

A Novel Approach for Studying Speech Errors

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Purpose

- explore a new approach for studying speech errors that alleviates many of the problematic aspects of existing methods

Motivation

- three traditional approaches to studying speech errors have well-known drawbacks:
 - 1) Spontaneously-produced errors are jotted down when they are noticed. Observer bias and differential perceptibility have been shown to distort the relative frequencies of different error types. There is no way to verify what was said and no way to perform acoustic measurements.

2) Slip elicitation paradigms (e.g., Baars, Motley & MacKay 1976; Bock & Miller 1991; Ferreira & Humphreys 2001; Martin et al. 2006) typically induce a narrow range of slip types, e.g. exchanges, substitutions, and/or focus on a particular linguistic level, e.g. inflection. SLIP, tongue-twister (Shattuck-Hufnagel 1983), etc. bear little resemblance to spontaneous speech situations, hence may be vulnerable to artifacts.

3) Recordings of real-world speech are transcribed after multiple listenings by several experimenters. This minimizes perceiver biases, but the density of errors is extremely low, making this method (often prohibitively) resource-intensive.

1) & 3) have the additional drawback that the experimenter has no control over the properties of the target utterances

Goals

- try gathering slips in a way that avoids these problems, as follows:
 - 1) an experimental setting with audio recording of participant responses allows for repeated listening, multiple coders, instrumental phonetic analysis

- 2) the task is relatively natural—essentially just saying a sentence you read moments earlier; it turns out that most familiar slip types are elicited and they involve a wide variety of linguistic levels/units
- 3) due to pressures placed on the subject (see below), the slip rate is quite high (about **25%** of response sentences contain a slip, counting conservatively)—gathering a lot of slips does not take much experiment time (but transcribing responses is still a bit of a bottleneck)
- 4) target utterances are explicitly provided, hence we know what they were and their properties can be manipulated as desired
- 5) work towards making coding scheme explicit enough to be replicable in other labs

Caveat

The preliminary data reported here are drawn from an experiment whose original purpose was unrelated to speech errors (see Kim 2006). As a result the analyses are entirely post hoc, with concomitant shortcomings that will be addressed in future experiments. For example, properties of

target sentences were not designed to manipulate factors potentially relevant for slip research.

Method

Participants

- 48 members of the UCLA community (mostly undergrads)
- native English speakers (not necessarily monolingual)
- received money or course credit

Materials

Targets were grammatical sentences of English, mean length 7.1 words (range 4–11), containing at most one main and one subordinate clause, describing plausible events

Apparatus

Computer; microphone connected to digital voice recorder which recorded continuously throughout the experiment

Procedure

- task adapted from syntactic priming research (Potter 1984; Potter & Lombardi 1990): requires participants to say, after a brief delay, a

sentence they read in Rapid Serial Visual Presentation (RSVP). The delay involves a simple distractor task, during which the participant must try to remember the sentence in order to subsequently repeat it. Time pressure is induced in two ways: explicitly, there is a limit on total response time before next trial begins; implicitly, participants rapidly discover that the faster they say the sentence, the less of it they are likely to forget

- the distractor task is intended to inhibit rehearsal of the target sentence without introducing any meaning or lexical material that is likely to interfere with memory of it
- instructions: “*After you answer Yes/No [to the distractor task], say the sentence you just read into the mic. Even if you can’t remember the sentence exactly, say whatever you can remember—the important thing is that you try to remember the gist of the sentence.*”
- 144 total trials, each consisting of the following:
 - crosshair (+) appears for 800ms
 - RSVP fixed window presentation of target sentence at 100ms/word

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- after final word of sentence, a number word in all caps (ONE, TWO, ...NINE) appears for 100ms
- array of four Arabic numerals is displayed until participant presses Y or N on keyboard to indicate whether the number represented by the spelled word occurs in the list
- visual prompt to speak the sentence into the microphone displayed for 6 sec
- next trial begins automatically

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- example of a trial:

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+           (800 ms)
The        (100 ms)
bystanders "
were       "
horrified "
by         "
the        "
rioters.   "
FOUR      "
3 7 8 2
Subject presses N
Say the sentence (6000 ms)
Subject says “The bystanders were horrified by the riot”
+           (800 ms)
etc.

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Results

Preliminaries

- recordings were transcribed, so far by only one listener each
- one of the listeners was blind to the original stimuli, the other was not—probably want both kinds of transcribers in future: non-blind may be biased to hear target words, but blind tend to mis-hear, particularly lower frequency words (e.g. *rioters* transcribed as *writers*)
- transcription was purely orthographic, but intent was to include phonemic errors, hesitations, etc.; transcribers for this pilot probably did not do this systematically enough (see Caveat above)
- preliminary filtering: two participants found this task extremely difficult and generally reproduced little of the target sentence in most trials; their data aren’t discussed further; this leaves approx. 6450 total responses (including uncodable ones)
- for remaining participants, in order for a particular response to be codable it had to contain a main verb
 - rationale: consider this target—>response pair

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The chemistry TA bored the undergrads —>
The chemistry and the boy

—hard to align response with target in order to say what has been substituted vs. deleted, etc.
- by contrast, this also diverges widely from the target:

The detective interrogated the inmate —>
The interrogator asked questions

—but main verb provides an anchor point for aligning constituents; hence, a replicable analysis: *detective* —> *interrogator*, *interrogated* —> *asked questions*, *the inmate* —> \emptyset

- analysis of *codable* responses proceeds as follows:
 - literally compare the response string to the target and identify all *differences*
 - divide *differences* into those we treat as *potential slips* versus others, ignore the latter (see Exclusion criteria below)
 - classify the *potential slips* according to type, etc.

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- c) Intrusions from the distractor task: Very commonly the number word that appears immediately after the sentence will be integrated into the participant's response, e.g.

The bus driver was assaulted by the fugitive. SIX —>
The bus driver was assaulted by six fugitives

(typically, as in this case, the rest of the sentence shows accommodation, here the plural -s)

—It is hard to be certain at which level(s) of the production process the intrusion occurs, so we don't consider it a clear case of breakdown in the sentence production machinery (though in the spontaneous slip literature analogous things would probably be counted as noncontextual addition errors).

- d) Omission of “nonessential” information from the response: participants frequently omit modifiers, such as attributive adjectives, and articles (*a*, *the*). This is plausibly because they choose (unconsciously) to produce a shorter version of the sentence that preserves the essential meaning but allows them to spit out their response faster, before memory decays too much.

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Exclusion criteria

Rationale: Our interest is in gathering slips for the same purposes that they have traditionally been used: as evidence about how the production system works based on how it breaks down. Therefore, differences that are plausibly NOT the result of a breakdown in utterance generation are not of interest for this purpose. We find that the nature of this task makes several such types of differences quite common, so to be conservative we do not treat any of them as slips (though of course some of them could have been). Rather, we attribute them to other stages of the task, viz.:

- a) Subject's perception of the original visual target: many of our targets contain proper names, which were replaced in responses by names that are spelled similarly (e.g. *Dana*—>*Dan*). These were probably inaccurately perceived to begin with, due to their low frequency.
- b) Difficulties in transcriber's hearing of the response: Despite our best efforts, recordings were not as clear as we would have liked; inflectional -s was especially hard to hear confidently, so we ignored differences of number on nouns.

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- In contrast, to say that these were slips would mean that the formulation of the utterance plan included these words, and their omission was the result of something going wrong during utterance generation. There might have been some cases of this, but these omissions are much more frequent than we would expect deletion slips to be based on existing studies.

- Note in particular that omission of attributive adjectives generally does not cause ungrammaticality, whereas genuine word omission errors can of course do so. (The grammatical status of article omission in informal speech is tricky; we assume that participants can allow themselves to respond in a register in which it is possible.) We assume that an omission that creates ungrammaticality is a slip, because we assume the production system always intends to produce grammatical output.

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Example of an omission that is NOT coded as a slip:

The firemen rescued the baby kittens. —>
The firemen rescued the kitten.

Example of an omission that IS coded as a slip:

Erin's boss rose from his seat during the meeting. —>
Emily's boss rose his seat during the meeting

e) Forgetting/re-supplying certain details: Consider differences such as the following:

The girl dropped the book —>
The girl dropped her book

- we assume this could arise because the exact identity of the determiner in the target was forgotten, and in generating the response, since a determiner was syntactically required, a plausible one was supplied. So, we exclude differences involving substitution of articles, pronouns, replacement of proper names with pronouns
- In contrast, to say that this was a slip would mean that the formulation of the response utterance actually represented the

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semantics of *the*, but when it came time to realize the relevant determiner slot, the lexical item *her* mistakenly popped out instead.

- Likewise for the linear position of adverbs when meaning is not affected
- Sometimes when participants forget details they explicitly acknowledge this in their responses, e.g. using words like *someone* or *something*:

The paramedics came after the fire broke out —>
Someone came after the fire broke out

- Here again, we do not assume that the production system had a plan containing the noun *paramedics* and accidentally said the word *someone* instead; rather, we assume that detailed information about the participant in question was never part of the utterance plan to begin with.

f) Running out of time/memory: A class of differences that we identify as *truncations* involve a response that matches the target except that a final substring is missing, generally yielding ungrammaticality, e.g.

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The detective interrogated the inmate —>
The detective interrogated

- here it seems plausible that the speaker cannot remember any more of the sentence, or has interrupted him/herself thinking he/she has made an error, etc.

g) Syntactic priming: The original purpose of the experiment was to study active~passive syntactic priming. As a result, we did not code changes of voice as slips, regardless of whether they preserved the theta-role assignments of the target (see Kim 2006)

Classification of potential slips

We call these *potential* slips because in some cases we still have to entertain the possibility that these differences have arisen in one of the ways listed in the previous section, although we also believe (based on the literature) that these plausibly represent breakdowns in production per se. These generally occur in the class of (word) substitutions:

- When a target word is replaced by one that is orthographically similar, this could be because the target word was originally misperceived, cf. exclusion criterion a) above. This seems particularly likely when the target is relatively low frequency and the substitution is higher frequency, e.g.

The director encouraged the interns —>
The director encouraged the items

- Although many orthographically similar words are also phonologically similar, there are some that are not (123 such cases); the fact that we find these in substitutions supports the hypothesis that orthographic confusions are an independent source of differences, e.g.

Emma embarrassed her brother —>
Someone was harassed by her brother

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The attested slip types

• ADDITIONS

The little boy shoved the other boy during recess —>
The little boy shoved the other little boy during recess

The doctor vaccinated the travelers for typhoid. ONE —>
The doctor was vaccinated one by one

Note: “one by one” was part of the target 8 items earlier, but was not produced in that response; “one” in the distractor of this item may have reactivated it

• DELETIONS

The students interviewed the psychologist for a class project. —>
The students interviewed for a psychology class

Erin's boss rose from his seat during the meeting —>
Emily's boss rose his seat during the meeting

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• EXCHANGES

The defendant was confused by the prosecutor. —>
The prosecutor was confused by the defendant

Richard's friends left before the party was over. —>
The party was over before Richard's friend left

• BLENDS: No clear cases found

• PURE SHIFTS

The rival team members accosted the cheerleaders. —>
The rival team accosted the member cheerleaders

The competitors defeated the math team last weekend. —>
The competitors finished last in the math team

Note: Involves two different senses of “last”

• SUBSTITUTING SHIFTS: target word is replaced by a word from elsewhere in the target sentence, which is then not produced in its own target position

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The wasp stung the baby elephant. —>
The baby stung the elephant

The department chair was nominated by the faculty members. FOUR —>
The department was nominated by four chairs

Note: We do not treat these as substitutions, because that would require positing an unrelated deletion in the same response; we assume the word disappeared from its target position BECAUSE it was ‘used up’ elsewhere

• SUBSTITUTIONS:

- PHONOLOGICALLY RELATED (but probably not orthographically confusable)

The counselors were puzzled by the high schoolers. —>
They were punished by the high schoolers

The carcass decayed rapidly in the heat. —>
The carcass lay dead in the street

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- SEMANTICALLY RELATED

The roommates were dragged to the show by the girls. —>
The roommates were dragged to the show by the boys

The ambassador was assassinated by the sniper. —>
The politician was assassinated by a sniper

The burglar was photographed by the bystander. —>
The burglar was witnessed by five bystanders

- sometimes the intruding word is semantically related, not to the target word, but to other material in the sentence, as in the following case of apparent perseveration of meaning via a different lexical item:

The boa constrictor swallowed the small rodent. —>
The boa constrictor swallowed the snake

- BOTH PHONOLOGICALLY AND SEMANTICALLY RELATED

The lobbyist bribed the councilman. —>
The lobbyists bribed the congressman

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The sleeping baby was stung by the mosquito. —>

The sitting baby was stung by the mosquito

Craig's brother pinched Angie's brother on the playground. —>

Craig's brother pinched Angie's baby on the playground

- SOURCE UNKNOWN

The FBI agents were tape-recorded by the spies. TWO —>

The agents were notified by the two spies

Note: “notify” does not appear in the targets

The voters were alarmed by the mayor. —>

The lawyers were alarmed by the mayor

Note: “lawyer” does not appear in the targets

Discussion

- we can catch slips here of sorts you wouldn't catch by spontaneous observations and would be hard to elicit with paradigms like SLIPs
- most kinds of slips (other than blends) are well-attested here, at least at the word level
- it's easy to see the influence of earlier utterances
- downside: many potential slips must be discarded as potentially attributable to parts of the task other than sentence generation *per se*

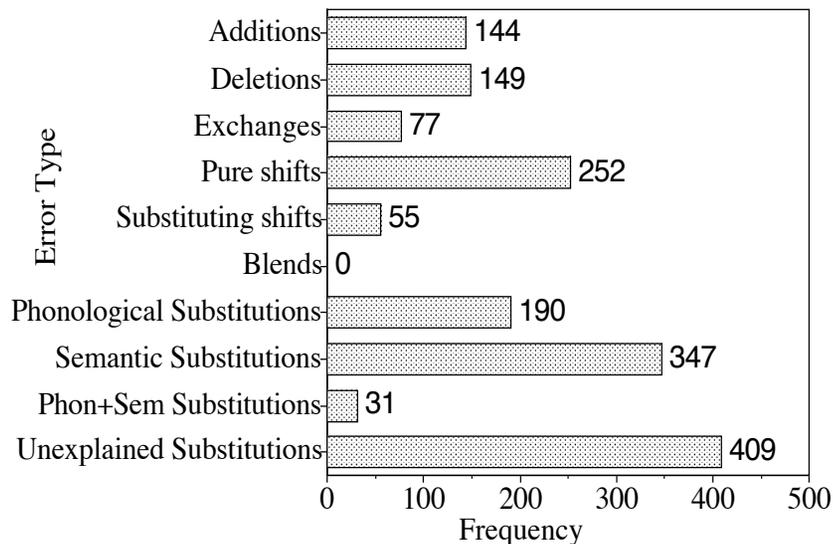
Next steps

- slower presentation rate, to reduce misperception
- multiple listeners, inter-coder reliability ratings
- manipulate properties of sentences

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Distribution of Error Types



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