

Class 1 (Jan. 3): Intro and overview

1 Course description

(1) Topic

- Some morphologically complex words get pronounced as though simple
 - English *cupboard* ['kʌbɔ:d]: at one time must have been a compound, but now looks monomorphemic (only one stress, /p/ deleted).
- Phonological analyses of morphologically complex words sometimes appeal to lexical storage or access.
 - idea that some complex words are stored as unanalyzed wholes (--> greater phonological unity) and others as analyzed or as separate morphemes
 - explaining prefix/suffix phonological asymmetries through sequential processing
- So what does the psycholinguistic literature say?
 - What factors make a word more likely to be accessed/stored as a whole?
 - morpheme type, frequency, semantic transparency, phonological changes, phonotactic properties...
 - Are there relevant differences between production and perception?

(2) Goals

- Goal 1: Get a sense of what's an a priori plausible claim about lexical storage/access in a particular case.
- Goal 2: Get familiar with the methods in use for probing the status of morphologically complex words.
 - Could we feasibly test a claim about words' status in a particular case?
- Goal 3: Get familiar with models of lexical access to see how they might connect with phonological grammar.

We'll talk at the end of today about what we'll produce in the course.

2 Example of an appeal to lexical access: Hay 2003

(3) Starts with some (I think) uncontroversial assumptions about lexical access:

- Each lexical entry has a resting activation, largely determined by frequency (how many times you've encountered the word in your life)
 - Under the conception of resting activation as activation-before-lexical-access-starts, it's also affected by how recently you've encountered the word.
- During lexical access, various factors (depending on the model) increase or decrease item's activation
 - In production: e.g., activation of conceptual feature "furry" spreads to *cat*
 - In perception: e.g., activation of [k] spreads to *cat*
- The first item to cross some threshold "wins" and gets accessed.

(4) Adds a more controversial assumption:

- *daftly*, *daft* (and possibly *-ly*) can both exist as lexical entries
- If the goal is to produce *daftly*, *daft* and *daftly* compete for access.
 - *daftly* could win: whole-word access
 - *daft* could win, and then be composed with *-ly*: compositional access
- All else being equal, the outcome depends on which is more frequent, *daft* or *daftly*

(5) Proposal

Phonological/phonetic reduction, in this case /t/ deletion, is more likely within a lexical item than across a boundary between two separately accessed items.

- Q: How could we spell this out, be it in the processing model or in the grammar?
- Hay suggests this could actually be a listener-oriented effect
 - if perception includes a “Fast Phonological Preprocessor” (Pierrehumbert 2001a) that posits a boundary in phonotactically illegal sequences like *ftl...*
 - ...then retaining the /t/ encourages the listener to attempt decomposed access, and in this case (because the /t/ belongs to the base) makes accessing the base easier too
 - this is good if decomposition is going to be the faster route

(6) Experiment

daftly-type words: word < base, word infrequent

softly-type words: word < base

swiftly-type words: word > base

briefly-type words: control; no /t/

(5 quadruples like this)

but *softly* and *swiftly* have similar frequency

Hypothesis: more /t/-deletion in *swiftly* than in *daftly* and *softly*

Alternate hypothesis: high freq. -> reduction, so more /t/-deletion in *softly* and *swiftly* than *daftly*

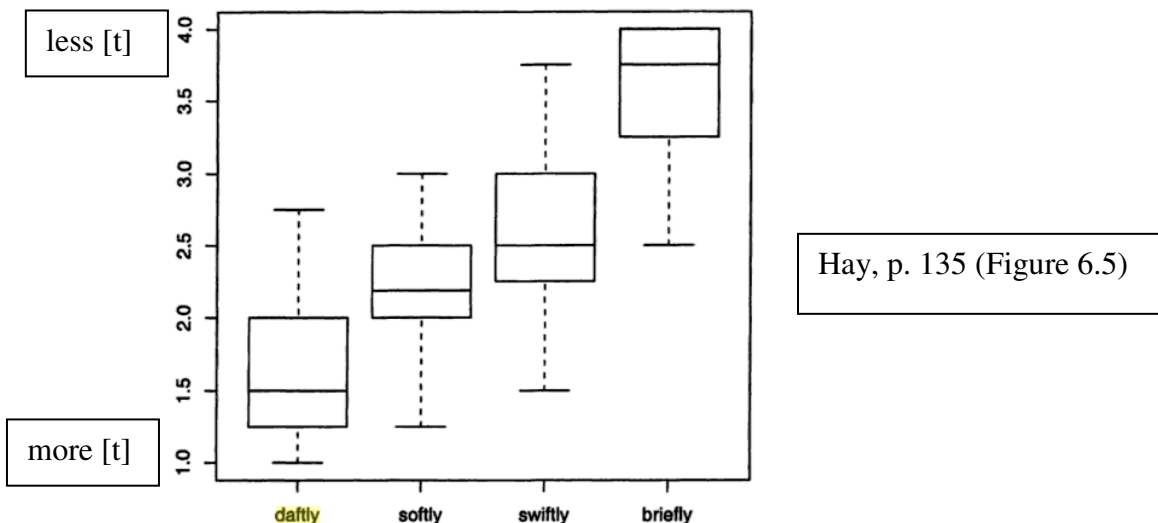
Subjects (6 NWU undergrads) read sentences like *Chris dropped by very briefly*

- 4 repetitions for each of the 4 words in each of the 5 quadruples

For each repetition or each quadruple in each subject, ranked the 4 tokens for [t]-ness (/t/ duration if any, but geminated /f/ ranked above singleton. Then averaged the rankings.

(7) Results

- Relative frequency matters: *softly* vs. *swiftly*
- Absolute frequency matters too: *daftly* vs. *softly*
 - Hay speculates that *soft*, being more frequent than *daft*, might itself have more [t]



Just for fun, tried a regression model. 3 factors (word freq, base freq, which is more frequent), so tried 2^3 possibilities. Best model:

```
Linear mixed model fit by REML
Formula: rank ~ (1 | subject) + log(word_freq + 0.1) which_more_freq

              Estimate Std. Error t value
(Intercept)      1.77670    0.07971  22.289
log(word_freq + 0.1) 0.06511    0.01813   3.592
which_more_freqword 0.37547    0.12437   3.019
```

(once you have a binary which-is-more-frequent factor, adding or substituting base frequency doesn't improve the model)

(8) Summary

- Hay finds evidence that a phonological/phonetic process is conditioned by relative frequency.
- Interpretation: difference lies in lexical access route (which, all else being equal, is determined by relative frequency)

3 Questions

Taking the Hay study as an example for concreteness--but the same questions apply to any research in this vein:

- What happens if we fully implement the processing model (e.g., MATCHCHECK, Baayen & Schreuder 2000, Baayen, R Schreuder, & Sproat 2000)
 - Depending on the details, factors besides relative frequency will matter: neighborhood/cohort size, segmentability (for comprehension in running speech)...
 - Should a base's frequency be how often it occurs in isolation? Or how often it ends up getting accessed (system gets more complicated)? What about bound morphemes?
 - Some of these other factors may be just noise; others could turn out to be confounds
- Are frequency effects due to access route online? Or are the effects fossilized in the lexical entries (so that *softly* underlyingly has less /t/)?
 - If we prime subjects with *soft* to increase its resting activation, will *softly* start behaving like *swiftly* (more [t])?
 - In a corpus, does recent occurrence of *soft* cause *softly* to be pronounced with more [t]?
 - If the difference is in the lexical entry, what exactly is the mechanism by which lexical entries get that way?
 - It can't be strictly Bybee usage (e.g. Bybee 2001; Pierrehumbert 2001b); not just word frequency but also frequency relative to base needs to have an effect
 - Could be that there's an online effect in comprehension, which affects updating of lexical entries, which in turn affect production
 - If effect is online, let's return to the question of just what the mechanism is, esp. in production
 - size of chunk over which phonological or gestural grammar calculates?
 - grammatical restrictions on reduction across access-unit boundaries?
 - aiding listener in achieving fast lexical access?
 - other ideas?

4 Another example: N. Italian s-voicing

(9) Basic pattern and prosodic approach

(Nespor & Vogel 1986, Peperkamp 1997, also some data from Baroni 2001)

p-word-span rule (in Selkirk's 1980 terms): /s/ becomes [z] iff it's contained in a V__V span uninterrupted by a p-word boundary.

$$s \rightarrow z / \overbrace{\dots V _ V \dots}^{\text{p-word}}$$

[s] and [z] both correspond to letter <s>. Letter <z> represents an affricate.

(10) Within a stem or stem+suffix: rule applies

I.e., stem and suffix form a single p-word

(stem)	(cá[z]a)	'house'
	(a[z]ílo)	'asylum'
	cf. ([s]ánto)	'saint'
	cf. (bu[s])	'bus'
(stem+suffix)	(ca[z]-ína)	'house-dim'
	(cau[z]-áva)	'caused'
	(famo[z]-íssimo)	'very famous'
	(va[z]-áio)	'potter'

(11) Across word boundary, or word/clitic boundary, rule doesn't apply

I.e., these don't form a single p-word

(stem) (stem)	(bella) ([s]era)	'beautiful evening'
(clitic (stem))	(la ([s]iréna))	'the siren'
	(lo ([s]apévo))	'I knew it'
((stem) clitic)	((telefonáti) [s]i)	'having phoned each other'
((stem) clitic clitic)	((andando) ci [s]i insieme)	'(our) going there together'

(12) Two parts of compound act as two separate words

(stem)+(stem)	(pórta)-([s]igaréte)	'cigarette holder'
	(tocca)-([s]ana)	'cure-all'

(13) Prefixes—at least when transparent—stand aloof from their stems...

[But stress data—see below—indicates that monosyllabic prefixes and disyllabic ones have different prosodic relationship to stem.]

(prefix+(stem))	(a-([s]ociále))	'asocial'
	(ri-([s]aláre))	're-salt'
(prefix)+(stem) or maybe (stem)+(stem)	(fílo)([s]oviético)	'pro-soviet'

(14) ...except when the /s/ is prefix-final

(prefix+stem)	(di.[z]-uguale)	‘unequal’
	(di.[z]-armo)	‘disarmament’
	(di.[z]-innescare)	‘defuse’
	(ci.[z]-alpino)	‘located on this side of the Alps’
	(bi.[z]-avo)	‘great-grandfather’

See Peperkamp for full OT analysis, and van Oostendorp 1999 for a somewhat different one.

(15) What about s-final free stems?

Kenstowicz 1996 reports that they don’t voice (*bu[s]-íno* ‘bus-*dim*’), supporting a base-to-derived correspondence analysis.

Peperkamp’s consultants disagree, producing occasional [s] but much more often [z] or [s:]:

(lapi[z~s:] - áccio)	‘pencil- <i>aug</i> ’
(lapi[z~s:] - íno)	‘pencil- <i>dim</i> ’

Peperkamp notes that other C-final free stems can (variably) geminate before suffixes too:

<i>autosto</i> [p:] - <i>ísta</i>	‘hitchhiker’
<i>vermou</i> [t:] - <i>íno</i>	‘vermout- <i>dim</i> ’

Assuming that the geminate fricative is exempt from voicing (*[z:]), this could explain why s-voicing is only optional in these cases.

(16) Prosodic constituents need not match morphological constituents

ri-[s]uddivi[z]-ione	‘resubdivision’	ri-[s]ocial-izzare	‘to resocialize’
(ri-(suddivis-ione))		(ri-(social-izzare))	
[[ri[suddivis] _V ione] _N		[ri[[socia] _A izzare] _V] _V	

(17) Other evidence on p-word boundaries: primary stress (Nespor & Vogel, Peperkamp)

Primary stress can be diagnosed by vowel quality: [ɛ], [ɔ] allowed only in primary-stressed sylls.:

(stem)	(t[ɔ̃]sta)	‘toast’
	(s[ɔ̃]lito)	‘usual’
(stem+suffix)	(t[ò]sta-tóre)	‘toaster’
	(s[ò]lita-ménte)	‘usually’
(stem) (stem)	(s[ɔ̃]lita) (ménte)	‘usual mind’
(stem)+(stem)	(t[ɔ̃]sta)-(páne)	‘bread toaster’ (toast bread)
	(t[ɛ̃]rra)-(c[ɔ̃]tta)	‘terra cotta’
	(p[ɔ̃]rta)-(ombr[ɛ̃]lli)	‘umbrella-stand’
	(par[ɔ̃]la) (mod[ɛ̃]llo)	‘model word’
(?)+(stem) unclear whether prefix or just bound stem	([ɛ̃]kstra)-(coniugále)	‘extramarital’
	([ɛ̃]x)-(presidénte)	‘ex-president’
	([ɛ̃]uro)-(parlamentáre)	‘Europarliamentarian’
	(ps[ɛ̃]udo)-(concétto)	‘pseudoconcept’
	(pr[ɔ̃]to)-(notariáto)	‘protonotaryship’ ¹

¹ I’m assuming the [ɔ̃] should also be long, but this datum is from a section of Nespor 1999 that’s not concerned with length

Primary stress is also said to be diagnosed by vowel lengthening: vowels in primary-stressed, open, nonfinal syllables lengthen (but see, e.g., D'Imperio & Rosenthal 1999).

(stem) _o	p[á:]pero	'duck'	
(stem+suffix)	(abbai[á:]-va)	'(it) was barking'	
(fossilized.prefix+stem)	(p[à]ramétrico)	'parametric'	See discussion of Baroni, below!
(prefix?)+(stem)	(c[á:]po)-(p[ó:]polo)	'chief'	
	(p[á:]ra)-(milit[á:]re)	'paramilitary'	
	(s[ú:]per)-(vel[ó:]ce)	'superfast'	
(prefix+(stem))	([à]-soci[á:]le)	'asocial' ²	

(18) Problematic case: “familiar” (i.e., frequent) compounds (Peperkamp)

Familiar compounds have contradictory behavior for V-raising and s-voicing, and Peperkamp proposes a (stem+(stem)) prosodic structure (see her pp. 127-128 for analysis):

(c[ò]pri-(létto))	'bedspread'	cf. c[ó]pri 'cover'
(r[è]ggi-([s]éno))	'bra'	cf. r[é]ggi 'hold'

(19) Invisible prefixes (N&V pp. 124-134)

- (re[z]istenza) 'resistance'
- (pre[z]entire) 'to have a presentiment'
- cf. (pre)([s]entire) 'to hear in advance'

Why do some prefixed words behave as though they're not? Are they represented the same way as monomorphemic words? Baroni investigated...

(20) An experiment on s-voicing: Baroni 2001

12 (usable) speakers of Standard Northern Italian read 102 target sentences 5 times—plus 10 controls where only one option should be possible, e.g. monomorphemic words—and then rated the semantic transparency of all the items.

3 (usable) speakers judged whether the same words, plus 40 additional controls, were acceptable with [s] only, with [z] only, or with either.

E.g. *Il giallo è un colore che risalta ovunque* 'Yellow is a colour that stands out everywhere'

(21) Results: productivity

The phenomenon is productive (good news! otherwise it would be less clear that it should be represented in the grammar), despite the potential for interference from other dialects.

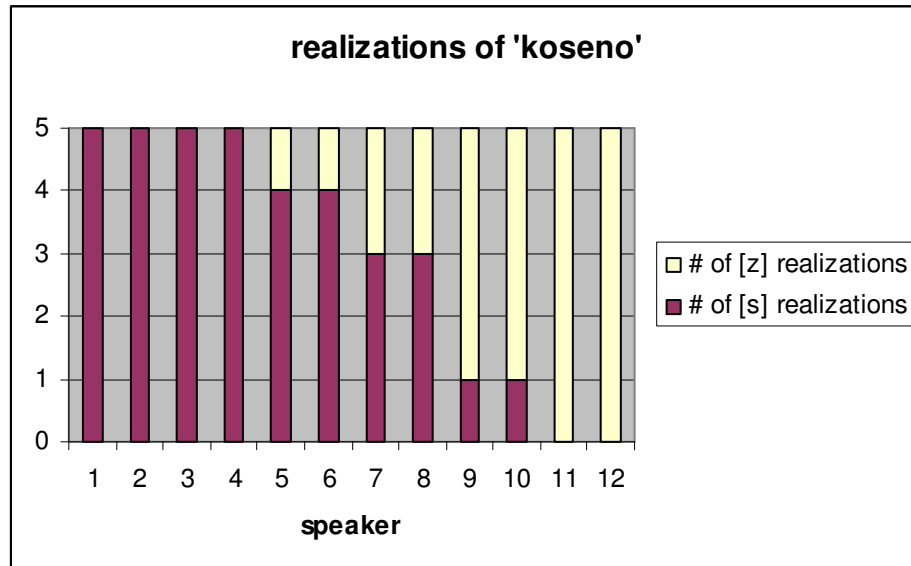
- In a another study with 58 participants (Baroni 1996), subjects read nonsense words in the expected way: [s]amo, pa[z]a.
- Loans are adapted in the expected way: [s]arland < German [z]aarland, me[z]a < Spanish or English me[s]a.
- 10 Italian speakers were asked to form *ri-X-izzare* ('re-X-ize') for various proper names X and behaved as expected: ri-[s]andr-izzare 're-Sandro-ize', but di[z]-Ald-izzare 'de-Aldo-ize'.

² I'm extrapolating from Peperkamp's discussion.

(22) Results: variation

Variation is both between and within items

- To a large extent, subjects agree: the three judges' ratings were highly correlated, as is the composite judges' score with the number of [s] realizations (for the 10 highly-correlated readers).
- But for some items, there's rampant variation: *coseno* 'cosine':



- For other items, there's variation but with a strong trend (a & c):

(17)			N of [s] realizations
a.	resuscitare	'to resurrect'	55/60
	risolvere	'to solve'	53/60
	riservato	'reserved'	52/60
b.	coseno	'cosine'	36/60
	residuato	'(war) surplus'	31/60
	bisettrice	'bisecting (line)'	28/60
c.	risalto	'prominence'	16/60
	risarcire	'to refund'	12/60
	desinenza	'(morphological) ending'	2/60

(p. 22 of ms. version)

(23) Results: representation of opaque forms

Total semantic transparency is not required for a prefixed parse

- *ri-[s]iede* 'resides', *ri-[s]olutive* 'resolutive', and *ri-[s]aputo* 'well known' were consistently produced with [s], despite the lack of iterative meaning (the productive meaning of *ri-*).

(24) Results: factors that influence a word's behavior

Baroni looked at...

- length of word, stem, prefix, and root (i.e., stem minus suffixes), in segments and in syllables
- type and token frequencies of word, prefix, and root
- ratio of prefix frequency to pseudo-prefix frequency (i.e., how many words begin with the prefix string, but don't actually contain that prefix, plus other criteria that would make it possible to parse out the prefix)
- root frequency for productively related forms only
- ratio of root frequency to pseudo-root frequency
- semantic transparency of prefix and stem, as rated by subjects
- stem autonomy (does it occur unprefixed?)—relevant for theories of paradigm uniformity
- frequency of the stem when autonomous
- ratio of autonomous stem frequency to word frequency (cf. Hay 2003)
- whether the root occurs word-initial
- frequency of root when word-initial
- stress position

The strong predictors turn out to be **stem transparency** and **prefix length** (in syllables).

- Baroni points out that the predictive factors account for about 42% of the variation in # of [s] realizations. This is a lot, but means there's still more to the story.
- Prefix length: Baroni points out that (from the learner's point of view) a longer string is less likely to have occurred by accident, and thus more likely to be a true prefix.
- Nice example: *parasanghe* 'parasangs (ancient Persian measurement unit)' was produced with [s] 37 out of 50 times, even though there's no semantic reason to think it's prefixed.
- Prefix length in syllables could be phonologically significant. If minimal word in Italian is disyllabic (unclear if it really is), then only disyllabic prefixes are able to stand on their own as p-wds.

(25) Interpretation

- Baroni's proposal is that speakers maintain two production representations for potentially complex words
 - a unitary representation (*coseno*) and a decomposed representation (*co+seno*).
- The activation threshold of each depends on "the degree of confidence that the speaker has in the fact that the form is complex, plus some degree of (random?) transient fluctuation." (p. 25 of ms.)
 - These fluctuations will be less significant—resulting in uniform productions—to the extent that the activation threshold is extreme (high or low).

(26) Prosodic structure?

Baroni is careful to say that he's looking only at prefixed words here, which is where we see two variants. What about the places where variation is not allowed?

- For semantics and distributional facts alone to account for all the *s*-voicing facts, what would have to be true of *s*-final prefixes? suffixes? compounds? clitics?

5 More on prosodic structure

(27) Grammar-dependence vs. distribution/usage dependence : possible scenarios

(i) Units determined entirely by the grammar

- E.g., Align(LxWd,L,PWd,L), or, in non-OT terms, the beginning of a lexical word initiates a prosodic word
- \Rightarrow compounds 2 words, prefixes and proclitics left out, suffixes and enclitics folded in p-word then acts as rule/constraint domain

(ii) Units determined entirely by processing

- Sequences stored as units (or, accessed in unit stored form, even if decomposed alternatives exist) display phonological fusion internally, propensity to alternate at edges.
- In general, (i) should predict a cleaner pattern than (ii), with fewer frequency effects on individual items.
- (i) also predicts tidy interaction with (presumably?) non-processing considerations such as prosodic minimality.

(iib) Processing masquerading as grammar

- Say that processing privileges left edges in such a way that prefixes and proclitics are, in general, more likely than suffixes and enclitics to get left out of the processing unit.
 - If the tendency is strong enough, it could look like the ALIGN constraint above, perhaps with some lexical exceptions.
- Similarly, effects of affix length, and differences between compounding and affixation (a given morpheme presumably participates in a wider variety of compounds than it does affixed forms) could come out of a processing model.
 - If strong enough, they could look like grammar (plus exceptions).

(iii) Grammar with processing-grounded constraints

- There's a cross-linguistic tendency for prefixes and proclitics to be less integrated than suffixes and enclitics (see Peperkamp 1997).
- We often appeal to phonetic motivations for constraint rankings—why not appeal to a processing motivation for the tendency $\text{ALIGN(LxWd,L,PWd,L)} \gg \text{ALIGN(LxWd,R,PWd,R)}$?
- We need a processing version of something like Hayes 1999's "inductive grounding" (which deals with how messy and fine-grained phonetic patterns could get phonologized into coarse phonological constraints).

(iv) Grammar that can refer to processing

- This is something I've tried—constraints like $\text{ALIGN(AccessedUnit,L,PWd,L)}$.
 - The idea is to be able to generate a cleaner pattern than the pure processing story would predict, by letting the grammar run things, in the usual way, with limited opportunities for processing to have its say.
- But, to argue for (iv) you need to also see if a processing model can generate the clean-looking pattern on its own, à la (iib).

(28) Hierarchical structure

- One of the main ideas in Nespor & Vogel and early Selkirk was that different rules would refer to different domains.
 - E.g. primary stress (and associated lack of vowel reduction) at the p-word level, stress retraction at the p-phrase level, spirantization at the intonational phrase level.
- What could be the equivalent of prosodic levels in the processing approach?
 - Perhaps looser processing units? What does that mean?
- This should predict that rule applicability is actually gradient and not tied to well-defined domains.
 - E.g. stress retraction is a weaker rule, that applies only to tightly cohering units, and spirantization is stronger, applying even to more loosely cohering units.
- What do you think about primary stress assignment in a framework like this (take the Italian case, where there can be a clear difference between primary and secondary stress, because of vowel reduction)—how do we make it obligatory that every stem or (say) disyllabic prefix has to get a primary stress?

(29) Large units

- Once we get up to units like the intonational phrase and utterance, it's implausible that we're dealing with stored units very often. Many intonational phrases will never have been heard or used by the speaker before. But phonology is nonetheless sensitive to those units (or so it's claimed).
- How could a processing theory deal with large units? Does it make any different predictions than the prosodic theory, and are they plausible?

6 Plan for rest of course

- Background: models of lexical access (production and recognition)
- Preview of methods in use: neuropsychological (speakers with deficits), speech errors, tip-of-tongue states, lexical decision, word naming (this last two often w/ priming or masked priming), eye-tracking during listening or reading, EEG/ERP, MEG, fMRI, PET, NIRS...
- Experimental studies of derivational morphology
- Experimental studies of inflectional morphology
- Family-size effects
- Experimental studies of compounds
- Effect of phonological alternations, including resyllabification (e.g., does presence of rendaku make a Japanese compound less decomposable?); various chicken-and-egg questions to ponder here
- Prefixation vs. suffixation and other left-to-right issues
- Back to linguistic proposals--what do we think of them now?
- Participants present cases/questions they've been working on or thinking about and try to relate them to what we've seen.

7 Products

- I'd like us to produce an annotated bibliography, of both psycholinguistic and linguistic research
 - best way to do it might be the wiki function on the CCLE page
 - I'll get things started by adding the articles I discuss in the first 2 weeks; you'll add articles you present and anything you run across
 - After the course is over I'll add the result to the public class web page
- Paper presentations
 - Starting in Week 3, class will consist mostly of presenting and discussing papers.
 - There's a ton of literature here, so we'll have to make each presentation brief.
 - Non-enrolled participants are welcome but not obligated to present.
 - I'll act as discussant, taking a slot at the end of each week to relate the papers discussed to each other and to the rest of the course.
 - Make handouts.
 - If you send me the PDF I'll post it on the public class web page, but if you don't want to that's OK.
- Final project, if you're enrolled for 4 units. Possibilities include but are not limited to...
 - literature review of some sub-area, with an eye to applying it to a particular problem
 - implement a model and apply it to a case
 - detailed research proposal, e.g. for an experiment to test predictions made by a lexical-access analysis of some phenomenon

8 Tell us what you're working on or thinking about that's potentially related

9 For next time

I'll be lecturing this week and next week. I'll get the readings for Weeks 3 and 4 posted soon (maybe by Wed.), so take a look and think about which ones you'd like to sign up for presenting.

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