Alice's Adventures in *Um*-derland: Dimensions of Variation in Disfluency Production

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ABSTRACT

This study demonstrates that four common types of disfluency (fillers, silent pauses, repairs, and repeated words) differ from one another on two dimensions: their temporal relation to speech production problems and the level of production at which those problems occurred. Disfluencies were examined using a storytelling paradigm in which participants read passages from *Alice's Adventures in Wonderland* and retold them based on a list of key points.

Comparisons between types in their relation to story events, to utterance length, to position within an utterance, and to other disfluencies suggest the four types reflect different difficulties in language production. Temporally, fillers and silent pauses represent difficulties in upcoming speech, while repairs and repeats represent past difficulties. Fillers were most associated with message-level problems, while silent pauses were more associated with grammatical and phonological problems.

DISFLUENCY TYPES

Examining differences between four common types of disfluency (Maclay & Osgood, 1959)

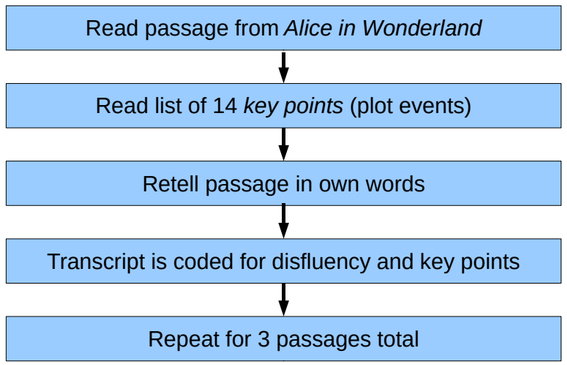
Fillers: Interruptions that do not contribute to semantic content
"Alice uhhh drinks the bottle"

Silent Pauses: Longer than would be expected from fluent utterance
"Alice // drinks the bottle"

Repairs:
Error repairs correct errors of form: "Alice drink drinks the bottle"
Information repairs revise content of utterance: "Alice eats the cake er drinks the bottle"

Repeats: Words repeated unmodified
"Alice drinks Alice drinks the bottle"

METHOD

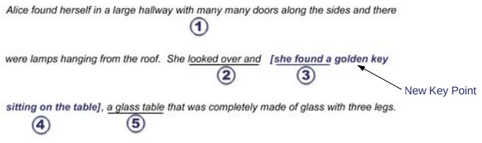


RESULTS – TEMPORAL LOCATION

Do disfluency types differ in relation to difficult material?

New key points expected to be difficult (new story events, lexical items, syntactic structures)

Divided transcript according to key points:



WHERE ARE DISFLUENCIES MOST COMMON?

Disfluency	① Between Key Points	② 3 Words Before Key Point	③ 3 Words at Start of Key Point	④ Within Key Point	⑤ 3 Words After Key Point
Filler	2.02	**5.19**	0.41	1.19	2.86
Silent Pause	2.47	**5.18**	1.86	1.81	4.14
Repair	1.37	1.38	1.57	1.29	**2.86**
Repeat	0.69	0.49	**1.19**	0.62	0.86

Fillers: Before KPs ($F_1(1,9) = 16.48$, $p < .001$) – upcoming problems
Silent Pauses Before KPs ($F_1(1,9) = 6.03$, $p < .01$) – upcoming problems
Repeats: Beginning of KPs ($F_1(1,9) = 6.86$, $p < .05$) – (more immediate?) upcoming problems
Repairs: After KPs ($F_1(1,9) = 5.57$, $p < .05$) – past problems

RESULTS – LEVEL OF PRODUCTION

Most models of language production posit at least three levels (see Bock, 1995):
- **Message:** Pre-verbal meaning
- **Grammatical:** Lexical items & syntactic structures
- **Phonological:** Phonology

Are different disfluency types associated with different levels of production?

CLAUSE BOUNDARIES

- Are disfluencies related to key points only because of clause beginnings, or because of story content too?
- Clause boundaries more apt to have fillers when they begin a key point ($t_{1(9)} = 2.44$, $p < .05$) – suggests fillers associated with message planning
- Silent pauses equally likely at all clause boundaries ($t_{1(9)} = 1.19$, $p = .24$) – silent pauses reflect grammatical / phonological planning demands of all new clauses

POSITION IN UTTERANCE

- Fillers ($t_{1(9)}$=3.48, $p < .01$), silent pauses ($t_{1(9)}$=4.52, $p < .01$), information repairs ($t_{1(9)}$=3.18, $p < .05$) more common in first half of utterance
- Suggests these may be more related to message level as message-level planning finishes earlier
- Error repairs ($t_{1(9)}$=1.54, $p = .16$) and repeats ($t_{1(9)}$=1.00, $p = .34$) equally common in both halves
- Suggests relation to grammatical and phonological planning, which continues throughout an utterance

CORRELATION

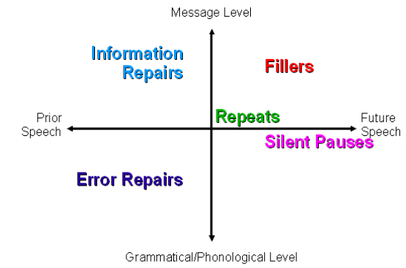
- Difficulty at a given level should increase the rate of all disfluencies associated with that level
- So, rate of disfluencies stemming from problems on the same level should correlate (by subjects)
- But disfluencies on different levels may be less related
- Rate of fillers correlated with rate of information repairs ($r = .70$, $p < .05$) but not of error repairs ($r = .44$, $p = .42$)

CONCLUSION

Message level: Fillers, information repairs
Grammatical/phonological levels: Error repairs
All levels: Silent pauses, repeats

CONCLUSION

Disfluency types differ in at least two ways:
- Temporal relation to underlying problem
- Level of production at which problem occurred



- Suggests a variety of problems can occur in language production
- And lead to different kinds of problems!

Are repeats used because of delays in planning (Clark & Wasow, 1998) or false alarms of repair system (Levelt 1983)?
- Repeats associated with planning new key points

Message-level problems are important to disfluency!

REFERENCES

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Alice's Adventures in *Um*-derland – additional data

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OVERALL FREQUENCY

Table 1.

Rate of disfluency per 100 words by type.

Type	*M*	*SD*
Total Filler	1.86	1.95
Uh	0.70	0.95
Um	1.09	1.09
Silent Pause	2.49	1.03
Repair	1.39	1.01
Repeat	0.63	0.87
Total	6.37	3.83

- Approximately 6 per 100 words, consistent with past estimates (e.g. Fox Tree, 1995)

RESULTS – TEMPORAL LOCATION

WHERE ARE DISFLUENCIES MOST COMMON?

Disfluency	① Between Key Points	② 3 Words Before Key Point	③ 3 Words at Start of Key Point	④ Within Key Point	⑤ 3 Words After Key Point
Filler	2.02	**5.19**	0.41	1.19	2.86
Silent Pause	2.47	**5.18**	1.86	1.81	4.14
Repair	1.37	1.38	1.57	1.29	**2.86**
Repeat	0.69	0.49	**1.19**	0.62	0.86

- Fillers: Before KPs ($F_1(1,9) = 16.48$, $p < .001$) – suggests relation to upcoming problems
- Silent Pauses Before KPs ($F_1(1,9) = 6.03$, $p < .01$) – suggests relation to upcoming problems
- Repeats: Beginning of KPs ($F_1(1,9) = 6.86$, $p < .05$) – suggests relation to (more immediate?) upcoming problems
- Repairs: After KPs ($F_1(1,9) = 5.57$, $p < .05$) – suggests relation to past problems

DISFLUENCY TYPES RELATIVE TO EACH OTHER

- Can also examine when disfluency types occur relative to each other.
- Disfluencies that reflect a past problem (repairs) should tend to occur *after* disfluencies that reflect an upcoming problem.
- Look at all sentences that contain at least one repair. Compare disfluencies before first repair vs. after last repair.

Table 3.

Rate of disfluency per 100 words before and after repairs within a sentence. (Standard errors in parentheses.)

Type	Before Repairs	After Repairs
Filler	2.44 (0.84)	1.21 (0.51)
Silent Pause	3.75 (0.69)	1.71 (0.52)
Repeat	0.53 (0.25)	0.56 (0.30)

- Fillers: More common **before** repairs than **after** ($t_1(9) = 2.46$, $p < .05$) – suggests relation to upcoming problems
- Silent Pauses: More common **before** repairs than **after** ($t_1(9) = 3.13$, $p < .05$) – suggests relation to upcoming problems
- Repeats: No more common before repairs than after ($t_1(9) = -0.10$, $p = .92$)

RESULTS – LEVEL OF PRODUCTION

CLAUSE BOUNDARIES

- Are disfluencies related to beginning of key points only because of new clauses, or because of story content too?
- Compare to end of key points. Also contain clause boundaries, but don't introduce new story elements.
- No significant difference in prevalence of clause boundaries between these regions ($t_1(9) = 1.868$, $p = .10$)
- Clause boundaries more apt to have fillers when they begin a key point ($t_{1(9)} = 2.44$, $p < .05$) – suggests fillers associated with message planning
- Silent pauses equally likely at all clause boundaries ($t_{1(9)} = 1.19$, $p = .24$) – silent pauses reflect grammatical / phonological planning demands of all new clauses

POSITION IN UTTERANCE

- Do different types of disfluencies tend to appear early vs. late within an utterance?
- Would expect a difference if different types associated with different levels of production – message level planning finishes before grammatical/phonological planning

Table 4.

Rate of disfluency per 100 words by position within utterance. (Standard errors in parentheses.)

Type	First Half	Second Half
Filler	3.20 (1.02)	1.24 (0.55)
Silent Pause	3.76 (0.58)	0.63 (0.20)
Information Repair	0.52 (0.14)	0.21 (0.08)
Error Repair	0.34 (0.10)	0.24 (0.07)
Repeat	1.07 (0.34)	0.69 (0.22)

- Fillers ($t_{1(9)}$=3.48, $p < .01$), silent pauses ($t_{1(9)}$=4.52, $p < .01$), information repairs ($t_{1(9)}$=3.18, $p < .05$) more common in first half of utterance
- Suggests these may be more related to message level as message-level planning finishes earlier
- Error repairs ($t_{1(9)}$=1.54, $p = .16$) and repeats ($t_{1(9)}$=1.00, $p = .34$) equally common in both halves
- Suggests relation to grammatical and phonological planning, which continues throughout an utterance

LEVEL OF PRODUCTION (CONT.)

CORRELATION

- Difficulty at a given level should increase the rate of all disfluencies associated with that level
- So, rate of disfluencies stemming from problems on the same level should correlate (by subjects)
- But disfluencies on different levels may be less related
- Rate of fillers correlated with rate of information repairs ($r = .70$, $p < .05$) but not of error repairs ($r = .44$, $p = .42$)
- Rate of silent pauses did not correlate with rate of information repairs ($r = .13$, $p > .99$) nor with error repairs ($r = .37$, $p = .60$)

RELATION TO UTTERANCE LENGTH

- Longer utterances require more grammatical/phonological planning
- But, not necessarily more complex on message level
- So, rate of message level disfluencies should be less strongly related to utterance length
- Does # of content words predict disfluency in a regression?

Table 5.

Rate of disfluency per 100 words as related to number of content words in an utterance, controlling for subjects.

Type	*B*	*r*	$t_{1(9)}$	*p*
Filler	-0.01	< 0.01	0.14	0.89
Silent Pause	0.23	0.11	2.75	< .01 **
Information Repair	0.10	0.05	1.20	0.23
Error Repair	0.18	0.09	2.09	< .05 *
Repeat	-0.06	-0.03	-0.73	0.47

- Rates of silent pauses and error repairs predicted by utterance length – suggests relation to grammatical/phonological planning
- Rates of fillers, information repairs, and repeats not predicted by utterance length – suggests relation to message planning