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

Scott H. Fraundorf and Duane G. Watson
University of Illinois at Urbana-Champaign

**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. Filler rates were more associated with message-level problems, while silent pauses were more associated with grammatical and phonological 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? 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:

1. Fillers: Interruptions that do not contribute to semantic content *Alice uhhh drinks the bottle*
2. Silent Pauses: Longer than would be expected from fluent utterance *Alice drinks Alice drinks the bottle*
3. Repairs: Error repairs correct errors of form: *“Alice drinks drinks the bottle”*
4. Information repairs revise content of utterance: *“Alice eats the cake er drinks the bottle”*
5. Repeats: Words repeated unmodified *“Alice drinks Alice drinks the bottle”*

**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:

- Fillers Before KPs ($F_{1,9}=16.48, p<.001$) — upcoming problems
- Silent Pauses Before KPs ($F_{1,9}=6.03, p=.03$) — upcoming problems
- Repairs: Beginning of KPs ($F_{1,9}=6.98, p>.05$) — (more immediate?) upcoming problems
- Repairs: After KPs ($F_{1,9}=5.57, p>.05$) — past problems

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

**REFERENCES**

**ACKNOWLEDGMENTS**
Scott H. Fraundorf was supported by National Science Foundation Graduate Research Fellowship 2000703221.
Contact: sfraund2@uiuc.edu
Alice’s Adventures in Um-derland – additional data

Scott H. Fraundorf and Duane G. Watson
University of Illinois at Urbana-Champaign

OVERALL FREQUENCY

Table 1: Rate of disfluency per 100 words by type

<table>
<thead>
<tr>
<th>Type</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1.99</td>
</tr>
<tr>
<td>Fillers</td>
<td>0.10</td>
</tr>
<tr>
<td>Silent Pauses</td>
<td>0.14</td>
</tr>
<tr>
<td>Repairs</td>
<td>0.04</td>
</tr>
<tr>
<td>Pause Series</td>
<td>0.19</td>
</tr>
<tr>
<td>Pause</td>
<td>0.12</td>
</tr>
<tr>
<td>Total</td>
<td>2.27</td>
</tr>
</tbody>
</table>

*Approximately 6 per 100 words, consistent with past estimates (e.g. Fox Tree, 1993).*

RESULTS – TEMPORAL LOCATION

WHERE ARE DISFLUENCIES MOST COMMON?

**Disfluency** | **Before Key Point** | **Between Key Points** | **Before Key Point** | **Between Key Points** | **After Key Point** | **Between Key Points** | **Before Key Point** | **Between Key Points** | **After Key Point** |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fillers</td>
<td>9.23</td>
<td>6.18</td>
<td>0.41</td>
<td>1.79</td>
<td>2.98</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silent Pauses</td>
<td>2.47</td>
<td>1.56</td>
<td>0.96</td>
<td>1.51</td>
<td>4.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repairs</td>
<td>0.83</td>
<td>1.09</td>
<td>0.26</td>
<td>0.52</td>
<td>0.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Fillers: Before KPs \((/1,9) = 16.48, p < .001\) – suggests relation to upcoming problems
- Silent Pauses Before KPs \((/1,9) = 6.03, p < .01\) – suggests relation to upcoming problems
- Repairs: After KPs \((/1,9) = 5.97, p < .001\) – 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>
<thead>
<tr>
<th>Type</th>
<th>Fillers</th>
<th>Silent Pauses</th>
<th>Repairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Repair</td>
<td>1.49 (0.06)</td>
<td>1.75 (0.08)</td>
<td>0.89 (0.06)</td>
</tr>
<tr>
<td>After Repair</td>
<td>1.09 (0.04)</td>
<td>1.10 (0.05)</td>
<td>0.69 (0.07)</td>
</tr>
</tbody>
</table>

- Fillers: More common before repairs than after \((/9) = 2.46, p < .05\) – suggests relation to upcoming problems
- Silent Pauses: More common before repairs than after \((/9) = 2.13, p < .05\) – suggests relation to upcoming problems
- Repairs: No more common before repairs than after \((/9) = 0.10, p = .32\)

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 \((/9) = 1.868, p = .150\)
- Clause boundaries more apt to have fillers when they begin a key point \((/9) = 2.44, p < .05\) – suggests fillers associated with message planning
- Silent pauses equally likely at all clause boundaries \((/9) = 1.19, p = .24\) – 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>
<thead>
<tr>
<th>Type</th>
<th>First Half</th>
<th>Second Half</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fillers</td>
<td>0.73 (0)</td>
<td>0.28 (0)</td>
</tr>
<tr>
<td>Silent Pauses</td>
<td>0.78 (0)</td>
<td>0.22 (0)</td>
</tr>
<tr>
<td>Repairs</td>
<td>0.70 (0)</td>
<td>0.30 (0)</td>
</tr>
</tbody>
</table>

- Fillers \(p = .34, p < .05\), silent pauses \(p = .42, p < .01\), information repairs \(p = .43, p < .001\) more common in first half of utterance
- Suggests these may be more related to message level as message-level planning finishes earlier
- Error repairs \(p = 1.74, p < 10^{-6}\) and repairs \(p = 1.00, p = .34\) 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 \((/70, p < .05)\) but not of error repairs \((/44, p = .42)\)
- Rate of silent pauses did not correlate with rate of information repairs \((/3, p < .99)\) nor with error repairs \((/37, p = .80)\)

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>
<thead>
<tr>
<th>Type</th>
<th>Full</th>
<th>Silent</th>
<th>Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fillers</td>
<td>0.21 (0)</td>
<td>0.25 (0)</td>
<td>0.29 (0)</td>
</tr>
<tr>
<td>Silent Pauses</td>
<td>0.23 (0)</td>
<td>0.23 (0)</td>
<td>0.23 (0)</td>
</tr>
<tr>
<td>Repairs</td>
<td>0.20 (0)</td>
<td>0.20 (0)</td>
<td>0.20 (0)</td>
</tr>
</tbody>
</table>

- 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

- Fillers \(p = .33, p < .05\), silent pauses \(p = .48, p < .01\), information repairs \(p = .50, p < .01\) more common in first half of utterance
- Suggests these may be more related to message level as message-level planning finishes earlier
- Error repairs \(p = 1.74, p < 10^{-6}\) and repairs \(p = 1.00, p = .34\) equally common in both halves
- Suggests relation to grammatical and phonological planning, which continues throughout an utterance
- Levels of production (cont.)

- 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 \((/70, p < .05)\) but not of error repairs \((/44, p = .42)\)
- Rate of silent pauses did not correlate with rate of information repairs \((/3, p < .99)\) nor with error repairs \((/37, p = .80)\)

- 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