The Effects of Altered Auditory Feedback (AAF) on Fluency in Adults Who Stutter: A Systematic Review

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The Effects of Altered Auditory Feedback (AAF) on Fluency in Adults Who Stutter: A Systematic Review
Sullivan Kiley, Nicholas Nocella, and Sarah Romeiser

Background
- Stuttering affects 70 million people worldwide, approximately 1% of the population.
- Altered auditory feedback (AAF) has been used to reduce the frequency of stuttering since the 1950s.
- AAF involves the electronic alteration of an auditory speech signal to temporarily increase the fluency of a person who stutters.
- AAF is known to increase fluency during oral reading and monologue tasks.
- Studies on the effects of AAF during spontaneous and conversational speech tasks have revealed mixed results.

Objectives
To determine whether AAF enhances fluency in adults who stutter.

Methods
- **Data sources:** Ovid MEDLINE, PubMed, PsychINFO (ProQuest), CINAHL
- **Search Terms:** "stuttering," "AAF," "altered auditory feedback," "feedback," "sensory," "auditory," "delayed," "feedback," "frequency," "fluency disorders," "stutter*"
- **Inclusion criteria:** Adults ages ≥18 years old who stutter, comparison of altered auditory feedback forms and/or no altered auditory feedback forms in the treatment of stuttering, use of DAF and/or FAF, outcomes related to aspects of stuttering or people who stutter (e.g., fluency level, speech naturalness, speech rate), experimental research
- **Exclusion criteria:** Prior history with any form of AAF for any participant, studies only including adults who do not stutter, any original format of articles not in English
- **Intervention:** Altered Auditory Feedback
- **Outcome:** Fluency
- **Measurements:** Stuttering severity (e.g., SSI-4), Overall stuttering frequency (e.g., %SS), Frequency of stuttering type (e.g., repetition), Duration of individual stutters, Stuttering probability, Speech rate, Speech Naturalness
- **Study Quality:** Appraisal via the Assessing the Quality and Applicability of Systematic Reviews (AQASR) checklist completed and cross-checked by 3 graduate student reviewers
- **Data Extraction:** Study Characteristics/Results Table created and completed based on most applicable study characteristics as judged by 3 graduate student reviewers

Results

Clinical Features of Studies

<table>
<thead>
<tr>
<th>Authors (Year)</th>
<th>Study Design</th>
<th>Number of Participants</th>
<th>Age Range</th>
<th>Type of Speech Assessed</th>
<th>Outcomes</th>
<th>Measurement</th>
<th>Significant Results</th>
<th>Conclusion (Efficacy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundas et al. (2013)</td>
<td>QE</td>
<td>24 males (14 PWS, 10 PNS)</td>
<td>20-46</td>
<td>R, M, C (DAF + FAF combo device)</td>
<td>1. ↓ stuttering freq.</td>
<td>1. %SS</td>
<td>1. R vs. M, device use</td>
<td>1. Yes</td>
</tr>
<tr>
<td>Geetha et al. (2017)</td>
<td>QE</td>
<td>50 males (25 PWS, 25 PNS)</td>
<td>18-30</td>
<td>SP (DAF, FAF)</td>
<td>1. Speech naturalness</td>
<td>1. Rating scale</td>
<td>1. Diff. b/w groups (all conditions)</td>
<td>1. No</td>
</tr>
<tr>
<td>Hargrave et al. (1994)</td>
<td>SS</td>
<td>14 PWS (12 males, 2 females)</td>
<td>18-52</td>
<td>R (FAF levels)</td>
<td>1. ↓ stuttering freq.</td>
<td>1. %SS</td>
<td>1. FAF levels vs. NAF</td>
<td>1. Yes</td>
</tr>
<tr>
<td>Hudock &amp; Kalinowski (2014)</td>
<td>SS</td>
<td>9 PWS (8 males, 1 female)</td>
<td>21-72</td>
<td>R (DAF + FAF combos)</td>
<td>1. ↓ stuttering freq.</td>
<td>1. %SS</td>
<td>1. Combos vs. NAF, COMBO-4 vs. COMBO-2</td>
<td>1. Yes</td>
</tr>
</tbody>
</table>

*Abbreviations: C=conversation/dialogue; DAF=delayed auditory feedback; FAF=frequency altered feedback; M=monologue; NAF=non-altered auditory feedback; PWS=people who do not stutter; PNS=people who stutter; QE=quasi-experimental; R=reading aloud; SP=spontaneous speech; SS=single subject; %SS=percentage syllables stuttered

Conclusions
- The overall quality of the articles assessed was ‘moderate.’
- AAF was generally effective at reducing stuttering frequency, with most benefit apparent during reading tasks.
- Fluency enhancement was variable across participants, with notable dependence on their stuttering severity level.
- The evidence to support improved speech naturalness is inconsistent.

Recommendations
- The results imply that clinical effectiveness is highly variable and that AAF is not a 'one size fits all' intervention.
- AAF is likely most effective when used in conjunction with traditional speech therapy.
- Effectiveness of AAF is limited to more structured speaking tasks, such as oral reading.
- Further research is needed to better understand the relationship between AAF and stuttering.