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 \textit{gave the book to the monk} vs. \textit{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)
    - \textit{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)

  (p. 125) (also p. 125)

• \textit{result}: clear tendency to put the unprimed 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 wagging* (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)

![Graph showing frequency trends of speech errors.](image)

- 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 /r/ is still lying around
  - you’re forced to pick up the /r/ for the second slot
    - *l___ and r___*
• Spreading-activation version (Dell)
  ▪ the phoneme you’re going to use first is /ʌ/
  ▪ 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 /ʌ/ 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
• **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

    ![waveform](image)

    (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
    - [ɔæʃ] tends to be perceived as [dæʃ], [əæk] as [tæsk]
  - (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* → /ɹl, /l/, /ʌs/, /ʌl/, /ʌl/, etc.
- phonemes send activation back to words
  - /ɹl, /l/, /ʌs/, /ʌl/, /ʌl/, 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 shéparátion
  - púlt of cărsonáity
  - 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 terri charrt
  - Mait a wínute
  - Ouch, I have a stick neff
  - This isn't green 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….
  - pároť fád fóot péřil
    - /l/ and /p/ share word position & stress → 182 errors
  - paráďe fád fóot paróře
    - don’t share stress → 130 errors
  - repéáť fád fóot répáid
    - don’t share word position → 55 errors
  - ripple 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
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!

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

• 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”
  - “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
  ▪ [ma⁶⁶ba]: difficult (near-repetition)
  ▪ [la⁶⁶ba]: easy
  ▪ [m⁶⁶ba⁶⁶ba]: 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

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!!

<table>
<thead>
<tr>
<th></th>
<th>within-word</th>
<th>between-word</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>60:220 (78.6%)</td>
<td>28:1735 (98.4%)</td>
</tr>
<tr>
<td>German</td>
<td>14:56 (80.0%)</td>
<td>40:984 (96.1%)</td>
</tr>
<tr>
<td>Arabic</td>
<td>172:106 (38.1%)</td>
<td>13:57 (81.4%)</td>
</tr>
</tbody>
</table>

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)

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.
• 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>
<thead>
<tr>
<th></th>
<th>initial–initial</th>
<th>final–final</th>
<th>within-syllable adjacent</th>
<th>between-syllable adjacent</th>
<th>within-syllable non-adjacent</th>
<th>between-syllable non-adjacent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arabic</td>
<td>99 (35.5%)</td>
<td>7 (2.5%)</td>
<td>6 (2.2%)</td>
<td>90 (32.4%)</td>
<td>69 (24.8%)</td>
<td>7 (2.5%)</td>
</tr>
<tr>
<td>German</td>
<td>45 (56.3%)</td>
<td>11 (13.8%)</td>
<td>2 (2.5%)</td>
<td>4 (5.0%)</td>
<td>7 (8.8%)</td>
<td>1 (1.3%)</td>
</tr>
</tbody>
</table>

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
  - /sid/ + /ip/ → [i.din]

• 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

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


