V-ing" (*ends up paying, ended up working*) and the "*get* passive" (*he got hired* vs. *he was hired*) increasing or decreasing over time?
- (**Semantic**) Words such as *hot, lame, green*, or *random* have recently changed meaning. What have been the most important periods of change, and exactly how have the new meanings been acquired?
- (Discourse analysis) What are we saying differently about women, or the environment, or immigrants than we were 15-20 years ago?

Characteristics of useful monitor corpora



- Large (probably 100 million words or more)
- Recent texts (ideally updated to within a year of the present time)
- Balance between several genres (e.g. not just newspapers)
- Roughly the same genre balance from year to year (comparing apples to apples)
- An architecture that shows frequency over time and which allows one to compare frequencies between different periods

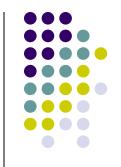
Corpus of Contemporary American English (www.americancorpus.org)



- 400+ million words (cf. BNC, 100m)
- From more than 160,000 texts
- 20 million words each year from 1990-2009
- Balanced across spoken, fiction, popular magazines, newspapers, and academic journals (20% in each genre each year)
- Balance across years makes it a nice monitor corpus
- Updated 1-2 times a year; unique linguistic history of contemporary English

Composition of the corpus

400+ million words (1990-present) Same composition each year



- <u>Spoken</u>: (83 million words) Transcripts of <u>unscripted</u> conversation from more than 150 different TV and radio programs (examples: *All Things Considered* (NPR), *Newshour* (PBS), *Good Morning America* (ABC), *Today Show* (NBC), *60 Minutes* (CBS), *Hannity and Colmes* (Fox), *Jerry Springer*, etc).
- <u>Fiction</u>: (**79 million** words) Short stories and plays from literary magazines, children's magazines, popular magazines, first chapters of first edition books 1990-present, and movie scripts.
- Popular Magazines: (84 million words) Nearly 100 different magazines, with a good mix (overall, and by year) between specific domains (news, health, home and gardening, women, financial, religion, sports, etc). A few examples are *Time, Men's Health, Good Housekeeping, Cosmopolitan, Fortune, Christian Century, Sports Illustrated*, etc.
- Newspapers: (79 million words) Ten newspapers from across the US, including: USA
 Today, New York Times, Atlanta Journal Constitution, San Francisco Chronicle, etc. In
 most cases, there is a good mix between different sections of the newspaper, such as local
 news, opinion, sports, financial, etc.
- <u>Academic Journals</u>: (79 million words) Nearly 100 different peer-reviewed journals. These were selected to cover the entire range of the Library of Congress classification system (e.g. a certain percentage from B (philosophy, psychology, religion), D (world history), K (education), T (technology), etc.), both overall and by number of words per year

Aren't there already monitor corpora of English?



- British National Corpus
- American National Corpus
- Brown family of corpora
- Bank of English (6/6 CL prefer...)
- Oxford English Corpus
- The Web and text archives

The creators of these corpora themselves usually never claimed they were monitor corpora, so not a criticism of the corpora per se (cf. Burnard 2002)

Previous corpora as monitor corpora



	BNC	ANC	<u>Brown</u>	<u>BoE</u>	OEC	Web Archives
Size (millions)	100	22	4	455	1900	Huge
Recent	1970s- 1993	??- 2004?	1961, 1991	1970s- 2005	2000- 2006	Yes
Genres	Yes	No	(Yes)	(Yes)	(Yes)	??
Genres: time	No	No	Yes	No	No	(Maybe)
Architecture, interface	(Yes)	No	No	(No)	(No)	<u>No</u>

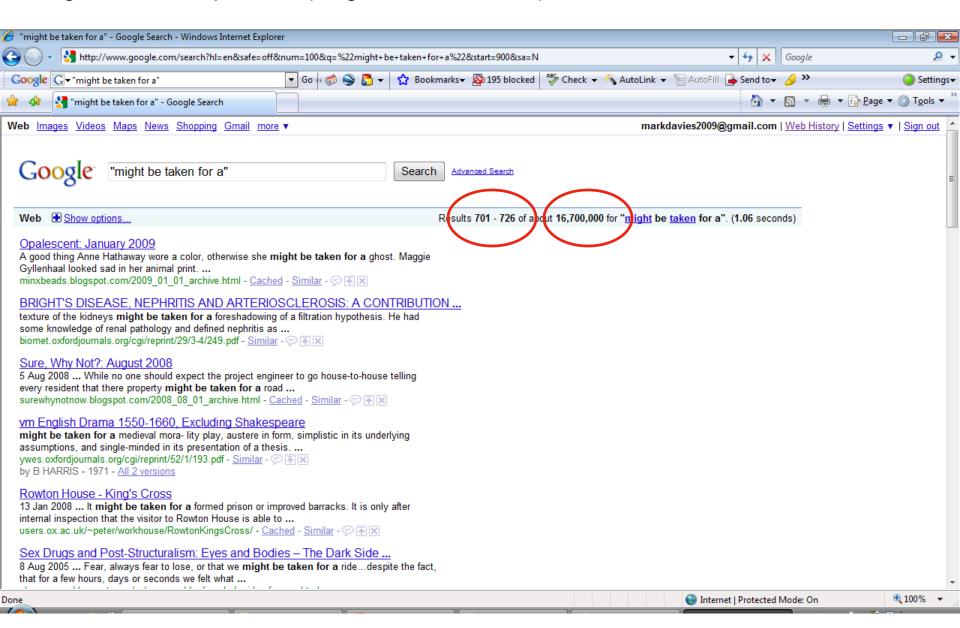
Web / text archives: limited architecture



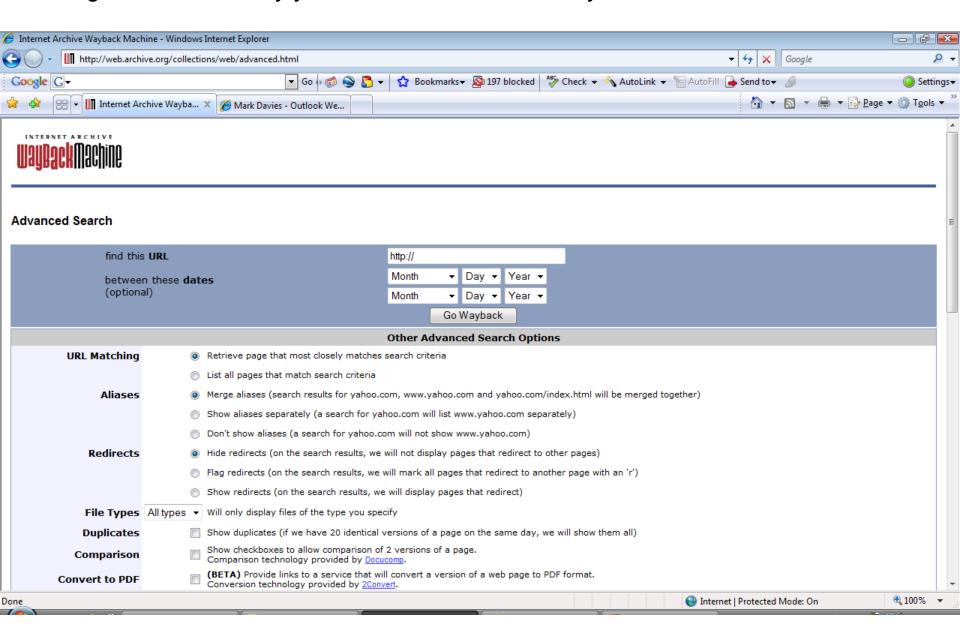
- Wildcards: morphology
- PoS tagged and lemmatization: syntax
- Collocates: semantics
- How to measure change over time / specifying [2000-03] or [2007] (even Internet Archive "Way Back Machine")

Google counts for multi-word searches

Google counts for phrases (might be taken for a): 726 vs 16,700,000



Limiting web searches by year: Internet Archive's "Way Back Machine"



Genres over time: Bank of English



Time period	Fiction	Total	% fiction	
1960-1979	1,030,000	1,414,000	72.8%	
1980-1989	3,087,000	8,792,000	35.1%	
1990-1994	1990-1994 6,049,000		29.0%	
1995-1999	3,100,000	19,187,000	16.2%	
2000-2004	18,800,000	123,055,000	15.3%	

Genres over time: Bank of English



	ALL	ALL	FICTION	FICTION
	90-94	95-99	90-94	95-99
mutter	378	269	326	159
(all forms)	18.1	14.0	53.9	51.3
pale	707	402	421	202
(all forms)	33.9	21.0	69.6	65.2
had + VBN	56239	31125	21590	10418
(e.g. had seen)	2669.5	1622.2	3569.2	3360.7

Genres over time: Oxford English Corpus



Year	Fiction	Total	% fiction
2000	6,479,988	66,455,562	9.8%
2001	14,326,315	89,913,492	15.9%
2002	36,938,545	142,621,850	25.9%
2003	61,788,465	191,239,937	32.3%
2004	53,462,736	240,840,436	22.2%
2005	57,083,698	180,930,648	31.6%
2006	12,740,916	15,442,798	82.5%

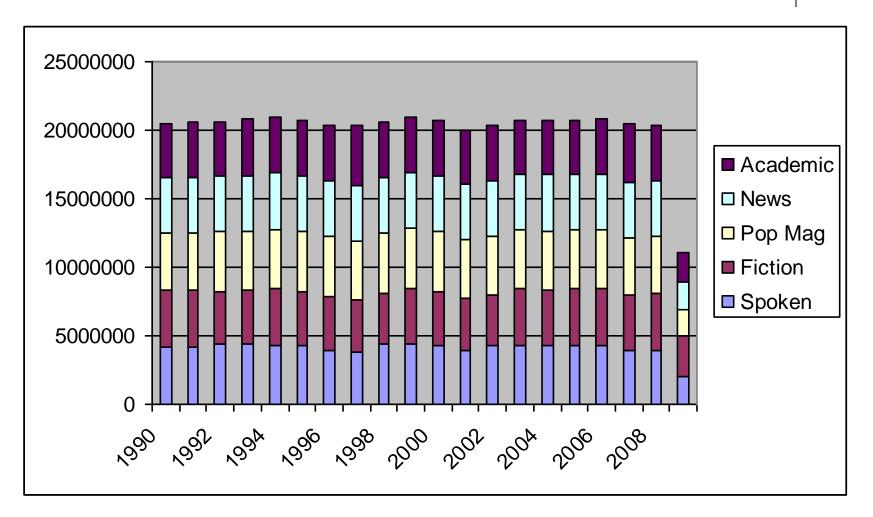
Genres over time: Oxford English Corpus



	E	Entire corpus	3	Fiction		
	2001	2004	2006	2001	2004	2006
mutter (all forms)	1669 18.6	8552 44.7	1652 107.0	1557 110.1	5927 110.9	1647 129.3
<i>pale</i> (all forms)	2186 24.3	6543 27.2	1203 77.9	1174 81.9	4223 79.0	1190 93.4
had + VBN (e.g. had seen)	81811 909.9	245966 1021.3	32178 2083.7	36135 2522.3	135952 2542.9	30535 2396.6

COCA: Consistent balance from year to year





COCA: Consistent genre balance from year to year

	SPOKEN	FICTION	MAGAZINES	NEWSPAPERS	ACADEMIC	TOTAL	
1990	4205614	4176786	4061059	4072572	3943968	20,459,999	
1991	4156011	4152690	4170022	4075636	4011142	20,565,501	
1992	4364709	3862984	4359784	4060218	3988593	20,636,288	
1993	4352561	3936880	4318256	4117294	4109914	20,834,905	
1994	4282812	4128691	4360184	4116061	4008481	20,896,229	
1995	4341675	3925121	4355396	4086909	3978437	20,687,538	
1996	3924700	3938742	4348339	4062397	4070075	20,344,253	
1997	3811276	3750256	4330117	4114733	4378426	20,384,808	
1998	4366325	3754334	4353187	4096829	4070949	20,641,624	
1999	4360090	4130984	4353229	4079926	3983704	20,907,933	
2000	4336780	3925331	4353049	4034817	4053691	20,703,668	
2001	3909994	3866142	4262503	4066589	3924911	20,030,139	
2002	4252128	3745852	4279955	4085554	4014495	20,377,984	
2003	4334295	4094865	4295543	4022457	4007927	20,755,087	
2004	4265799	4076462	4300735	4084584	3974453	20,702,033	
2005	4319109	4075210	4328642	4089168	3890318	20,702,447	
2006	4320522	4081287	4279043	4085757	4028620	20,795,229	
2007	3952720	4028998	4185161	3983473	4267452	20,417,804	
2008	3930889	4155298	4151215	4123332	4015545	20,376,279	
2009	2018476	3036507	1829399	2009360	2209061	11,102,803	
TOTAL	81,806,485	78,843,420	83,274,818	79,467,666	78,930,162	402,322,551	

COCA: Consistent genre balance



mutter	1990-1994	1995-1999	2000-2004	2005-2009
PER MIL	1.36	1.10	1.40	1.49
SIZE (MW)	103.3	102.9	102.6	93.6
FREQ	141	113	144	139
pale	1990-1994	1995-1999	2000-2004	2005-2009

pale	1990-1994	1995-1999	2000-2004	2005-2009
PER MIL	28.77	27.97	27.52	27.13
SIZE (MW)	103.3	102.9	102.6	93.6
FREQ	2973	2879	2823	2538

had + VVN	1990-1994	1995-1999	2000-2004	2005-2009
PER MIL	1,173.06	1,066.21	1,059.00	1,095.43
SIZE (MW)	103.3	102.9	102.6	93.6
FREQ	121208	109731	108624	102491

Bank of English: Informal spoken: quotative *like*: and *l'm like*, we're not going



Years	tokens	size	per million
1990-94	5	20,883,000	0.24
1995-99	1	19,187,000	0.05
2000-04	173	123,055,000	1.41

OEC: Informal genres: quotative *like*: and *l'm like*, we're not going



Years	tokens	size	per million
2000	45	66,455,562	0.68
2001	40	89,913,492	0.44
2002	111	142,621,850	0.78
2003	121	191,239,937	0.63
2004	202	240,840,436	0.84
2005	177	180,930,648	0.98
2006	12	15,442,798	0.78

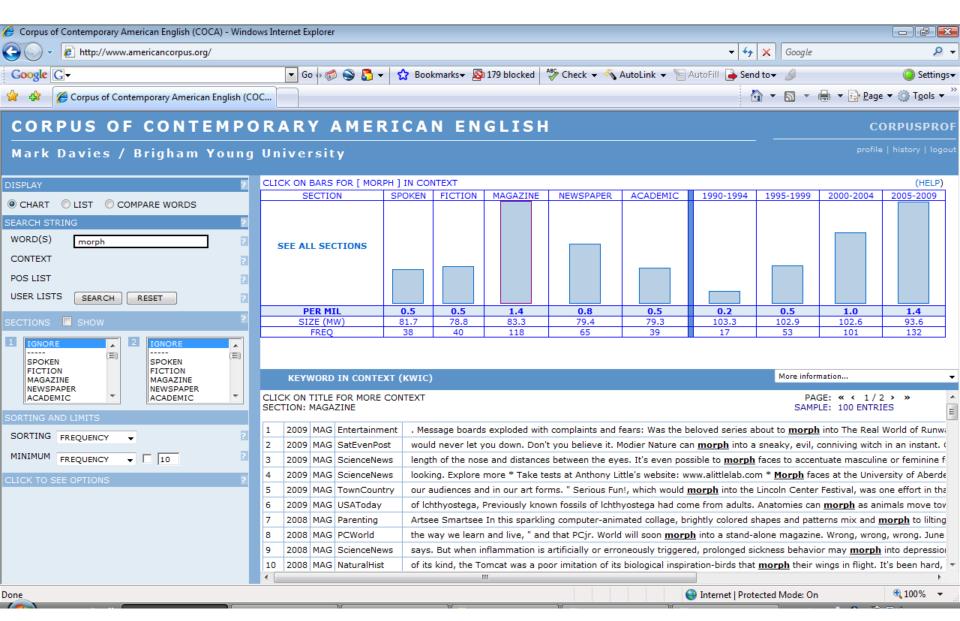




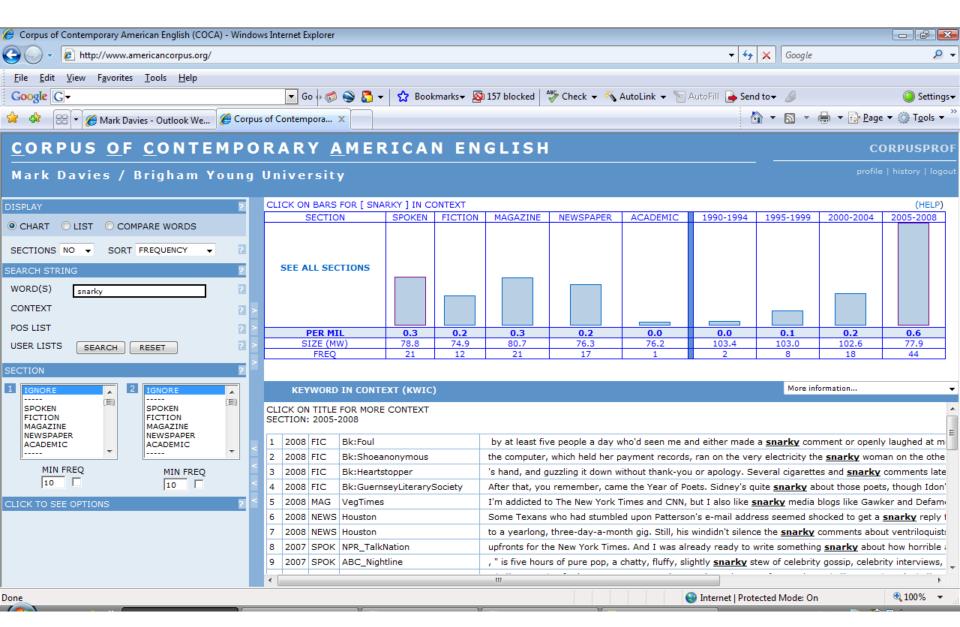
SECTION	SPOK	FICT	MAG	NEWS	ACAD	1990-94	1995-99	2000-04	2005-09
PER MIL	12.5	0.9	3.3	2.3	0.4	1.3	3.4	4.5	6.9
SIZE (MW)	81.7	78.8	83.3	79.4	79.3	103.3	102.9	102.6	93.6
FREQ	1025	72	271	179	29	130	347	462	645

- 4-5 times as common as Oxford English Corpus
- 3-66 times as common as the Bank of English

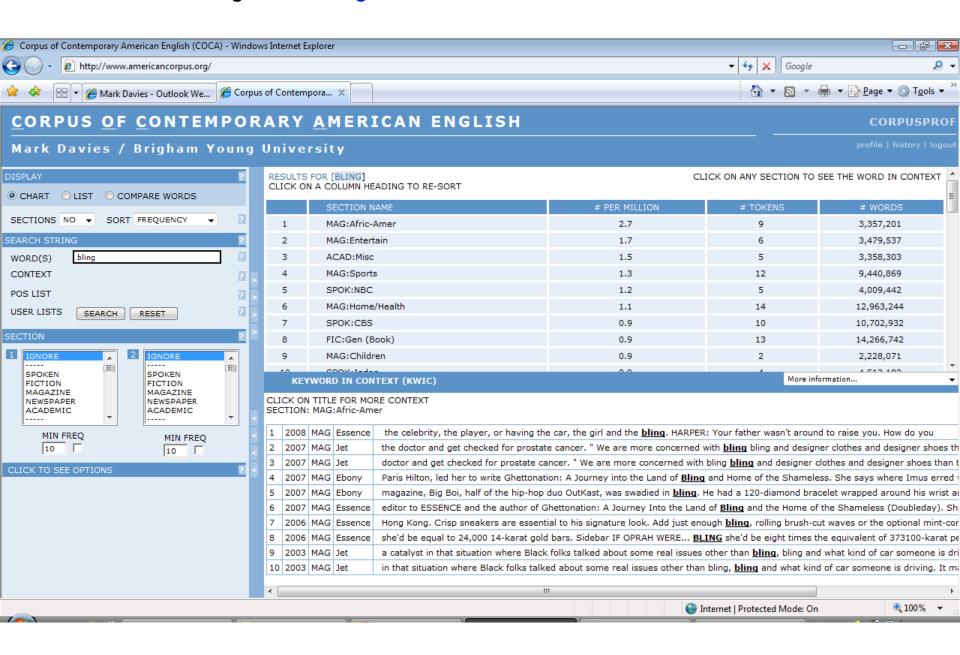
Lexical: charts: morph



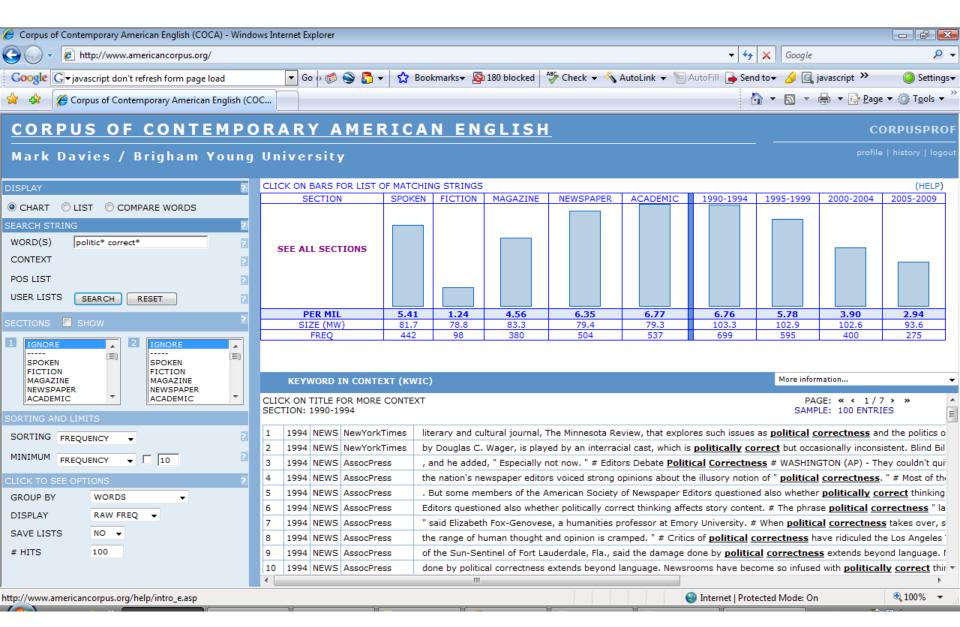
Lexical: charts: snarky



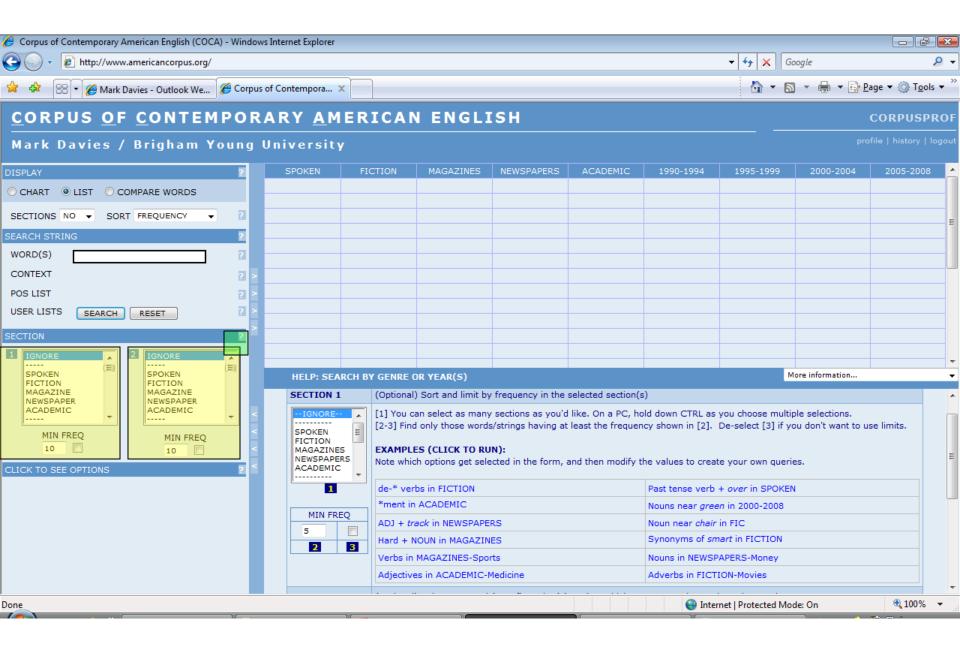
Lexical: charts: sub-genres: bling



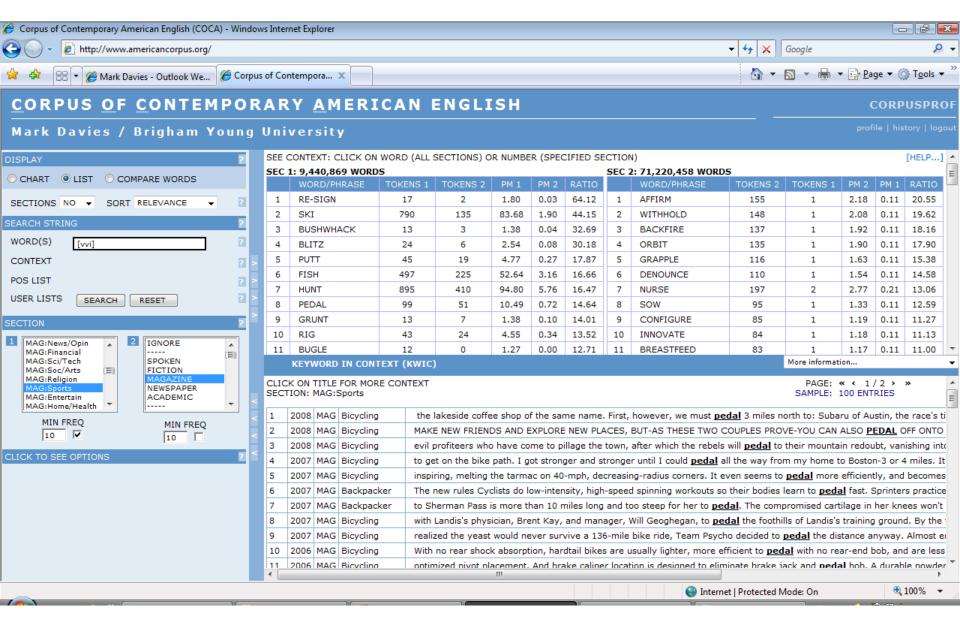
Lexical: charts: political* correct*



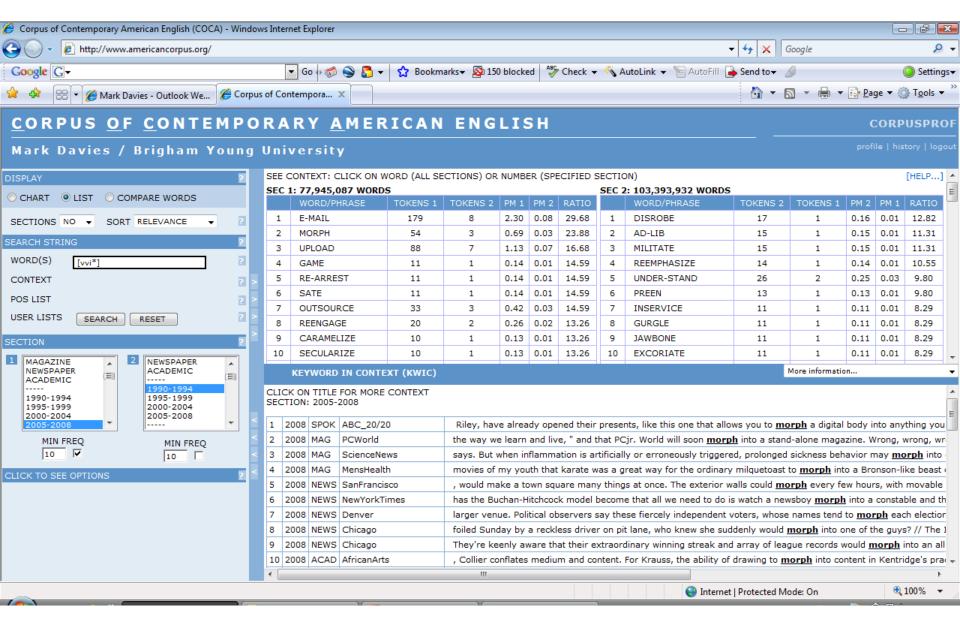
Sections: frequency by genre and time period



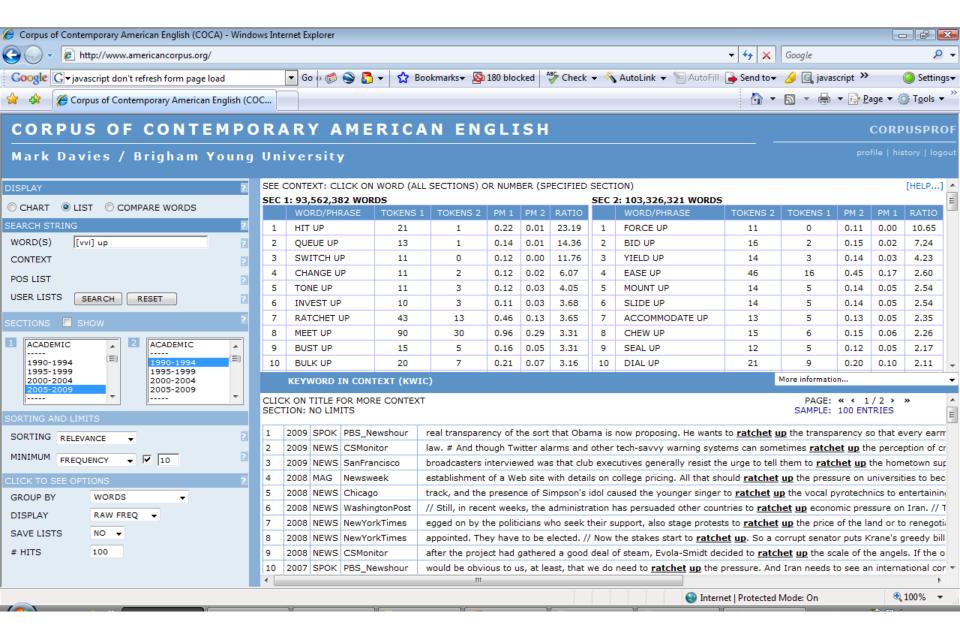
Sections: frequency by genre: Magazine: Sports vs Magazines



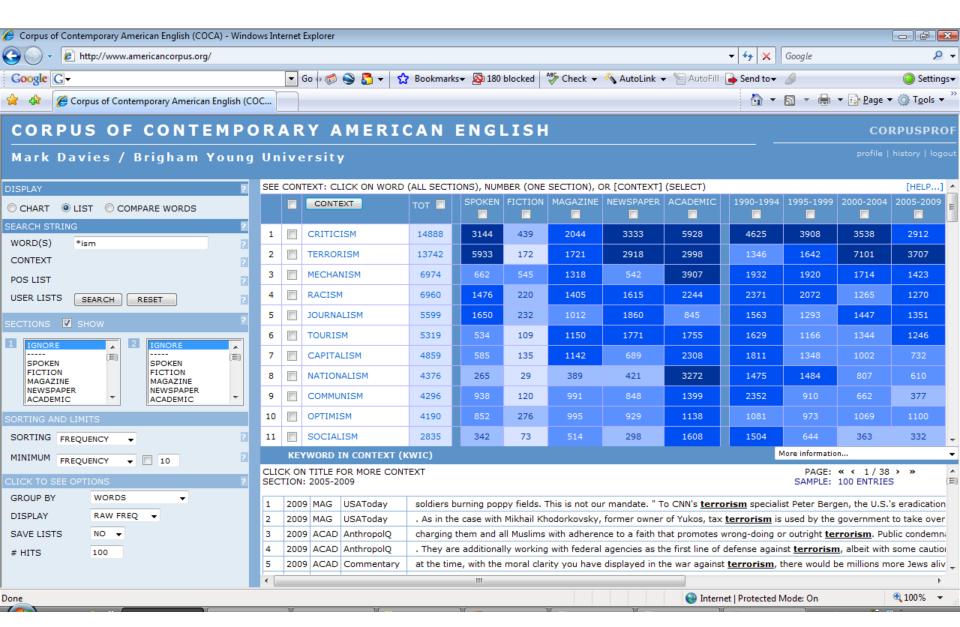
Lexical: comparison: verbs: [vvi]: 2005-09 vs 1990-94



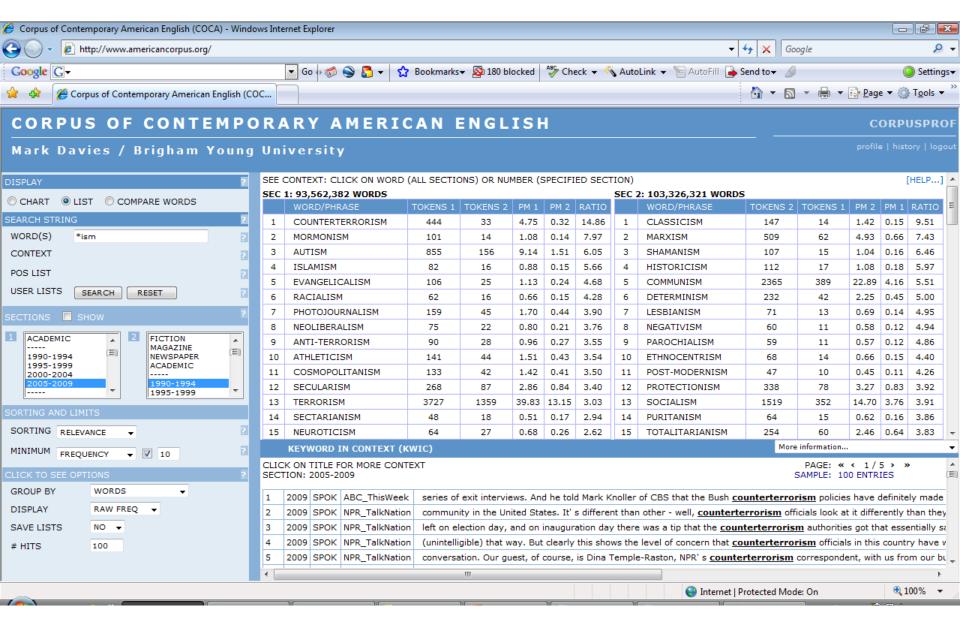
Lexical: comparison: phrasal verbs: [vvi] up : 2005-09 vs 1990-94



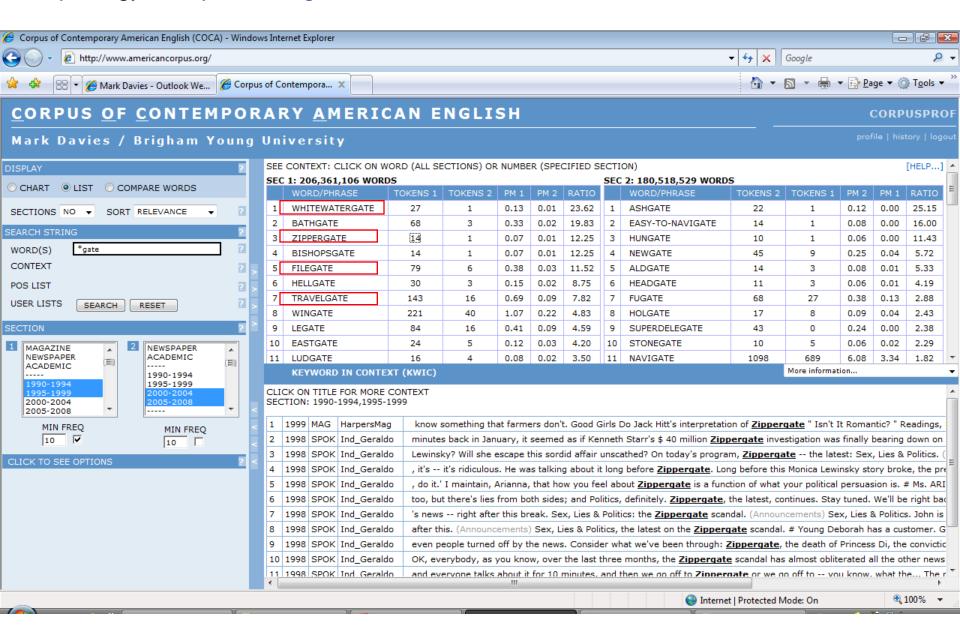
Morphology: *ism: by time period



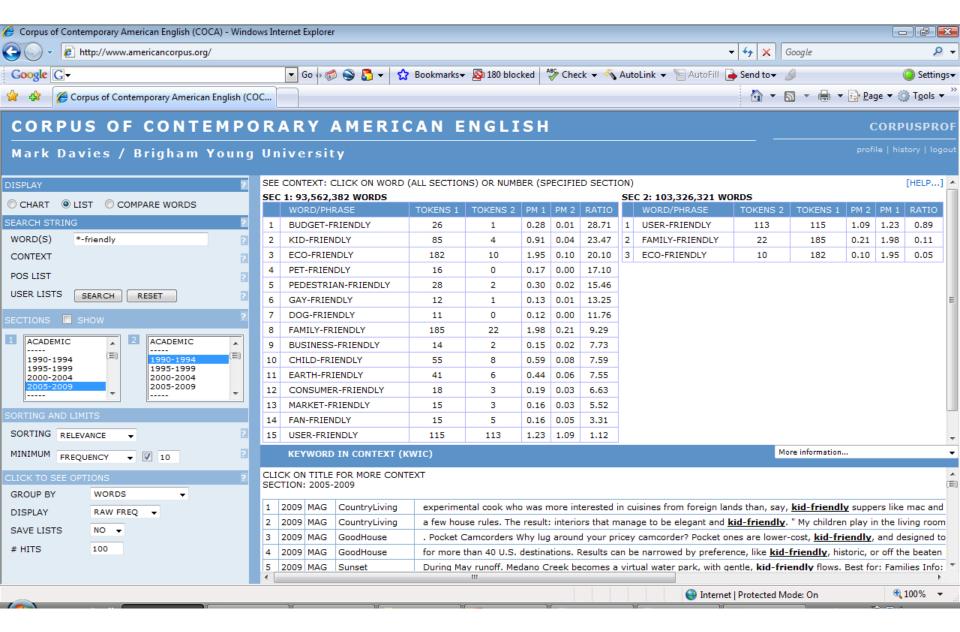
Morphology: comparison: *ism: 1990-94 vs 2005-09



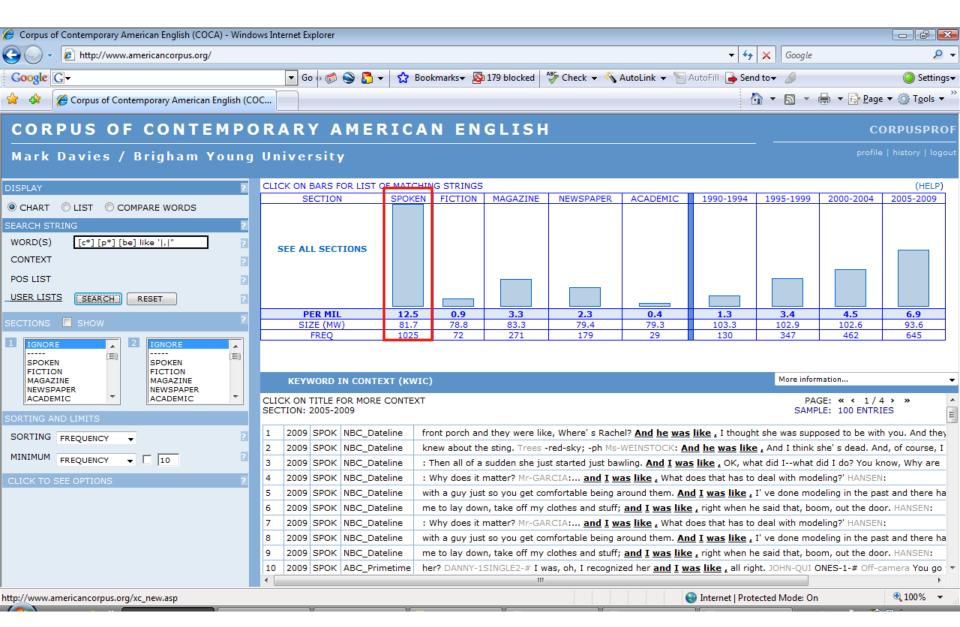
Morphology: comparison: *gate: 1990-94 vs 2005-09



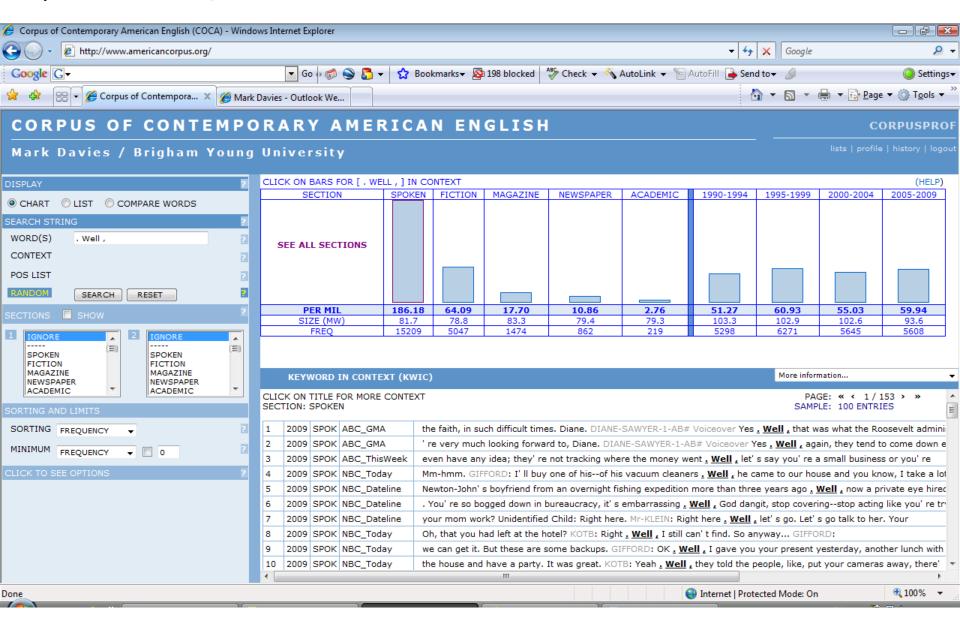
Morphology: comparison: *-friendly: 1990-94 vs 2005-09



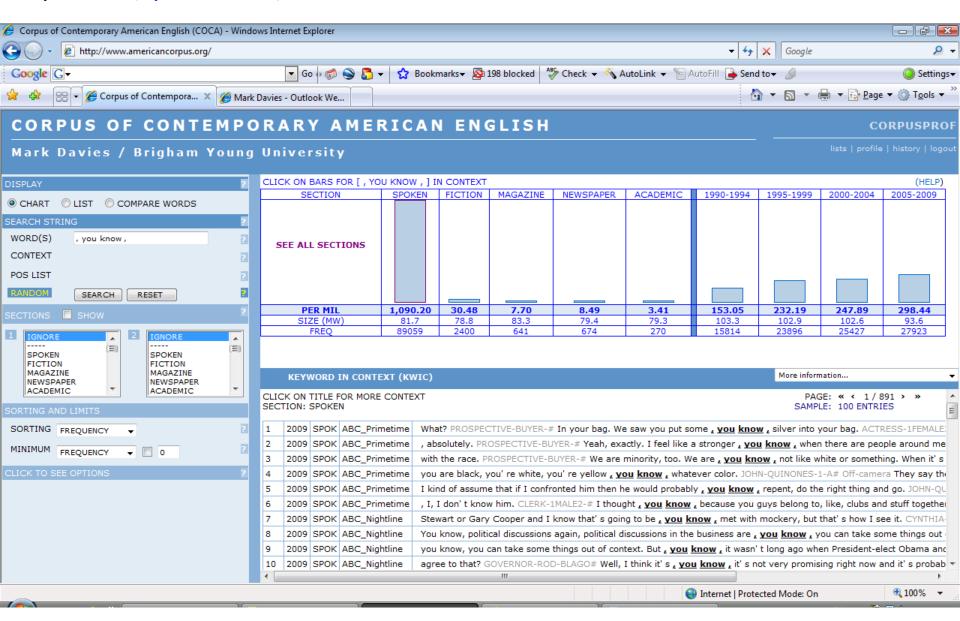
Syntax: charts: be like (he was like, I'm not going with her)



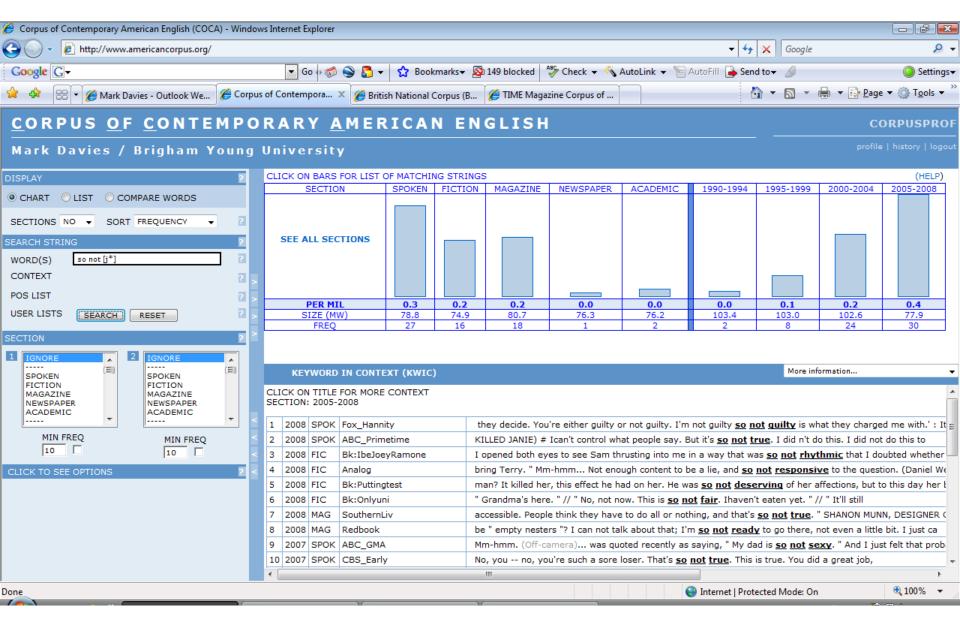
Spoken: . Well,



Spoken: , you know ,

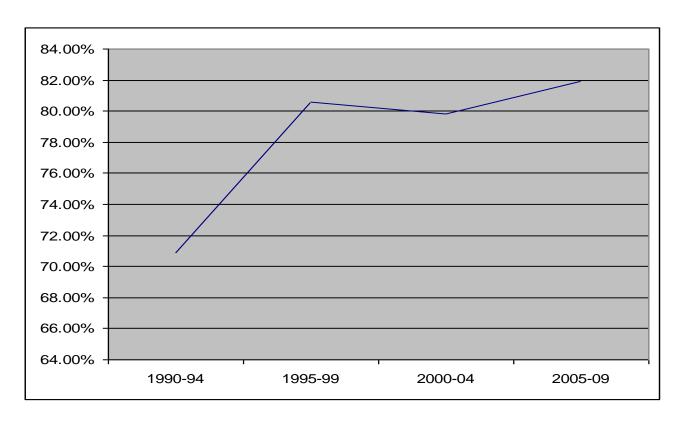


Syntax: charts: so not [ADJ] (I'm so not interested in going out with her)



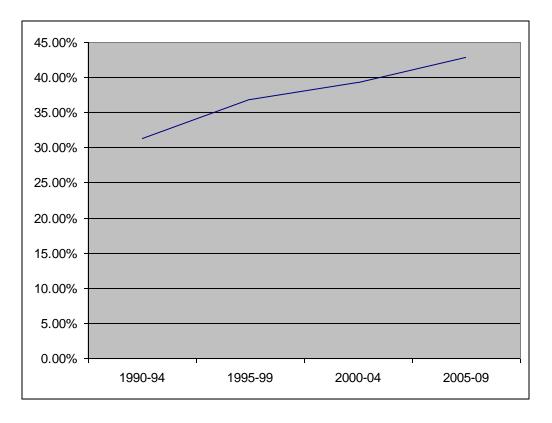
Syntax: prescriptive: can I vs may I

	1990-94	1995-99	2000-04	2005-09	1990-94 to 2005-09
may I	1223	855	768	674	
can I	2976	3541	3027	3055	Increase
% can I	70.9%	80.6%	79.8%	81.9%	16%



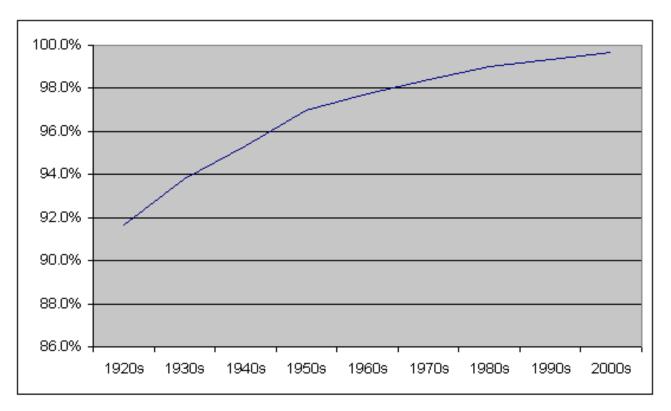
Syntax: prescriptive: split infinitive (to boldly go)

	search string	1990-94	1995-99	2000-04	2005-09	1990-94 to 2005-09
- split	to [v*] *ly.[r*]	17675	15981	16124	13859	
+ split	to *ly.[r*] [v*]	8068	9349	10419	10363	Increase
% split		31.3%	36.9%	39.3%	42.8%	37%



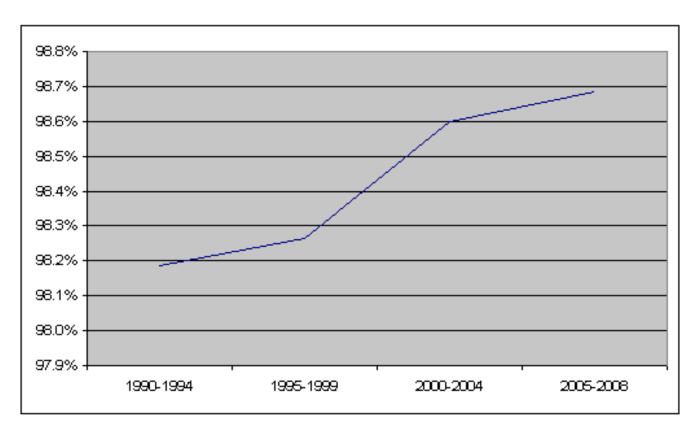
will / shall (I will / shall consider the following...): 184,450 tokens

	SEARCH STRING	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
Α	will [v*]	14190	17714	23754	27615	25789	23453	19075	16439	10719
В	shall [v*]	1295	1177	1162	857	590	375	193	109	34
	% A (i.e. <i>will</i>)	91.6%	93.8%	95.3%	97.0%	97.8%	98.4%	99.0%	99.3%	99.7%



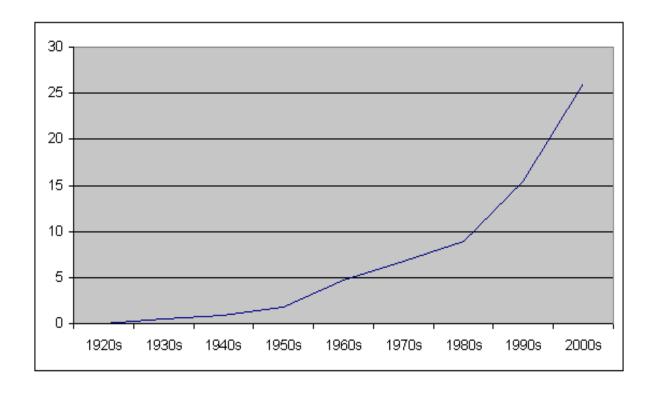
will / shall (I will / shall consider the following...): 592,165 tokens

	SEARCH STRING	1990-1994	1995-1999	2000-2004	2005-2008
А	will [v*]	166,445	154,623	155,676	105,992
В	shall [v*]	3,072	2,732	2,213	1,412
	% A (i.e. <i>will</i>)	98.2%	98.3%	98.6%	98.7%



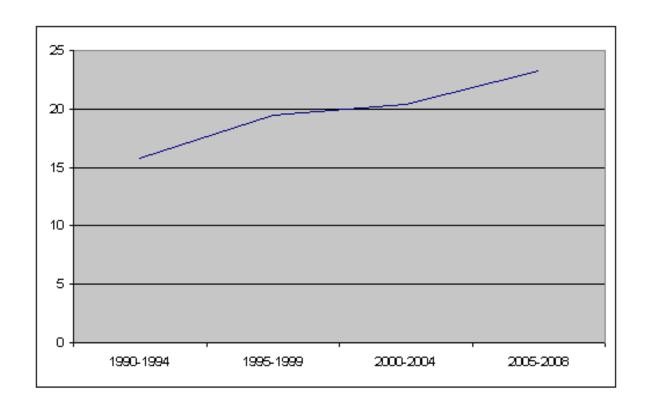
end up V-ing (we ended up paying too much): 637 tokens

SEARCH STRING	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s	
[end] up [vvg*]	0	6	14	30	76	93	101	150	167	(tokens)
	0	0.5	0.9	1.8	4.7	6.8	8.9	15.4	26.0	(per million words)



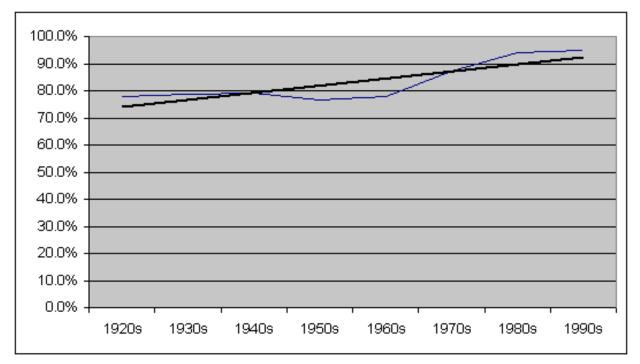
end up V-ing (we ended up paying too much): 7,546 tokens

SEARCH STRING	1990-1994	1990-1994 1995-1999		2005-2008	
[end] up [vvg*]	1632	2011	2011 2090		(tokens)
	15.8	19.5	20.4	23.3	(per million words)



help / help to (they helped her (to) clean the room): 17,887 tokens

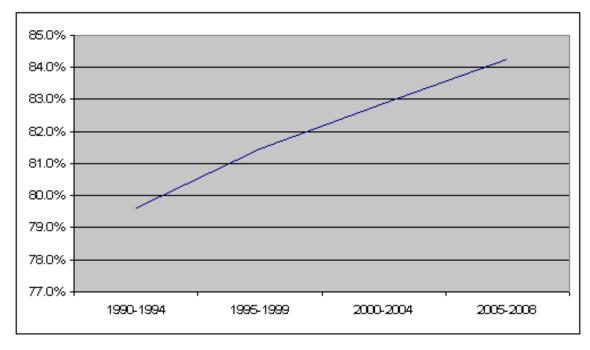
	SEARCH STRING	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
Α	[help].[v*] [v*]	209	825	1333	1707	1769	1665	1858	1662	1336
В	[help].[v*] [p*] [v*]	68	204	289	339	260	279	247	372	346
С	[help].[v*] to [v*]	137	259	391	489	566	492	284	116	86
D	[help].[v*] [p*] to [v*]	15	33	47	54	53	54	24	11	8
	% (A+B) (i.e. bare infinitive)	64.6%	77.9%	78.7%	79.0%	76.6%	78.1%	87.2%	94.1%	94.7%



% without [to]

help / help to (they helped her (to) clean the room): 78,763 tokens

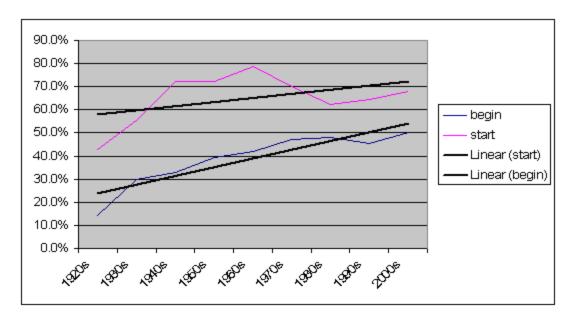
	SEARCH STRING	1990-1994	1995-1999	2000-2004	2005-2008
Α	[help].[v*] [v*]	9640	10073	11448	9023
В	[help].[v*] [p*] [v*]	5355	6312	6956	5816
С	[help].[v*] to [v*]	2998	2919	3074	2248
D	[help].[v*] [p*] to [v*]	841	808	727	525
	% (A+B) (i.e. bare infinitive)	79.6%	81.5%	82.9%	84.3%



% without [to]

start/begin + [to V / V-ing] (he began/started to sing / singing): 47,028 tokens

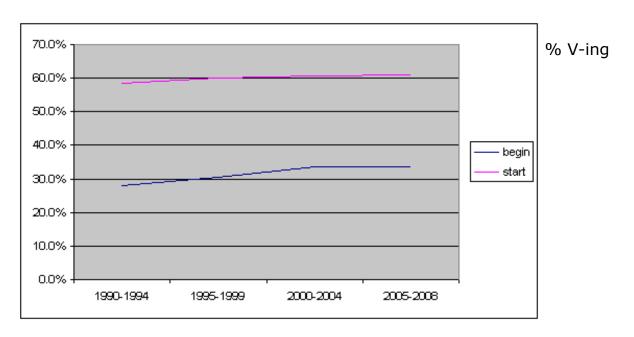
	SEARCH STRING	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
Α	[begin] [vvg*]	199	1194	1753	2412	2326	2344	1953	1326	799
В	[start] [vvg*]	99	495	957	1311	1179	879	732	922	1027
С	[begin] to [v*]	1193	2789	3575	3709	3233	2618	2101	1584	792
D	[start] to [v*]	131	400	364	503	322	373	445	505	484
	%A (vs C) (i.e. V-ing w/ <i>begin</i>)	14.3%	30.0%	32.9%	39.4%	41.8%	47.2%	48.2%	45.6%	50.2%
	%B (vs D) (i.e. V-ing w/ <i>start</i>)	43.0%	55.3%	72.4%	72.3%	78.5%	70.2%	62.2%	64.6%	68.0%



% V-ing

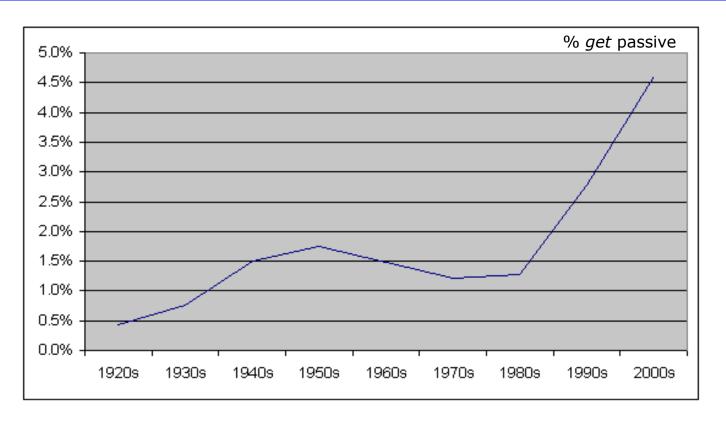
start/begin + [to V / V-ing] (he began/started to sing/singing): 190,737 tokens

	SEARCH STRING	1990-1994	1995-1999	2000-2004	2005-2008
Α	[begin] [vvg*]	8873	8879	9385	6443
В	[start] [vvg*]	11393	13291	14007	11199
С	[begin] to [v*]	22820	20184	18534	12675
D	[start] to [v*]	8069	8816	9023	7146
	%A (vs C) (i.e. V-ing w/ begin)	28.0%	30.6%	33.6%	33.7%
	%B (vs D) (i.e. V-ing w/ start)	58.5%	60.1%	60.8%	61.0%



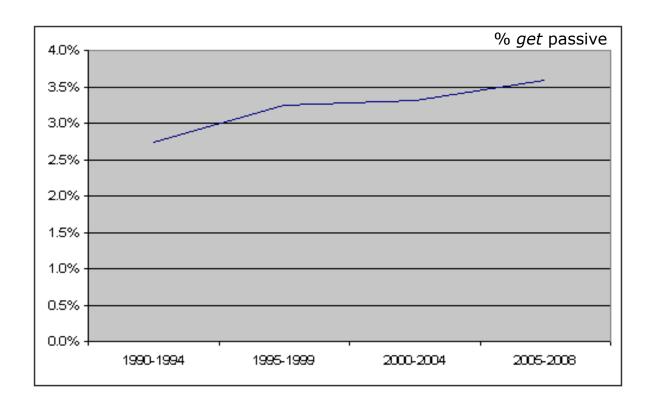
be/get V-ed (it was / got ran over): 536,066 tokens

	SEARCH STRING	1920s	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
Α	[get] [vvn]	224	533	1,113	1,279	1,099	836	728	1,129	1,115
В	[be] [vvn]	52,413	70,289	73,233	72,035	72,670	68,209	56,666	39,376	23,119
	% A (i.e. <i>get</i>)	0.4%	0.8%	1.5%	1.7%	1.5%	1.2%	1.3%	2.8%	4.6%

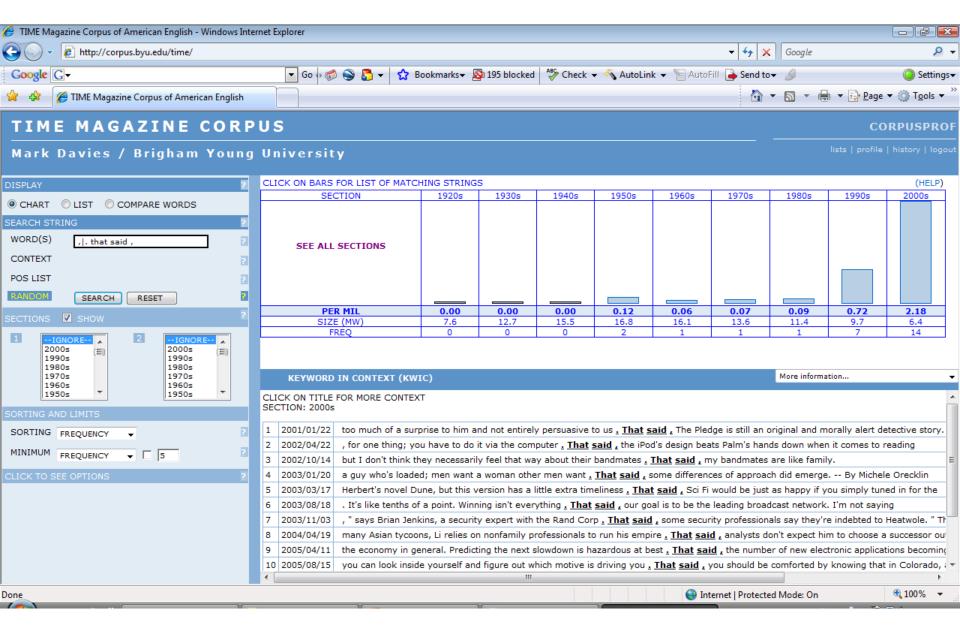


be/get V-ed (it was / got ran over): 1,817,092 tokens

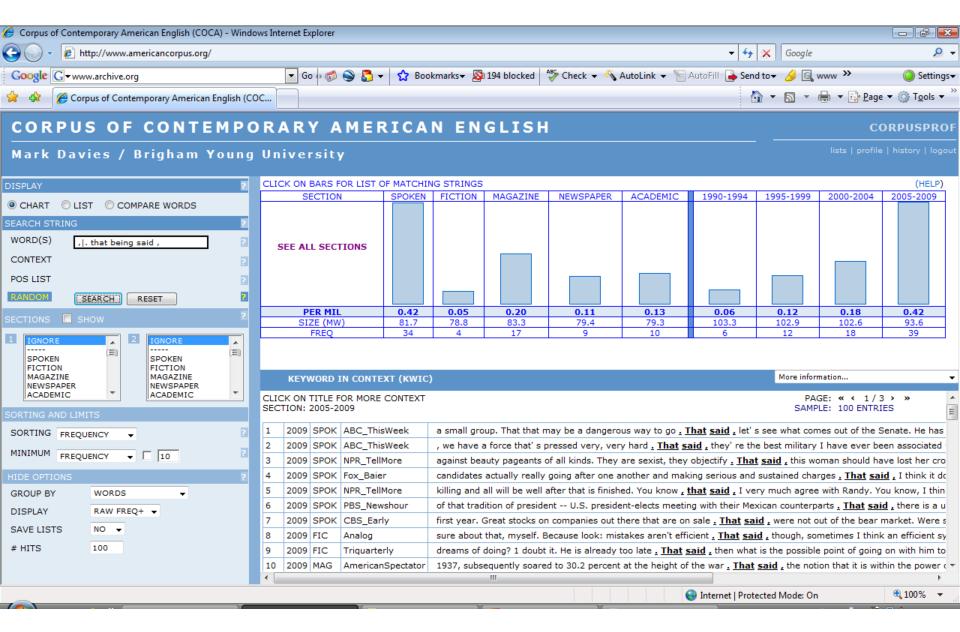
	SEARCH STRING	1990-1994	1995-1999	2000-2004	2005-2008
А	[get] [vvn]	13,971	15,669	15,645	12,607
С	[be] [vvn]	495,959	466,706	457,426	339,109
	% A (i.e. <i>get</i>)	2.7%	3.2%	3.3%	3.6%



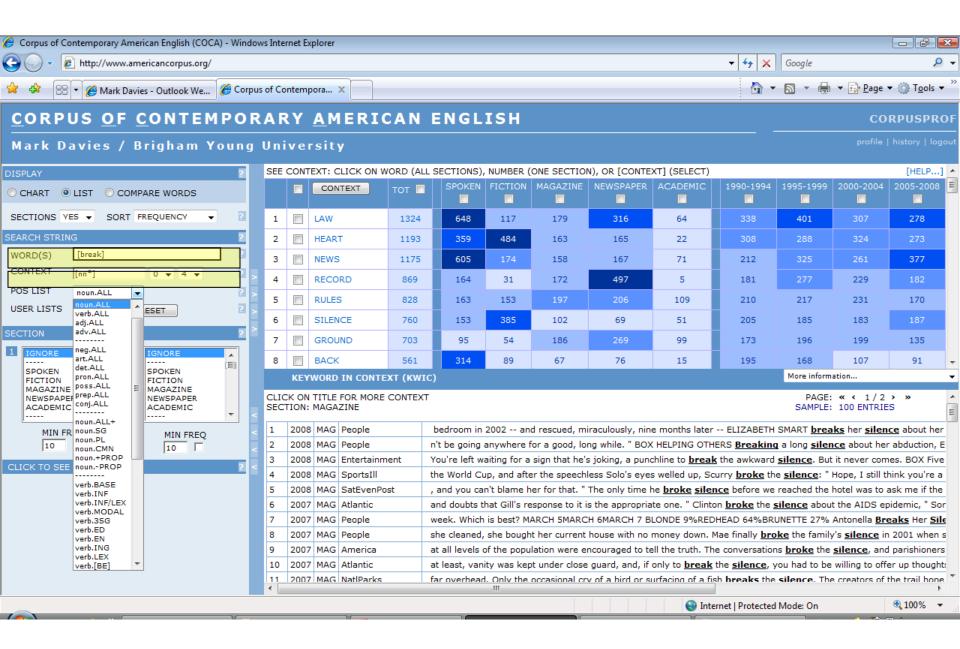
Syntax / pragmatics: TIME: [punc] that being said,



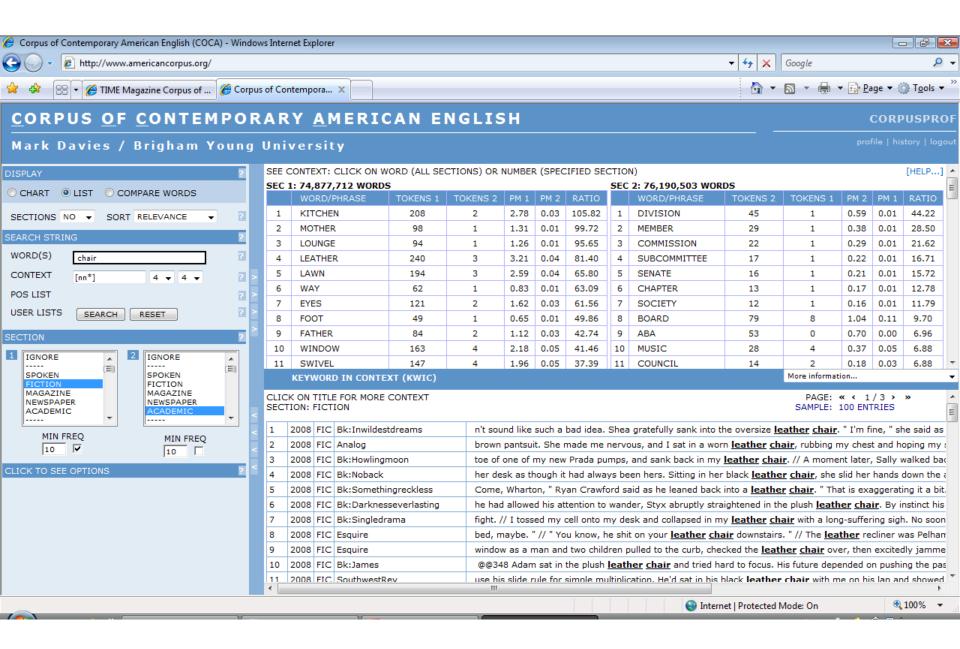
Syntax / pragmatics: [punc] that being said,



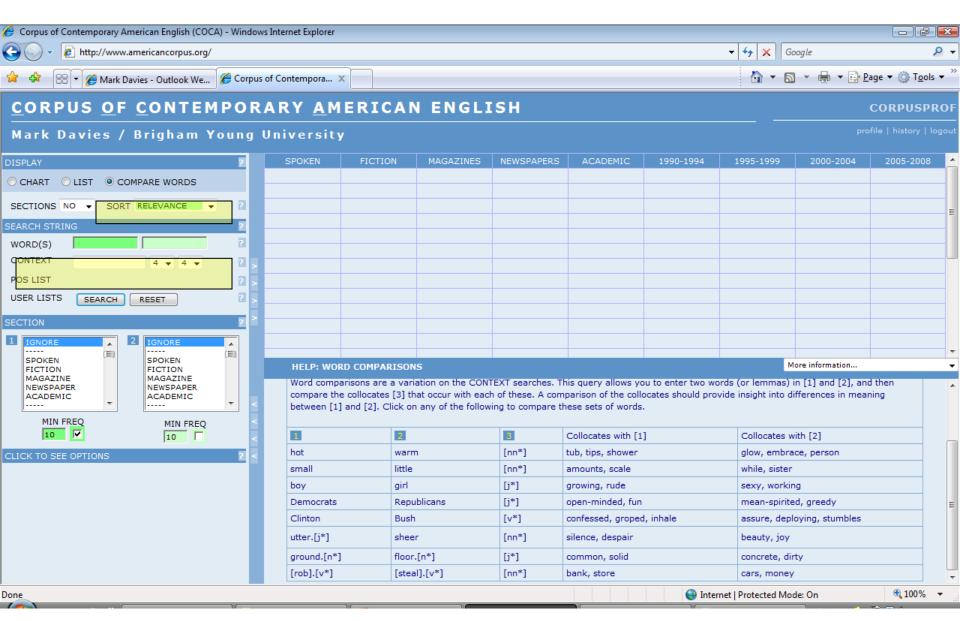
Semantics: collocates (up to 10 words L/R): [nn*] collocates of [break]



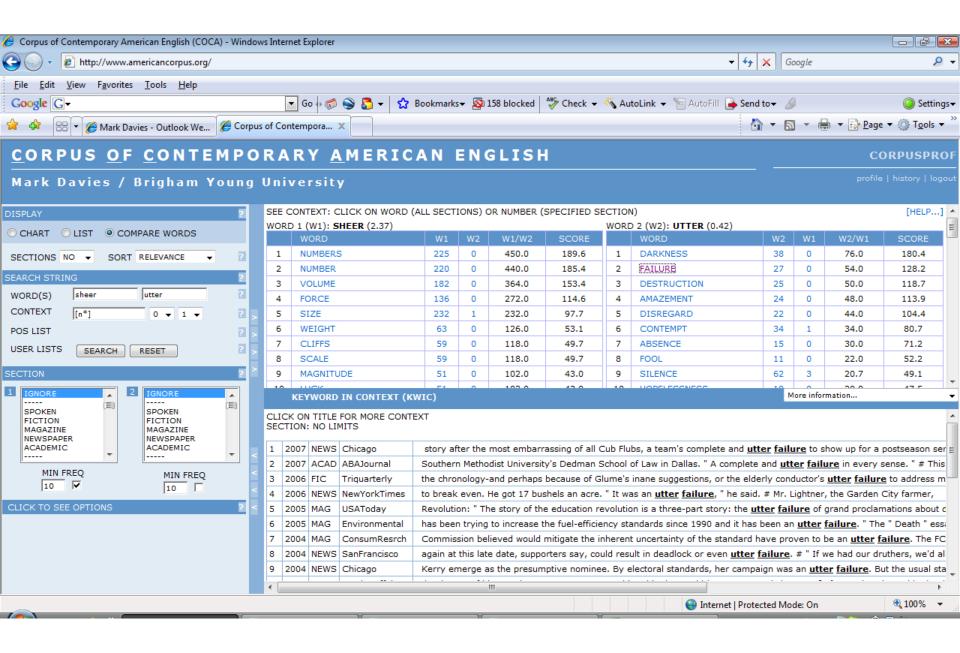
Sections: frequency by genre: collocates of chair (ACAD / FIC)



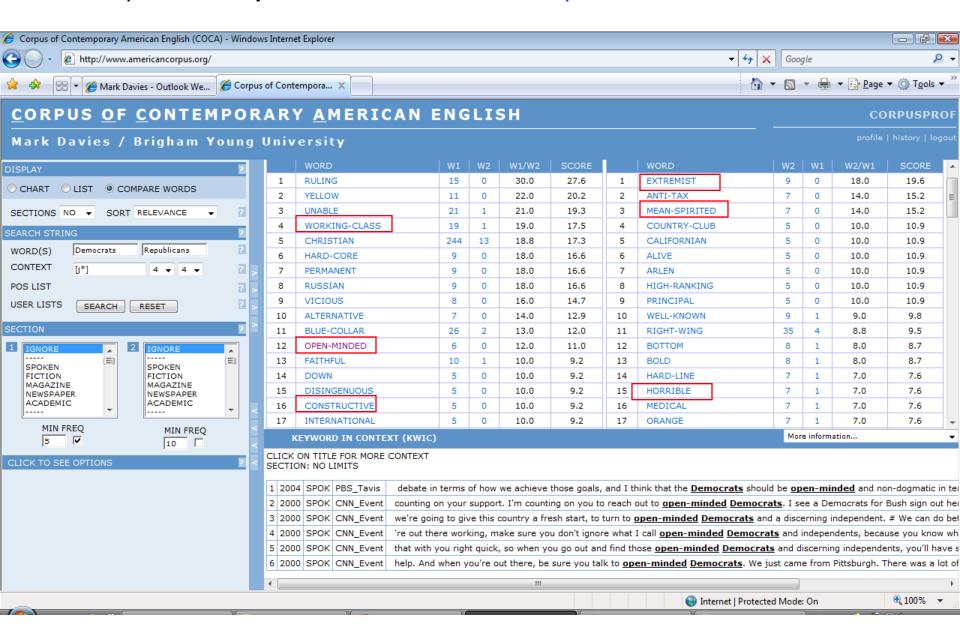
Word comparisons



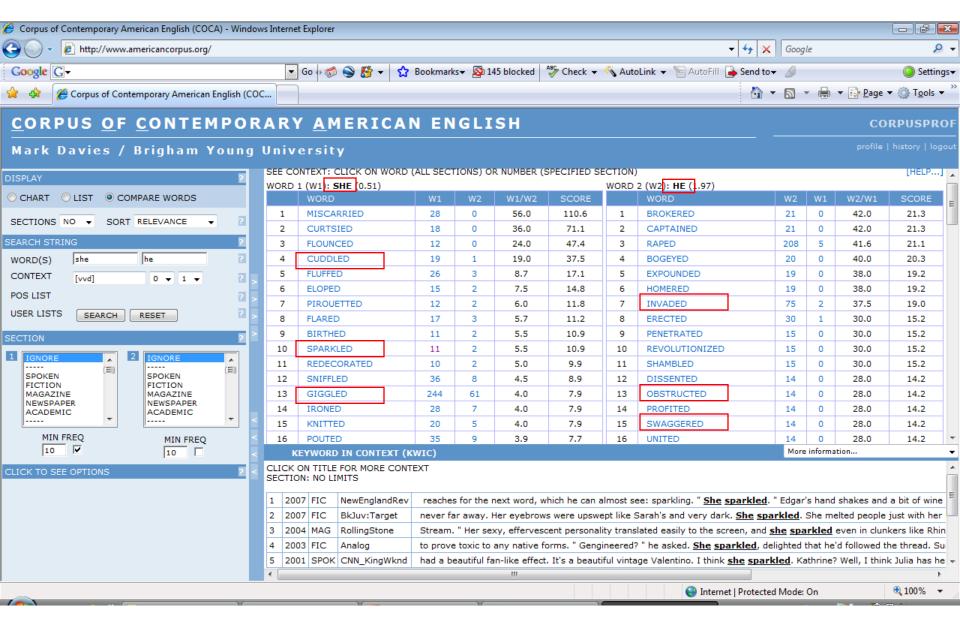
Word comparisons: *sheer / utter* + noun



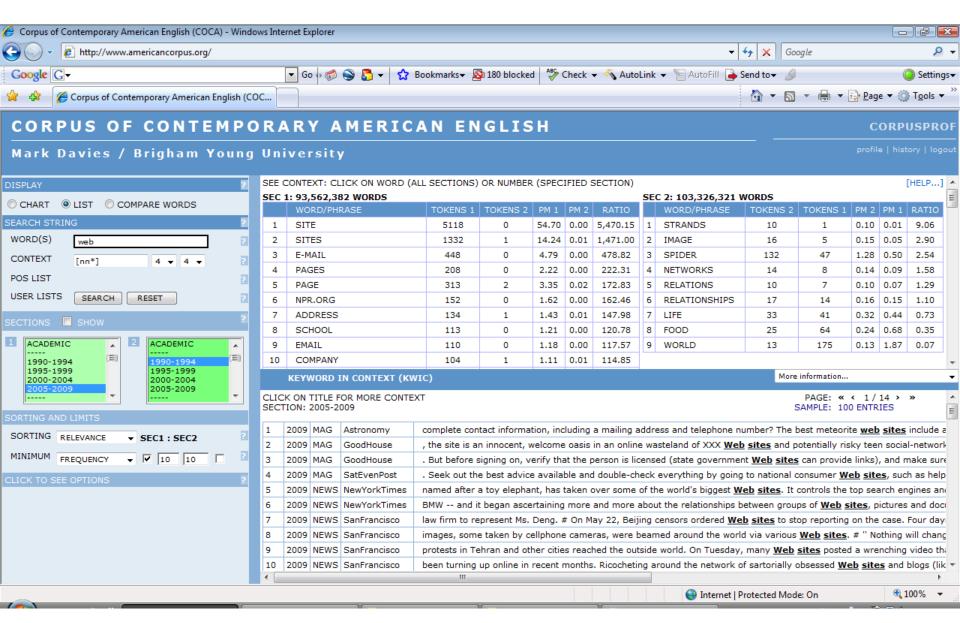
Word comparisons: adjectives near Democrats / Republicans



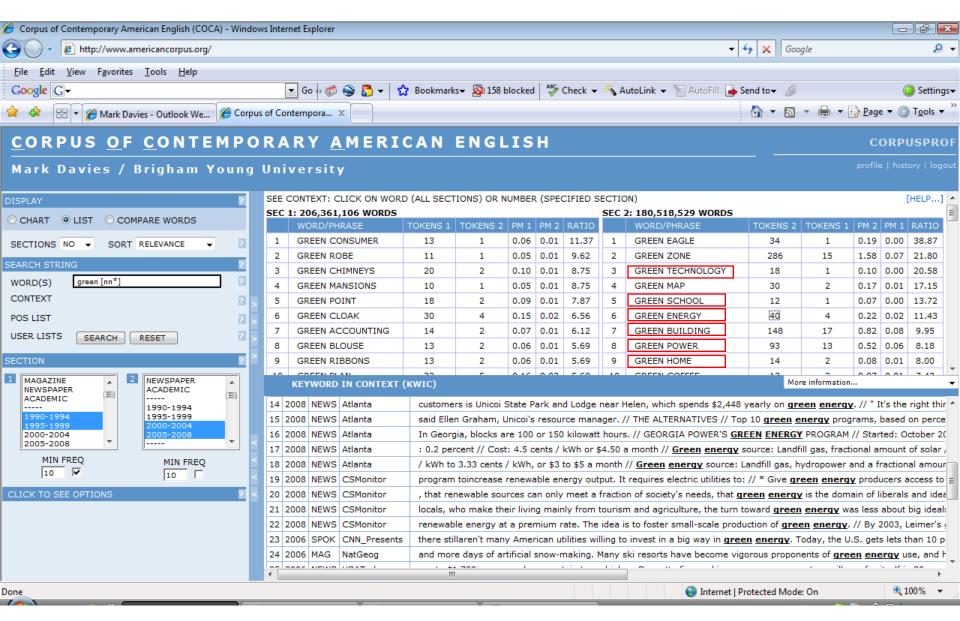
Word comparisons: verbs after *she / he*



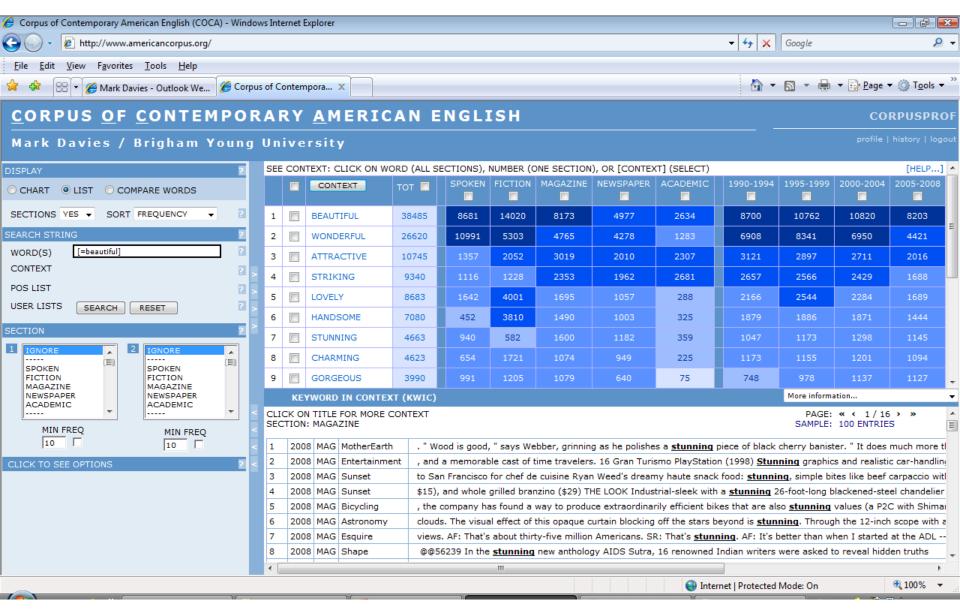
Semantics: collocates of web in 1990s vs 2000s



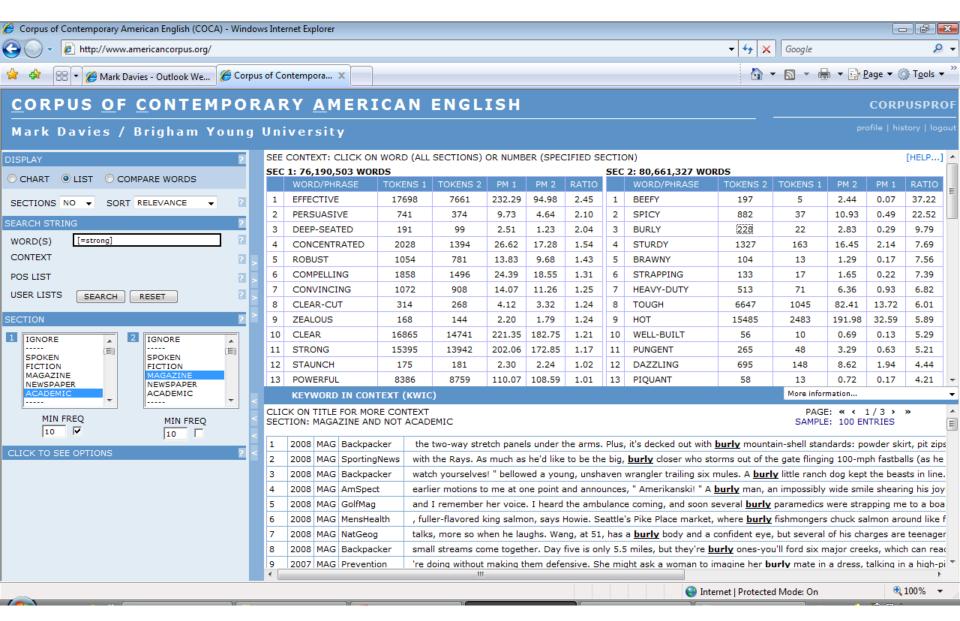
Semantics: collocates of green in 1990s vs 2000s



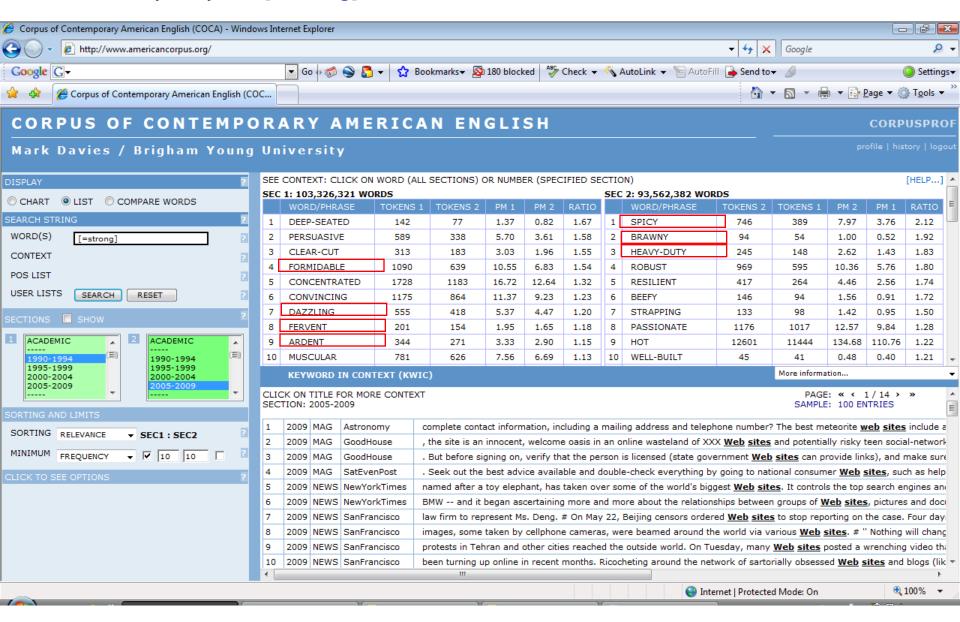
Semantics: synonyms: by genre and time periods: 60,000+ entries: [=beautiful]



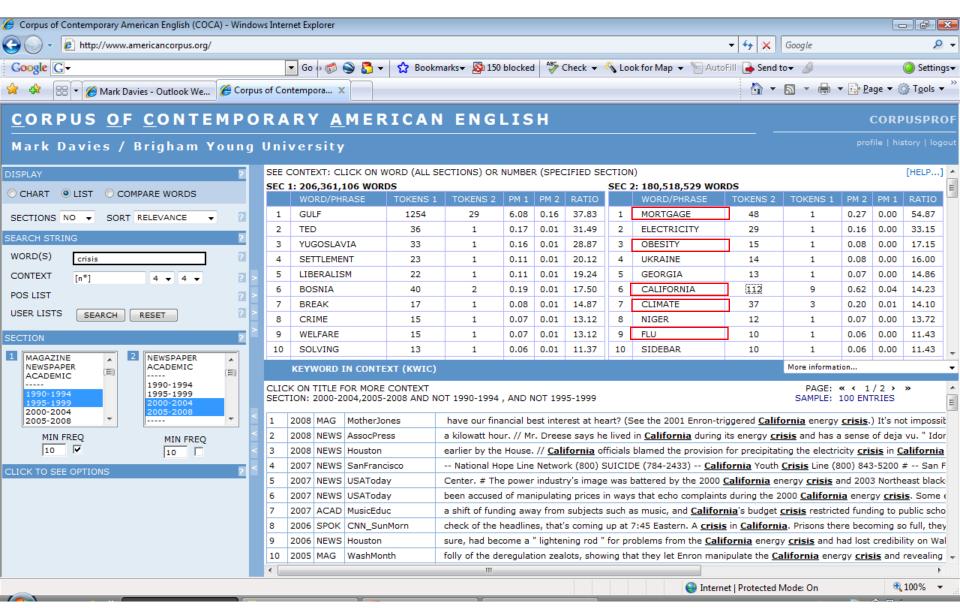
Semantics: synonyms: [=strong] in ACADEMIC vs MAGAZINES



Semantics: synonyms: [=strong] in 1990-94 vs 2005-09



Culture: collocates of crisis in 1990s vs 2000s



Davies, Gardner. (2010) A Frequency Dictionary of American English: Collocates, Word Sketches, and Thematic Lists. Routledge.



494 break *v*

<u>noun</u> •law, heart, news, •rule, silence, story, •ground, •barrier, leg, bone, •piece, •neck, larm, •cycle, voice• <u>misc</u> •into, •away, •free, •apart, •loose

up marriage, •fight, boyfriend, meeting•, girlfriend, union, band, pass, •demonstration,
•monotony down •into, •barrier, car•, •cry, •door, •tear, talk•, enzyme•, completely,
negotiation• out war•, fight•, fire•, sweat, fighting•, riot•, violence•, •laugh, •hive off piece,
talk, •engagement, negotiation, branch, abruptly, •relation

1999 tie *n*

<u>adj</u> close, strong, black, economic, political, social, diplomatic, red, closer, blue <u>noun</u> shirt•, suit•, family, bow•, jacket, silk•, coat• <u>verb</u> wear•, maintain•, break•, sever•, cut•, loosen, strengthen•, straighten•, knot, match 16447 | 0.95

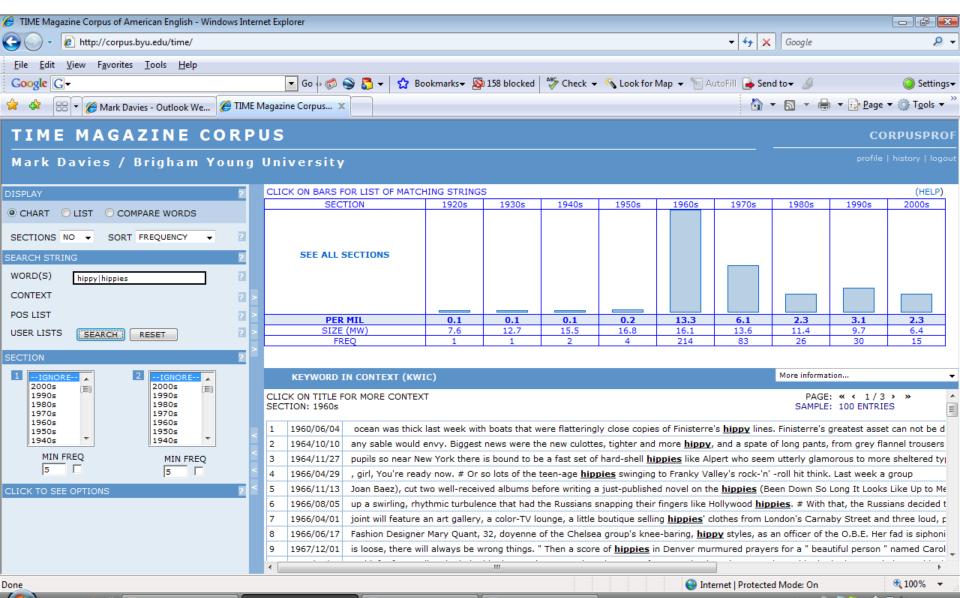
2001 promise *n*

<u>adj</u> great, broken, full, empty, future, unfulfilled, greatest, solemn, considerable <u>noun</u> campaign•, •keeper, president, government, land, lot•, hope, exchange•, kind, politician <u>verb</u> make, keep, hold•, show•, break•, deliver•, offer•, fulfill, live•, •help 16078 | 0.97

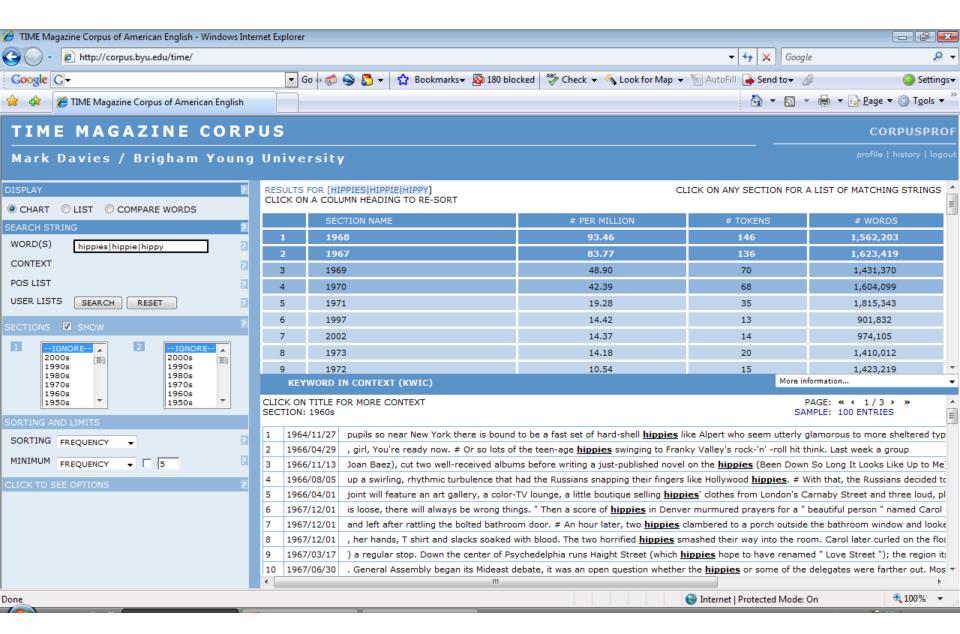
2002 dish *n*

<u>adj</u> main, shallow, favorite, dirty, vegetarian, Chinese, covered, deep, individual, light <u>noun</u> baking•, side•, satellite•, serving•, table, pasta•, petri•, •towel, casserole•, food <u>verb</u> wash•, serve, bake, cook, prepare, place, cover, eat, set, clear 17295 | 0.90 N

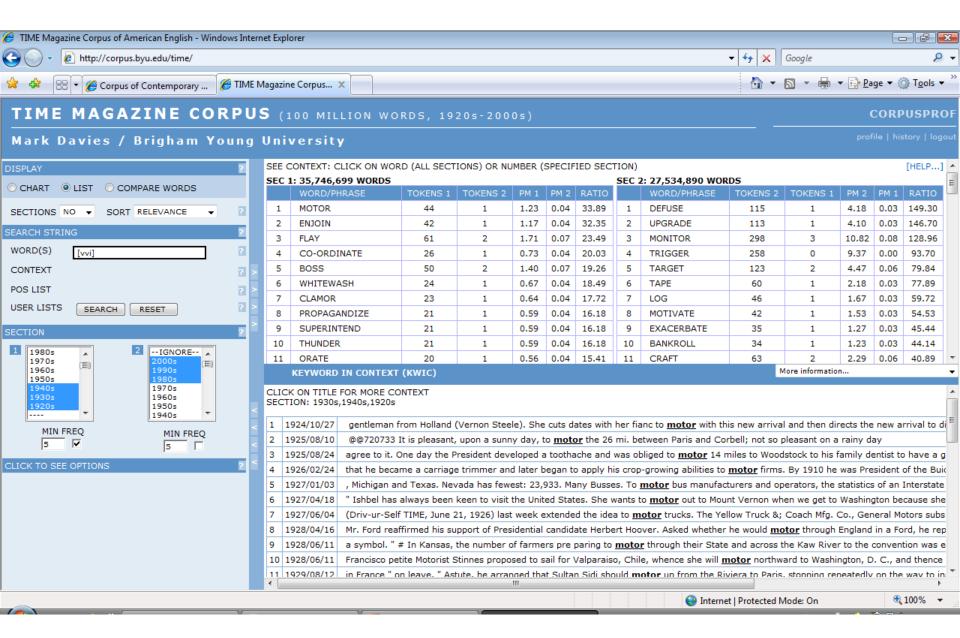
TIME: lexical: hippy | hippies



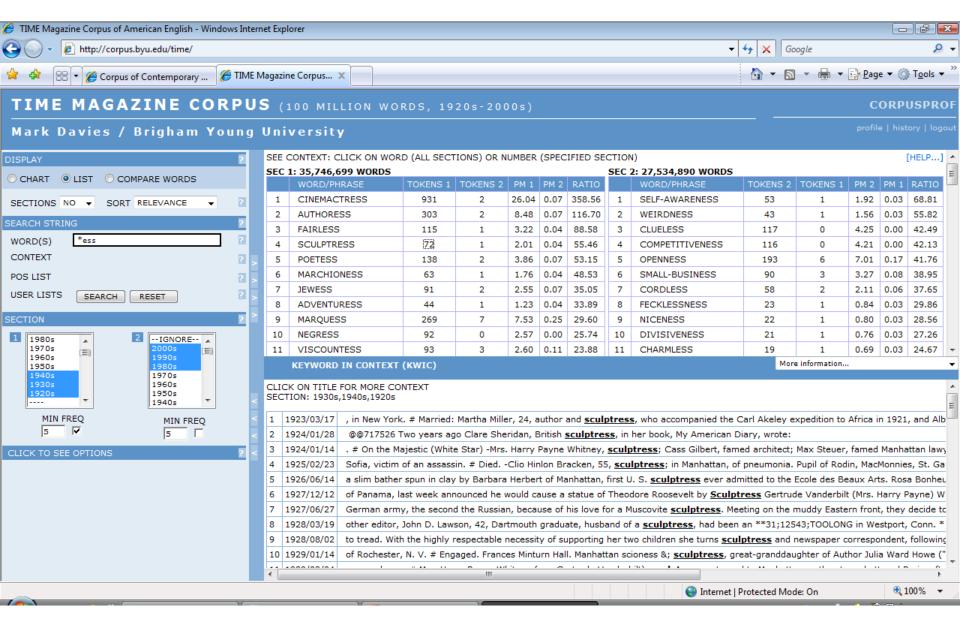
TIME: lexical: hippy | hippies (by individual year)



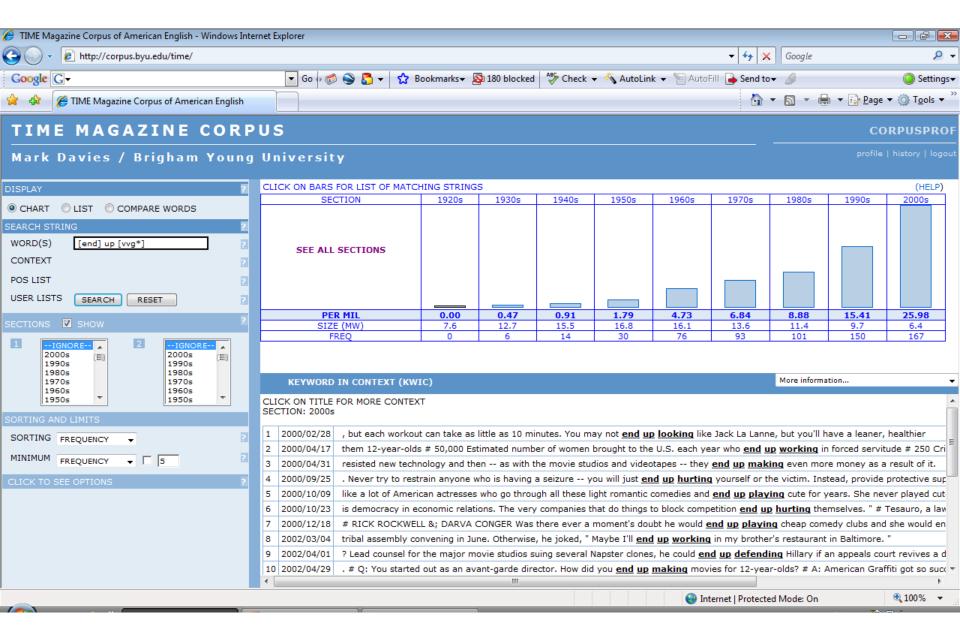
TIME: lexical: verbs 1920s-1940s vs 1980s-2000s



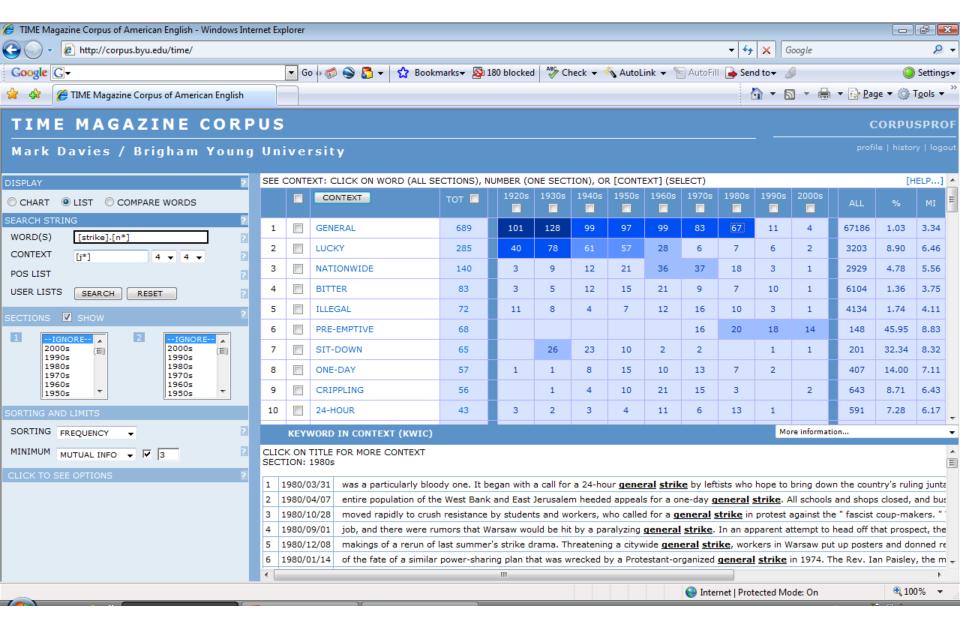
TIME: morphology: feminine nouns in *ess, 1920s-40s vs 1980s-2000s



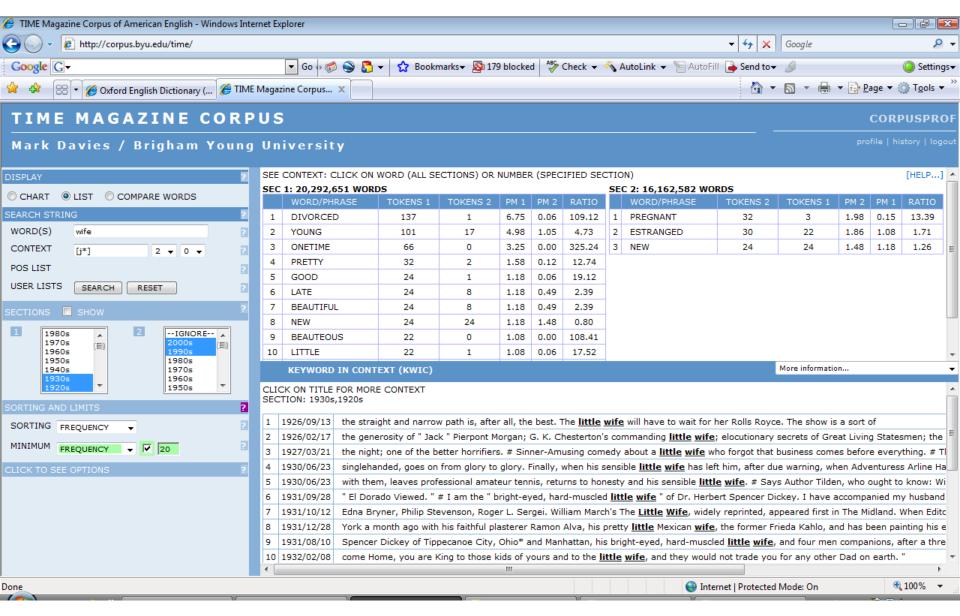
TIME: syntax: see above: (here: [end] up [vvg])



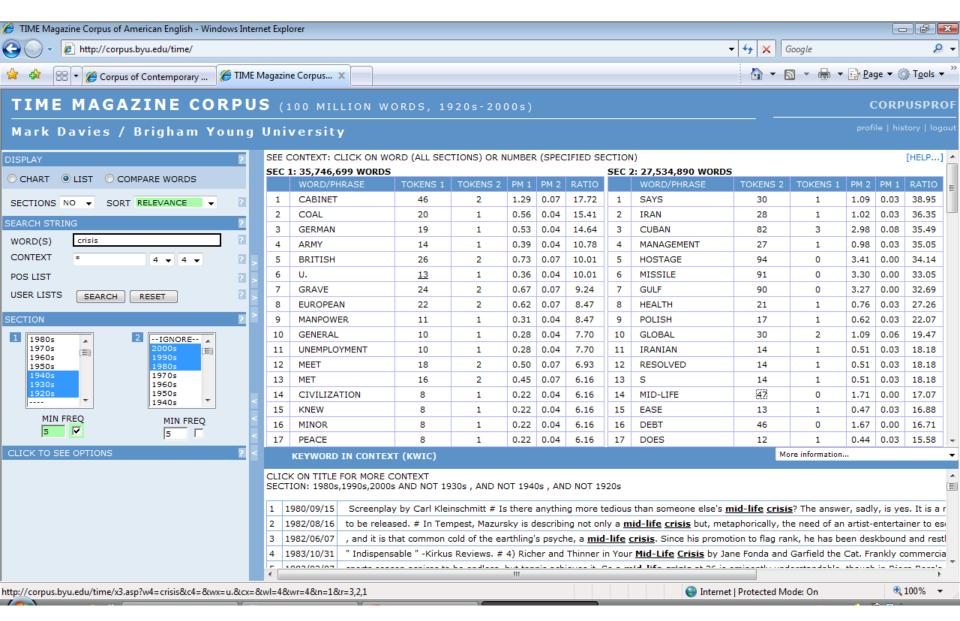
TIME: semantics: collocates: adjectives near strike (noun)



TIME: cultural: collocates of wife, 1920s-1930s, 1990s-2000s



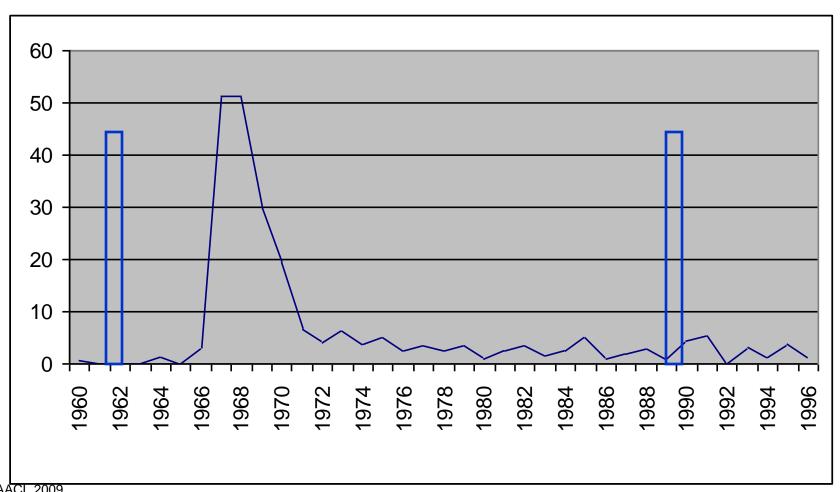
TIME: cultural: collocates of crisis in 1920s-1940s vs 1980s-2000s



Every 30 years: misses fine-grained analysis



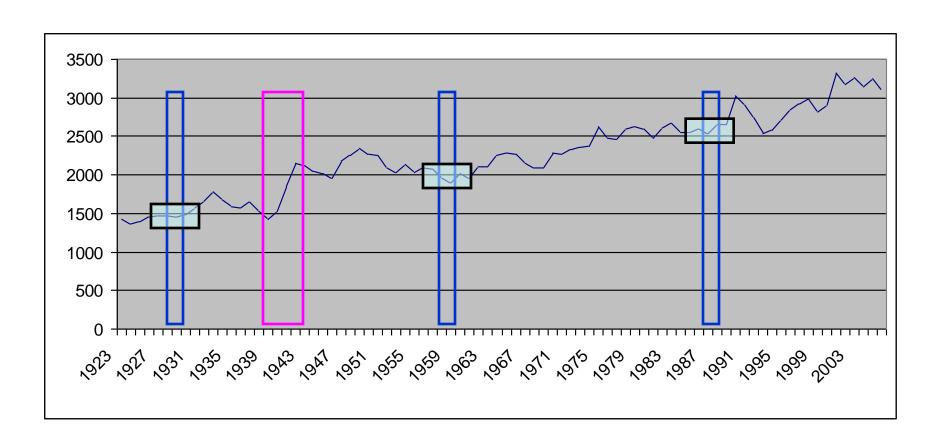
TIME Magazine (100m words): hippy|hippies (376 tokens)



Every 30 years: misses fine-grained analysis



TIME Magazine (100m words): [be] [vvg*] (242,000+ tokens)

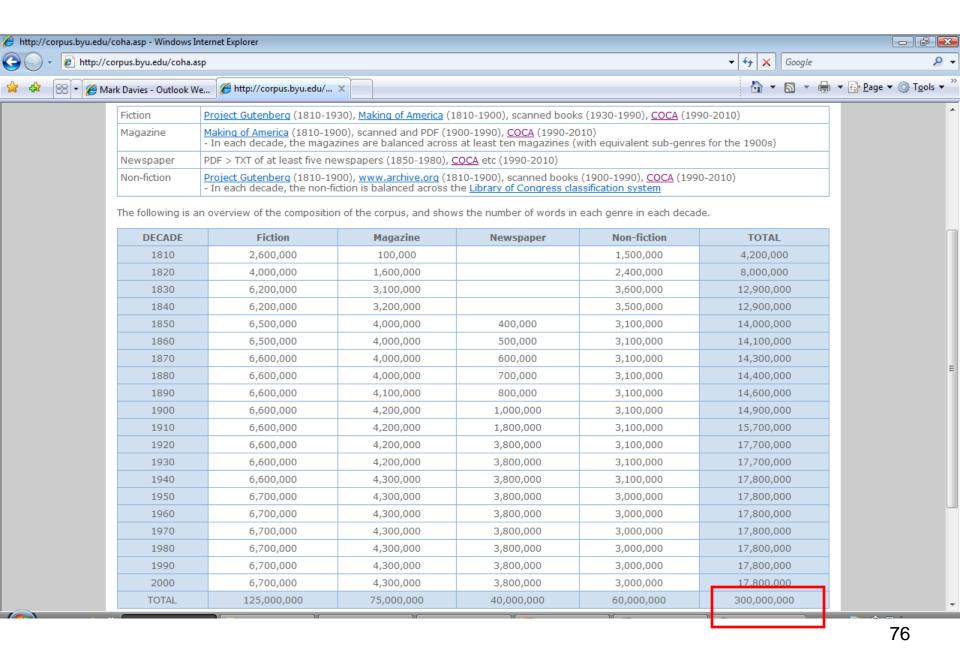


Corpus of <u>Historical</u> American English



- 2009-2010. Funded by the US National Endowment for the Humanities (March 2009)
- 300 million words, c1810-present
- Balanced between fiction, popular magazine, newspaper, other non-fiction
- Same composition in each decade
- Largest structured historical corpus of any language

COHA: Corpus of **Historical** American English (300,000,000 words, Aug 2010)



Corpus of <u>Historical</u> American English



- Map out linguistic shifts with much more precision than with any other corpus: lexical, word formation, syntax, meaning, stylistics
- Follow cultural shifts, as evidenced by language: gender issues, family life, customs, religion, technology, etc.
- Reference corpus against which to compare any particular text, author, or literary movement

Corpus of Contemporary American English



- 400 million words, 1990-present
- Balanced by genre, year by year
- Probably the only reliable monitor corpus of contemporary English
- Look at ongoing changes: lexical, morphological, syntactic, and semantic – in a way that is not possible with other corpora
- Will be extended back to 1800s with the Corpus of Historical American English (2010)

Thanks!

Architecture: intro



- Frequency: overall (genre and time period) and for each matching string
- Morphology: good substring searches
- Syntax: tagged and lemmatized
- Semantics: collocates
- Comparisons: across genres and time periods, as well as between words (small / little)

Architecture: goals



Three goals

- Size: Nearly 400 million words
- Speed: 2-3 seconds for most queries
- Annotation: POS, lemma, genre, time period, etc
- Complex searches:
 - [[=help]].[v*] [p*] * [[=clean]].[v*] * [nn*]
 help him to clean the car
 assist them in scrubbing the sink
- Easy to get two of the three (e.g. Google);
 very difficult to get all three

Architecture: how (not) to do it



- Relational databases (massively redundant data / indexes, joins between tables)
- Cf. to architectures for other large corpora: IMS Corpus Workbench, SketchEngine, VISL
- Difficult / impossible with older "standards"-based corpora (XML, TEI, etc)
 - [[=help]].[v*] [p*] * [[=clean]].[v*] * [nn*]
 - PoS, lemmas, synonyms, wildcards, customized wordlists...

 (Please don't impose standards from small 1-5 million word corpora on more robust corpora)