de Jong, Schreuder & Baayen 2000
The morphological family size effect and morphology
presented by Kie, Feb. 9, 2011

(1) Distributional properties already found to facilitate lexical decision
(see there for references)
- the word's (token) frequency
- summed token frequency of inflectional variants
- summed token frequency of inflected and derived forms with the same stem (free or bound)

Inflected forms	*Surface frequency*	*Family members*	*Base frequency*
calculate	108	*calculate*	574
calculated	340	*calculable*	4
calculates	21	*calculation*	343
calculating	105	*calculator*	89
		calculus	50
		incalculable	26
		incalculably	1
		miscalculate	5
		miscalculation	25

(p. 330)

⇒ baseFreq(*calculate*) = 108+340+21+105 = 574
⇒ cumulativeRootFreq(*calculate*) = baseFreq(*calculate*)+4+343+89+50+26+1+5+25
⇒ familyFreq(*calculate*) = cumulativeRootFreq(*calculate*) - baseFreq(*calculate*)

(2) Family <u>size</u>
- Previous finding that family frequency doesn't matter for simplex words (Dutch & English)
- Instead, **family size**, the number of morphological "family members", matters.
  - familySize(*calculate*) = 8 (length of 'family members' list above minus 1)
- Suggests that morphologically related words "are co-activated in the mental lexicon."
- Schreuder & Baayen 1997: maybe it's due to activation of shared semantic features
- Family size effect disappears in <u>progressive demasking</u>
  - display flashes back and forth between ##### and TABLE, with the whole pair always taking, say, 210 msec, but TABLE gradually taking more and more of the interval until subject responds
  - see gsite.univ-provence.fr/gsite/document.php?pagendx=2000&project=lpc for demo
  - deJong & al. speculate that the degraded input results in activation of multiple candidates, so multiple morphological families are activated, obscuring any family size effect

(3) What counts as a family member? What counts as a word?
- Once you've got a method that produces family size effects, you can indirectly probe what belongs to a word's family
- E.g., are response times better predicted if only Level 2 derivates are counted towards family size? (I don't know that anyone has actually done this)
- Previous evidence that only semantically transparent forms count towards family size--surprising in a model where only the opaque words would even be stored

(4) Model adopted here: Schreuder & Baayen 1995

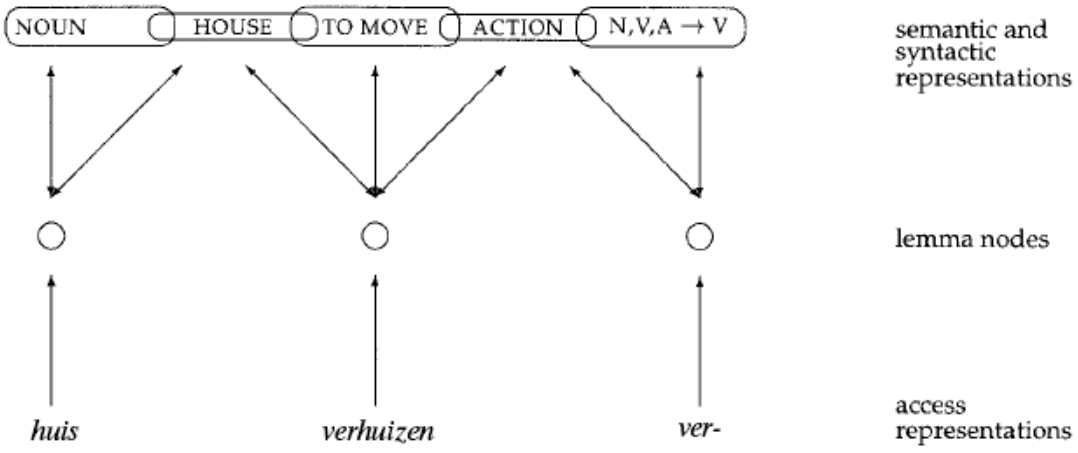

Figure 1. Representations for *huis*, "house", *verhuizen*, "move house", and the prefix *ver-* in a spreading activation model of morphological processing. (p. 333)

- Words interact by virtue of shared semantic features
- "Upon activation of the lemma node of *huis*, activation spreads to the semantic properties of *huis* [NOUN, HOUSE], from where it spreads to other lemma nodes just as *verhuizen*. The larger the number of co-activated lemma nodes becomes, the larger the amount of activation in the mental lexicon, and the easier it becomes in visual lexical decision to decide that an existing word is presented." (p. 334)

(5) Experiment 1: simple nouns vs. simple verbs

- In Dutch, nouns' family members are mainly compounds
- Previous results were for nouns, or for verbs that can also be nouns
- Verbs don't tend to appear in compounds, → smaller families
- This experiment looks only at verbs that, like English *think*, don't have a "nominal conversion alternant" (vs. *work*, which does)
- Task: just lexical decision.
- Result: significant effect of family size; no interaction with word category
  - → family size effect doesn't depend just on number of compounds

TABLE 2
Results of Experiment 1: Means and standard deviations of response latencies and error proportions (by participants)

	RT	*Error*	SD *RT*	SD *Error*
Nouns				
High Family Size	502	0.02	51	0.03
Low Family Size	521	0.03	48	0.03
Difference	– 19			
Verbs				
High Family Size	527	0.07	51	0.07
Low Family Size	551	0.07	53	0.07
Difference	– 24			

(p. 336)

(6) Experiment 2: family size vs. family frequency in complex words

- i.e., type vs. token
- Why looking at this?
  - different models make different predictions (Zhou & Marslen-Wilson: token frequency effects come from semantic/concept representations, not lemmas or access representations)
  - if token frequency doesn't matter, don't need to match for it in subsequent experiments
- same procedure, but with inflected verbs and comparative adjectives
- Result not quite significant (and in wrong direction) for family frequency:

TABLE 3
Results of Experiment 2a: Means and standard deviations of response latencies and error proportions (by participants)

	RT	*Error*	SD *RT*	SD *Error*
Complex words				
High Family Frequency	615	0.12	85	0.07
Low Family Frequency	602	0.14	80	0.08
Difference	+13			

(p. 339)

- Significant facilitation by family size:

TABLE 4
Results of Experiment 2b: Means and standard deviations of response latencies and error proportions (by participants)

	RT	*Error*	SD *RT*	SD *Error*
Complex words				
High Family Size	563	0.07	64	0.04
Low Family Size	583	0.08	66	0.05
Difference	–20			

(p. 339)

(7) Experiment 3: with inflectional suffix vs. bare stem

- Family size still matters for inflected verbs--in fact the correlation was stronger for inflected verbs (X-t) than for the same verbs uninflected (exp. 3b, not shown)

TABLE 5
Results of Experiment 3a: Means and standard deviations of response latencies and error proportions (by participants)

	RT	*Error*	SD *RT*	SD *Error*
Inflected verbs				
High Family Size	584	0.05	86	0.06
Low Family Size	604	0.10	76	0.11
Difference	–20			

(p. 342)

(8) Experiment 4: regular vs. irregular participles

- Dutch *ge-X-d* verb participles can be regular or irregular
  - regular: *roei* 'to row' *geroeid* 'rowed'
  - irregular: *zwem* 'to swim *gezwommen* 'swum': will it activate *zembad* 'swimming pool', etc.?
- If family size comes from activating shared semantic/concept features, family size should matter the same for regular and irregular.
- Exp. 4A, regulars only: family size facilitates, as expected, though *p* value didn't quite reach significance (.076, two-tailed, which might be too conservative)
- Exp. 4B, irregulars: family size still facilitates, about the same amount

(9) Further analyses and discussion

- What if you leave out the lowest-frequency words from the family?
  - family size does a worse job of predicting response time (correlation goes down)
  - one exception: the simplex, non-convertible verbs of Exp. 1. Authors didn't have an explanation.
- Uninflected verbs in Exp. 3
  - number of family members that are nouns was a better predictor than whole-family size
  - "without an overt affix that singles them out as verbs, only the nominal family members appear to be activated" (p. 352)
  - for the same verb stems, inflected, both nominal and full family size were good predictors.
  - explanation:
    - verbal affix *-t* is so high-frequency that its access representation gets activated first
    - that activates VERB, which in turn activates all the verbs in the lexicon, at least a bit
    - so the verbal family members are more activated (and thus contribute more to the facilitation) than if there had been no verbal suffix

(10) What does this mean for us?

- As mentioned above, provides a possible method for determining which words count as being in the same family (get activated during each other's access)
  - This is important under theories of "cyclic" effects whereby related words influence each other's pronunciation (e.g., Burzio; consider also Steriade's lexical conservatism)...
  - ...if we want to interpret that influence as resulting from activation of the other words
  - though presumably it's activation during production that's more important?
  - or maybe not--could be that cyclic effects happen during production and get lexicalized, hence affected produced forms
- Specific result along these lines:
  - Dutch irregular participles seem to stand in the same relation to their relatives as regulars do.
  - So, we could tentatively predict that irregular vowel changes wouldn't stand in the way of cyclic effects on, say, stress: in regulars show them, irregulars should too
  - this prediction can't be more than tentative unless we have an explicit theory of how cyclic effects would work