Speech errors: key models and results
23 Oct. 2017

1 First, back to an issue from earlier: can phonological accessibility/priming affect word order?

- E.g., can *form* priming affect your choice of *gave the book to the monk* vs. *gave the monk the book*
- Last time we saw that Slevc 2011 said no:
  - "The few studies that have directly addressed the effect of formal accessibility on speakers' choice of syntactic structures have found little or no effect (Bock, 1987; Levelt & Maassen, 1981; McDonald et al., 1993), suggesting that form-based accessibility is not a very relevant factor at the point when a speaker must commit to a particular syntactic structure."
- This is disturbing for people who (like me!) have claimed to find phonological effects on word order
  - This would eliminate one mechanism for such effects
- FYI, I happened to be looking at Bock 1987 though, and that's not her interpretation of her results
  - task: describe a picture (transitive action on conjunct argument)
    - *A bee is stinging a man/ A man is being stung by a bee*
    - after hearing a word similar to one or the other argument (*beet*, *mat*)

T: Bee, Man
P: Beet, Mat

(p. 125)

T: Lamp, Plant
P: Lamb, Plan

(also p. 125)

  - result: clear tendency to put the **un**primed word first (i.e., inhibition)
  - Bock cites her own earlier work that found effect of semantic priming only (not phonological)
    - but says that study used phonological primes that weren't as close as these ones (just V or just initial C)
- So maybe this issue is not so settled, and form-driven accessibility is a possible mechanism for phonology to influence word order?

2 Types of speech error (examples from Humphreys 2002)

- location of error source
  - from outside intended utterance
    - *It was like an epitome* (intended: *epiphany*)
    - I.e., the word *epiphnay* is interfering and causing an error, even though it's not part of the intended utterance
  - from within utterance
    - *That log might need another fire*

- unit of error
  - feature
    - *please pick up some toe-nuts* [thanks to V.S. Chidambaram for that one]
  - phoneme
    - *the next few flides* (intended: *slides*)
  - onset
    - *call Fyle first* (intended: *Kyle*)
  - rime
    - *that owbry waggling* (intended: *eyebrow*)
  - word
    - *That log might need another fire*
  - morpheme
    - *this bar is underrun by overgrads*
  - phrase
    - *talk to the phone on them*

- direction of error
  - exchange
    - *calcium lust and rhyme dissolver*

  - anticipation
    - *call Fyle first* (intended: *Kyle*)

  - perseveration
    - *the next few flides* (intended: *slides*)

  - intrusion
    - *It was like an epitome* (intended: *epiphany*)

3 Frequency trends

- maybe phoneme > word > morpheme > feature (Bock & Miller 1991)

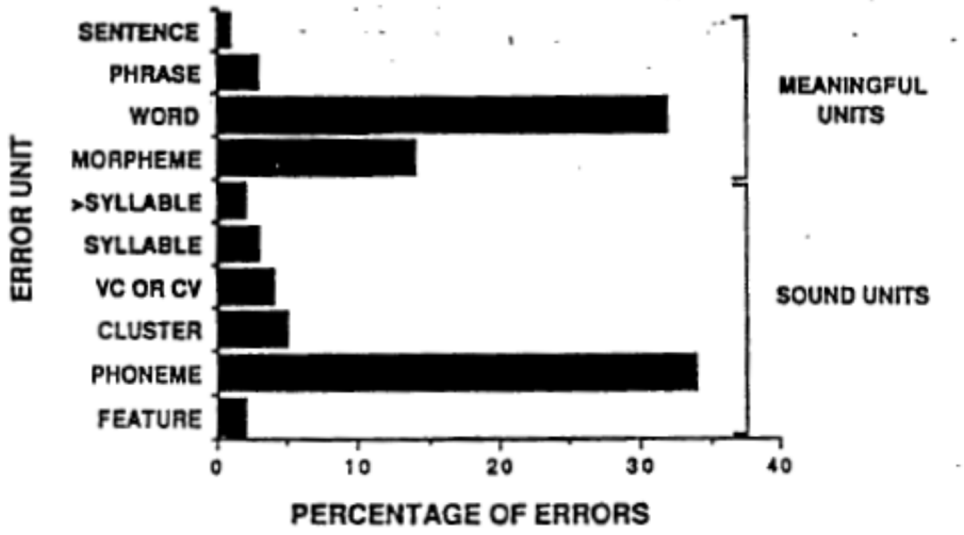


Fig. 2. Percentages of speech errors involving various linguistic units (modeled after a similar graph presented by Dell, 1987). The percentages are rough approximations and should be used for ordinal comparisons only.

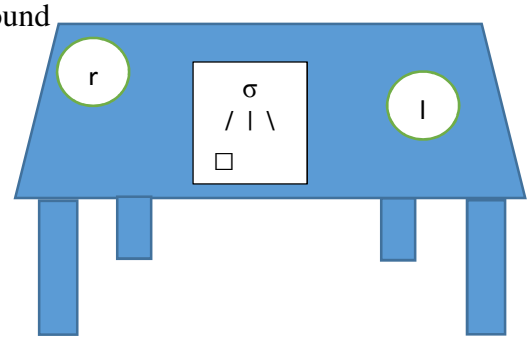
(p. 151)

- anticipation > perseveration? (Jaeger 2007)
  - yes in English, German, Dutch
  - no in Chinese, Japanese, Korean, Hindi, Spanish
  - Jaeger's speculation
    - tonic accent in English/German/Dutch tends to come late in sentence
    - strongly-accented word unlikely to be target of error—more likely to be source

4 Perseveration vs. anticipation vs. exchange

- Exchanges are more frequent than you would expect if they're just an anticipation plus perseveration

- Workbench model (e.g., Shattuck-Hufnagel)
  - You're trying to say *rust and lime*
  - /l/ and /r/ are both available for association to onset slot
  - Suppose you accidentally pick up the /l/ for the first slot
    - *l___ and ____*
  - now the /l/ is no longer available, but the /ɹ/ is still lying around
  - you're forced to pick up the /ɹ/ for the second slot
    - *l___ and r___*



- Spreading-activation version (Dell)
  - the phoneme you're going to use first is /ɹ/
    - it should get activated first
  - but suppose that by accident the /l/ gets activated first
  - once the /l/ is used, it gets inhibited for a while
  - now only the /ɹ/ is active enough to get used in the second word

5 Word vs. phoneme (Garrett 1988)

- In word errors, target and source…
  - usually are same part of speech
  - can be far apart (though as we saw, tend to be in same clause)
  - for intrusions, tend to be similar in either form (*epitome*/*epiphany*) or meaning (*sword*/*arrow*)
  - for swaps, little or no tendency for similarity (except part of speech)

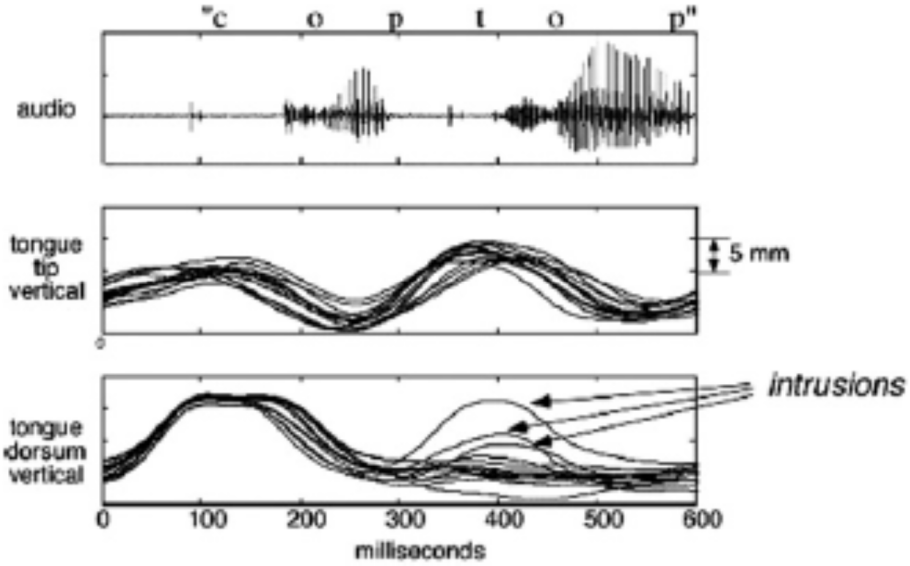
  ➔ suggests level of processing where words have been retrieved, but not their form

- In phoneme errors, target and source…
  - usually in same syllable position
  - don't have to be same part of speech
  - tend to be in adjacent or quite-nearby words (often same phrase)
  - tend not to be within same word
  - tend to involve similar sounds (see below)

6 Naturalistic speech errors

- Corpora collected by researchers as they go about their daily lives, often over the course of years
  - e.g., the Fromkin/UCLA corpus! Available and searchable at http://www.mpi.nl/resources/data/fromkins-speech-error-database/fromkins-speech-error-database

- Hazard: underperceiving gestures
  - speech errors induced in the lab, with articulation-measurement apparatus in place, find that often an error is a blend of gestures (e.g., Pouplier & Hardcastle 2005, Goldstein et al. 2007)
  - example: the "intrusion" tokens below will sound like *cop cop*, but look at what tongue tip is doing



(Goldstein & al. p. 393)

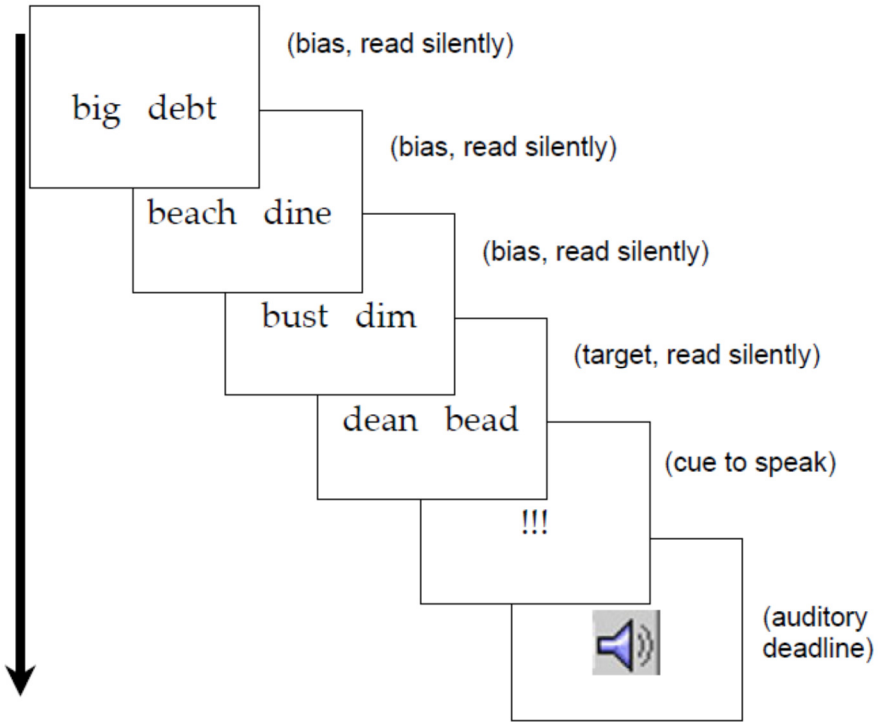
→ will get recorded as a segmental error, but is really a featural/gestural one

- Hazard: overperceiving real words
  - Ganong effect (Ganong 1980)
    - ambiguous sound is more likely to get perceived so as to create real word
    - [?æʃ] tends to be perceived as [**d**æʃ], [?æsk] as [**t**æsk]
  - (Problem: is this really occurring at an unconscious perceptual level, or is it a later conscious decision? Task was to write down what they heard.)
  - Could be true at a broader level—even unambiguous sounds might get misheard

7 Lab-induced speech errors

- Will be less representative of real life
  - speaker doesn't have to formulate an utterance all the way from the conceptual level
  - But easier to control and analyze!

- very common: **SLIPS** procedure (Baars, Motley & MacKay 1975)



(Humphreys 2002, p. 15)

  - tendency for error
    - *bean deed*
    - because *b*___ *d*___ pattern in previous trials conflicts with this trial

8 Lexical bias effect (overview from Humphreys 2002)

- intended *long rice* → *wrong lice*
  - both resulting words are real words
  - happens more often

- intended *log ripe* → *rog lipe*
  - both resulting words are non-words
  - happens less often

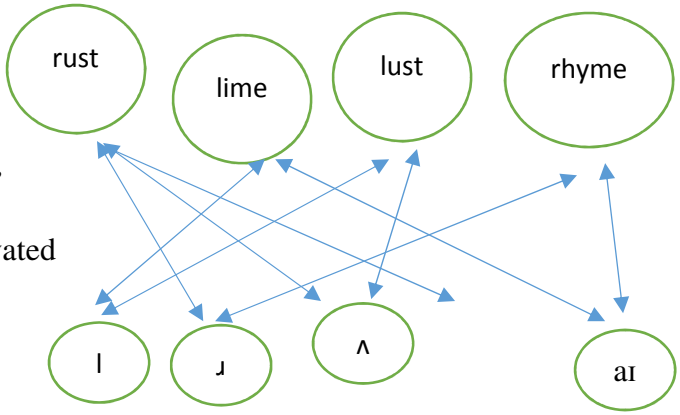
➔ output of error tends to be a real word

Humphreys compares two types of explanation…

8.1 Feedback models (e.g. Dell; Rapp & Goldrick)

- partially activated words activate phonemes
  - *rust, lime* → /ɹ/, /l/, /ʌ/, /s/, /aɪ/, etc.
- phonemes send activation back to words
  - /ɹ/, /l/, /ʌ/, /s/, /aɪ/, etc. → *rust, lime,* ***lust, rhyme***

⇨ possibility of error where wrong word gets activated



8.2 Feed-forward-only models (e.g., Levelt): "pre-articulatory editor"

- At some point before articulating a speech plan, check whether it's a real word

⇨ errors that produce non-words more likely to get detected and stopped

8.3 Humphreys's main experiment

- In (English) exchange errors, it's the *first* word that shows lexical bias
  - *dean beak → bean "deek"*
    - *more common* (51 responses/1000)
  - *deal bead → "beel" deed*
    - *less common* (20 responses/1000)

- "is predicted by feedback if exchanges are incremental, where the first part of the error precipitates the second" (p. iii)

- Workbench model interpretation (with feedback)
  - the first *word* is the real error
    - wrong sound gets grabbed for onset
  - the second word's error only happens because of what sounds are left lying around/not inhibited
  - So it's the first word that should show lexical bias
  - whereas an editor would be equally likely to catch either error

⇨ supports feedback model

9 Effects of frequency

- Does source word/syllable/segment tend to be higher-frequency than target?
- Seems to be quite a mess: see (Santiago et al. 2007) for review and experiments on Spanish

10 Effects of prosodic position

10.1 Most segment-exchange errors are word-initial consonants (Shattuck-Hufnagel 1992, also MacKay 1970)

- Fromkin 1976, corpus: 73%
- Shattuck-Hufnagel 1987, corpus: 88%
- Even true in polysyllables
  - Shattuck-Hufnagel 1987, corpus: 91%
  - (i.e., it's not just onsets in general)
- Even true if stress mismatches (S-H examples):
  - *ráth meviéw*
  - *sóulder shèparátion*
  - *púlt of cùrsonálity*
  - *pórm-fersuásive garments*
  - *róde of Nànvíer*
- When people have to repeat a sequence as fast as possible… (Butterworth & Whittaker 1980; Sevald & Dell 1994)
  - *bat gat* is easier
  - *tab tag* is harder (slower, fewer reps before making error)

10.2 Errors are usually within the same syllable position (Noteboom 1969, Mackay 1970)

- Garrett 1975: 207/211 phoneme exchanges in English corpus are same syllable position
- Examples from Shattuck-Hufnagel 1992 again:
  - *a terry chart*
  - *Mait a winute*
  - *Ouch, I have a stick neff*
  - *This isn't greep grane season, is it?*
  - *Did the grass clack?*
  - *sprit blain*

10.3 Shattuck-Hufnagel 1992: experiments to tease apart word/syllable/stress

- Say tongue twisters like….
  - *párrot fád fóot péril*
    - /f/s and /p/s share word position & stress → 182 errors
  - *paráde fád fóot paróle*
    - don't share stress → 130 errors
  - *repéat fád fóot rèpáid*
    - don't share word position → 55 errors
  - *rípple fád fóot rápid*
    - share neither (and syllable position uncertain) → 14 errors

- Similar results when words are made into a sentence
  - *Make the parrot a fad and the foot is in peril*

- Similar results when participants are given 4 words and asked to make a sentence

⇨ looks like word position and stress both matter

11 Effects of features

- Consonants get swapped more frequently than vowels (e.g., MacKay 1970)

11.1 Similarity and symmetry: Shattuck-Hufnagel & Klatt 1979

- Symmetry: for the most part each English sound is the target or source of errors equally often

- Similarity: segments that are similar (in place, manner, voicing) tend to interact more

MIT error corpus confusion matrix, rearranged (see over)

- Thick box around shared place/gross manner
  - labial/coronal/dorsal obstruent
  - labial/coronal/dorsal voiced non-continuant
  - coronal sonorant
  -
- Thin box around shared manner
  - approximant
  - nasal
  - voiceless stop
  - voiced stop

	p	f	b	v	t	d	θ	ð	s	z	ʃ	ʒ	t͡ʃ	d͡ʒ	k	g	ɹ	l	w	j	m	n	ŋ	h
p		**40**	**10**	1	**16**	0	0	1	2	0	0	0	1	1	**31**	1	0	0	1	0	4	10	0	2
f	**35**		2	5	1	1	5	0	**23**	1	1	0	1	0	7	0	2	1	2	1	1	0	0	3
b	4	3		13	1	**10**	0	0	2	1	0	0	0	3	3	**11**	4	4	3	2	**12**	2	0	0
v	2	6	5		1	9	0	3	1	5	0	0	0	1	0	1	3	1	1	0	3	0	0	0
t	**22**	4	0	0		9	4	0	**21**	3	1	0	**14**	4	**23**	1	0	8	0	0	1	6	0	2
d	0	1	**14**	3	3		1	1	4	**10**	0	0	1	**11**	1	**10**	0	3	0	0	4	**10**	0	0
θ	1	4	0	0	3	0		0	**19**	0	1	0	1	0	2	0	0	0	0	0	0	0	0	0
ð	0	0	0	4	0	1	0		0	5	0	1	0	1	0	0	0	0	0	0	1	0	0	0
s	3	**21**	1	3	**25**	5	**28**	0		3	**68**	0	**17**	3	**10**	0	0	1	0	0	0	4	0	3
z	0	0	1	9	4	8	0	2	1		0	3	0	4	0	0	0	0	0	0	0	4	0	0
ʃ	0	1	0	0	2	0	4	0	**33**	0		1	6	0	1	0	0	1	0	0	0	1	0	0
ʒ	0	0	0	0	0	0	0	0	1	6	0		0	1	0	0	0	0	0	0	0	0	0	0
t͡ʃ	5	0	1	0	4	2	0	0	1	0	3	0		0	6	0	0	0	0	0	0	0	0	0
d͡ʒ	1	1	1	1	1	**11**	0	0	1	1	1	1	1		0	0	0	0	1	1	3	1	0	0
k	**16**	4	0	2	**28**	1	2	0	7	1	4	0	**10**	0		6	1	0	0	0	0	1	0	7
g	0	3	9	2	1	7	0	0	0	1	0	0	0	3	**10**		0	0	0	0	2	1	1	1
ɹ	0	1	3	1	2	2	0	0	1	0	0	0	0	2	0	0		**86**	**27**	4	3	2	0	1
l	0	3	6	2	4	1	0	0	3	0	0	0	0	2	1	0	**67**		7	**17**	5	**14**	0	4
w	0	3	3	1	0	0	1	0	0	0	0	0	0	0	1	0	**37**	**13**		2	**18**	1	0	0
j	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	**12**	0		1	2	0	0
m	6	1	**12**	2	0	2	0	0	3	0	0	0	0	1	0	0	**17**	3	**13**	0		**34**	2	1
n	1	0	2	2	4	5	0	3	3	1	0	0	0	0	2	2	5	**27**	0	0	**34**		3	0
ŋ	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1		0
h	0	2	0	0	0	0	0	0	4	0	2	0	2	0	5	2	1	0	1	0	0	1	0	

- except that /s, t/ tend to get overwritten by /ʃ, t͡ʃ/
  - (they posit a palatalization rule as separate from other types of errors)

- Cf. MacKay (1970), who finds that while consonants that exchange tend to be similar in manner or voicing, they tend *not* to be similar in place!

11.2 Not all features are equal: Stemberger 1991

- In Stemberger's corpus…
  - labials prefer to interact with other labials
  - velars prefer to interact with other velars
  - alveolars are just as happy to interact with labials and velars
    - there is some effect of shared alveolarness, but it's weak/fragile

- Stemberger's interpretation: underspecification
  - p is [+labial]
  - k is [+dorsal]
  - t has no value for [coronal]

- Similarly argues that…
  - voiceless obstruents are underspecified for [voice]
  - stops are underspecified for [continuant]
  - non-nasals are underspecified for [nasal]

- But these underspecified features still matter a little—how?
  - Stemberger proposes that some errors occur at a later stage, when redundant features have been filled in

- An example of an even later (allophonic) feature
  - is dark [ɬ] more similar to [w] than light [l] is?
    - *weak leap:* [dorsal, +high, +back] vs. [ ]
    - *ward loom:* both [dorsal, +high, +back] → more errors m in a SLIPS experiment
      - assumes that onset /l/ becomes dark before back vowels

12 Repetition as a source of error

- Stemberger 1991: errors like this are particularly likely (also Shattuck-Hufnagel 1979)
  - *Looks mike—like my subject*

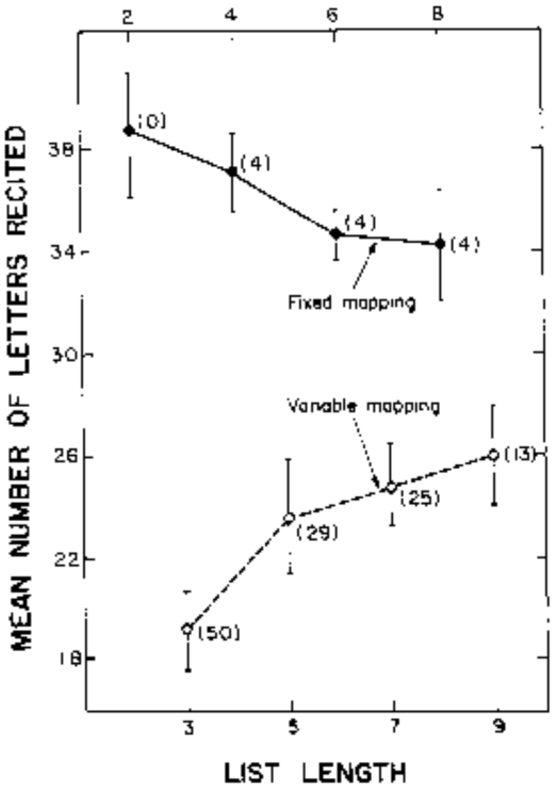
- The /l/ in *looks makes* the /l/ in *like* more vulnerable

- Possibly because /l/'s activation gets temporarily suppressed after it's used, and in this case it didn't recover in time

13 The difficulty of near-repetition

- Rosenbaum et al. (1986) invite us to try this experiment:
  - repeat *AbCdEf* (i.e., strong-weak-strong-weak) for 10 seconds [I modified this to make it same lenth as next one]
    - how fast can you go?
  - now try *AbCaBc*

- Their experiment: basically that!
  - easy (more letters managed in 10 seconds, fewer errors): Ab, AbCd, AbCdEf, AbCdEfGh
  - hard: AbCaBc, AbCdEaBcDe, AbCdEfGaBcDeFg, AbCdEfGhIaBcDeFgHi
  - Note that we might really want to compare 3 to 6
    - 3 is still harder though, even if compared to 6 rather than 2 or 4



Number in parentheses is % of trials with errors

(p. 724)

- Same results if starting weak
  - easy: aB, aBcD
  - hard: aBcAbC, aBcDeAbCdE

- and some parallel experiments on typing and violin playing

Rosenbaum & al.'s interpretation

- "variable mappings of parameters [e.g., stress] to responses [e.g., letters] impair performance" (p. 724)

- Consistent with two views:
  - "mappings of parameter values to motor subprograms are stored with the subprograms after the subprograms have been executed"

  or
  - "programs are prepared for forthcoming movements by editing programs that have just been executed"

- This will be relevant when the papers you're presenting look at whether near-repetition (of sounds or strings) is difficult
  - [ma^{m}ba]: difficult (near-repetition)
  - [la^{m}ba]: easy
  - [^{m}ba^{m}ba]: also easy (perfect repetition)

14 Paper I'm presenting: Berg & Abd-El-Jawad 1996

14.1 Overview

- Compared to English and German, Arabic phoneme errors…
  - are more likely to occur within a word (target & source are in same word)
  - are less likely to respect syllable structure

- Their interpretation
  - In Arabic, putting together the prosody takes longer
  - Thus there is more opportunity for errors to happen before there is syllable structure

In your upcoming presentations, to augment today's survey, include a part at the beginning where you bulletize the findings from the literature that the article reviews.

Some of the papers will have very little, like this one—most will have more

14.2 Highlights of literature review

- Stemberger 1985: "He argues that within-word slips occur earlier during sentence production than between-word slips"
  - for a between-word error to happen, you have to already have part of the later word's form retrieved

14.3 Data: English & German vs. Jordanian Arabic

- Remember how phoneme errors mainly had their source & target in different words, not same word?
  - Well, not in Arabic:

please give examples early and often!!

p.c.: Pro.ble.ma.**t**i**k** → Pro.ble.ma.**k**i**k**
p.p.: pe.ssi.mi**s**.ti**sch** → pe.ssi.mi**sch**.ti**s**

p.c.: hypothetical **k**eep a ta**p**e → **k**eep a ta**k**e
p. p.: **k**eep a **t**ape → **t**eep a **c**ape

	within-word p.c.:p.p.	between-word p.c.:p.p.
English	60:220 (78.6%)	28:1735 (98.4%)
German	14:56 (80.0%)	40:984 (96.1%)
Arabic	172:106 (38.1%)	13:57 (81.4%)

Table 2.
Frequency of position-changing and position-preserving errors in English, German and Arabic (percentage of position-preserving errors in brackets) (p.c. = position-changing; p.p. = position-preserving)

(p. 300)

- That same table also shows that Arabic within-word errors don't particularly preserve syllable position

- A closer look at the Arabic within-word errors
  - They tend to be in consonant-tier-adjacent Cs
  - but syllable position doesn't seem to be important

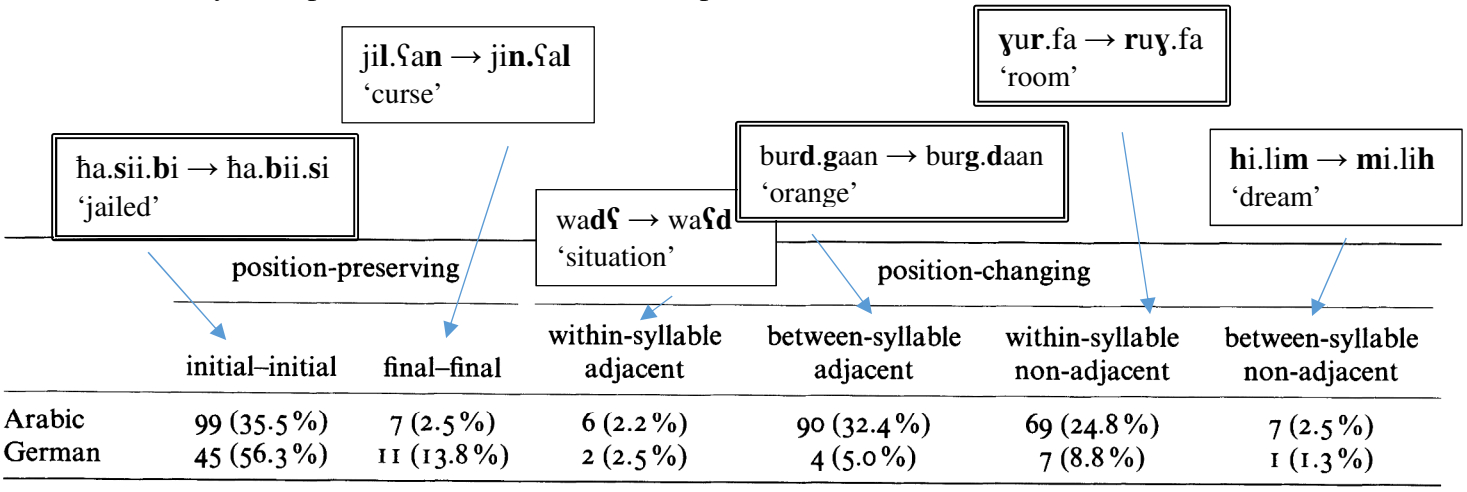


Table 3
Frequency of subtypes of within-word errors in Arabic (N = 278) and German (N = 70)

14.1 Their proposal

- Arabic root entries are rather abstract: /ktb/ 'book'
  - gets integrated online with CV template and vowel morpheme(s)
  - /ktb/ + CVCVC + /aa/ → [ka.tab] 'he wrote'
  - /ktb/ + CVCVVC + /ia/ + /-un/ → [ki.taa.bun] 'book'
  - /ktb/ + CCVC + /a/ + /ma-/ → [mak.tab] 'office'

- The process of integrating root, CV template, vowels, and affixes takes time
  - slower than assembling syllable structure in English or German
    - /ɹid/ + /ɪŋ/ → [ɹi.dɪŋ]

- Assume that the same total amount of time is allocated in all languages
  - then an Arabic word spends more time in the not-yet-syllabified state, less in syllabified state
    - more chance to make errors that don't care about syllable structure, less chance to make errors that do care about syllable structure

- Let's discuss: how can this proposal explain preponderance of within-word rather than across-word errors in Arabic?

References

Baars, Bernard J., Michael T. Motley & Donald G. MacKay. 1975. Output editing for lexical status in artificially elicited slips of the tongue. *Journal of Verbal Learning and Verbal Behavior* 14(4). 382–391. doi:10.1016/S0022-5371(75)80017-X.

Berg, Thomas & Hassan Abd-El-Jawad. 1996. The unfolding of suprasegmental representations: a cross-linguistic perspective. *Journal of Linguistics* 32(2). 291–324. doi:10.1017/S0022226700015905.

Bock, Kathryn. 1987. An effect of the accessibility of word forms on sentence structures. *Journal of Memory and Language* 26(2). 119–137. doi:10.1016/0749-596X(87)90120-3.

Bock, Kathryn & Carol A Miller. 1991. Broken agreement. *Cognitive Psychology* 23(1). 45–93. doi:10.1016/0010-0285(91)90003-7.

Butterworth, Brian & Steve Whittaker. 1980. Peggy Babcock's Relatives. In George E. Stelmach & Jean Requin (eds.), *Advances in Psychology*, vol. 1, 647–656. (Tutorials in Motor Behavior). North-Holland. doi:10.1016/S0166-4115(08)61976-7. http://www.sciencedirect.com/science/article/pii/S0166411508619767.

Ganong, William F. 1980. Phonetic categorization in auditory word perception. *Journal of Experimental Psychology: Human Perception and Performance* 6(1). 110–125. doi:10.1037/0096-1523.6.1.110.

Garrett, M. F. 1975. The Analysis of Sentence Production. In Gordon H. Bower (ed.), *Psychology of Learning and Motivation*, vol. 9, 133–177. Academic Press. doi:10.1016/S0079-7421(08)60270-4. http://www.sciencedirect.com/science/article/pii/S0079742108602704.

Garrett, Merrill E. 1988. Processes in language production. In Frederick J Newmeyer (ed.), *Linguistics: the Cambridge survey*, vol. Vol. 3 Language: psychological and biological aspects, 69–96. New York: Cambridge University Press. http://psycnet.apa.org/record/1988-97905-003 (21 October, 2017).

Goldstein, Louis, Marianne Pouplier, Larissa Chen, Elliot Saltzman & Dani Byrd. 2007. Dynamic action units slip in speech production errors. *Cognition* 103(3). 386–412. doi:10.1016/j.cognition.2006.05.010.

Humphreys, Karin. 2002. Lexical bias in speech errors. University of Illinois PhD dissertation.

Jaeger, Jeri J. 2007. Universals vs. language-specific factors in speech production planning: the effect of prosody and information structure. (Ed.) Carson Schutze & Victor S Ferreira. *MIT Working Papers in Linguistics* 53. 347–357.

MacKay, Donald G. 1970. Spoonerisms: The structure of errors in the serial order of speech. *Neuropsychologia* 8(3). 323–350. doi:10.1016/0028-3932(70)90078-3.

Pouplier, M. & W. Hardcastle. 2005. A Re-Evaluation of the Nature of Speech Errors in Normal and Disordered Speakers. *Phonetica* 62(2–4). 227–243. doi:10.1159/000090100.

Rosenbaum, David A, Robert J Weber, William M Hazelett & Van Hindorff. 1986. The parameter remapping effect in human performance: Evidence from tongue twisters and finger fumblers. *Journal of Memory and Language* 25(6). 710–725. doi:10.1016/0749-596X(86)90045-8.

Santiago, Julia, Elvira Pérez, Alfonso Palma & Joseph Paul Stemberger. 2007. Syllable, word, and phoneme frequency effects in Spanish phonological speech errors: the David effect on the source of the error. (Ed.) Carson Schutze & Victor S Ferreira. *MIT Working Papers in Linguistics* 53. 265–303.

Sevald, Christine A. & Gary S. Dell. 1994. The sequential cuing effect in speech production. *Cognition* 53(2). 91–127. doi:10.1016/0010-0277(94)90067-1.
Shattuck-Hufnagel, Stefanie. 1992. The role of word structure in segmental serial ordering. *Cognition* 42(1). 213–259. doi:10.1016/0010-0277(92)90044-I.
Shattuck-Hufnagel, Stefanie & Dennis H. Klatt. 1979. The limited use of distinctive features and markedness in speech production: evidence from speech error data. *Journal of Verbal Learning and Verbal Behavior* 18(1). 41–55. doi:10.1016/S0022-5371(79)90554-1.
Slevc, L. Robert. 2011. Saying what's on your mind: working memory effects on sentence production. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 37(6). 1503–1514.
Stemberger, Joseph P. 1991. Radical underspecification in language production. *Phonology* 8. 73–112.
Stemberger, Joseph Paul. 1985. *The Lexicon in a Model of Language Production*. Garland.