

Effects of FORBRAIN DAF on Stuttering Frequency During Story Retelling in Middle School Students: A Multiple-Baseline Study

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Planned data collection: January–February 2027.

Participants:

Participants will be middle school-aged students who stutter. Participants will be recruited using three geographic tiers based on participant availability. Tier I will include students who attend middle school in Rockland County, New York. If an adequate number of eligible participants is not obtained through Tier I recruitment, Tier II will expand recruitment to students in Westchester County, New York. If additional recruitment is necessary, Tier III will expand recruitment to Bronx County, New York.

Participants may be monolingual or bilingual. Bilingual students will be eligible to participate if they demonstrate proficiency in English, which will be established during the intake process.

Sampling:

A purposive sampling method will be used to recruit potential participants from multiple school districts. Recruitment information will be distributed to appropriate school personnel, such as speech-language pathologists, who may identify students who potentially meet the study's eligibility criteria. Interested families will be provided with information about the study and an opportunity to contact the primary investigator regarding participation.

Recruitment

Potential participants who express interest in the study will be considered for participation based on the established inclusion and exclusion criteria. The primary investigator will review eligibility information and complete the study's screening procedures. Three students who meet all eligibility criteria and whose parent or legal guardian provides informed consent, and who provide assent, will be enrolled in the study.

Screening Procedures

Potential participants will be screened to determine whether they meet the established inclusion and exclusion criteria. Screening will include confirmation of the student's grade level, primary language, and stuttering diagnosis/severity.



Documentation of an SSI-4 administered within the previous year will be reviewed to confirm moderate to severe stuttering. The investigator will also determine whether any exclusionary conditions are present before enrollment.

Consent

Written informed consent will be obtained from the parent or legal guardian of each participant prior to participation in the study. Participant assent will also be obtained prior to initiation of study procedures.

Protections

Each participant will be assigned a number to protect their identity. Participant names will not be used on data collection forms or when reporting the results of the study. All recordings and study data will be stored on a password-protected device and will only be available to the primary investigator and approved research personnel. Consent and assent forms will be stored separately from the study data. The names of the participants, schools, and school districts will not be included when the results of the study are presented or reported.

Inclusion

Participants must be middle school-aged students in grades 6–8 who stutter. Participants must demonstrate moderate to severe stuttering as measured by the SSI-4 within the past 12 months. If an SSI-4 has not been completed within the past 12 months, it will be administered by the primary investigator. Participants must demonstrate basic conversational and expressive language skills necessary to complete the speaking tasks used in the study. Participants may be monolingual or bilingual; however, bilingual participants must demonstrate proficiency in English during the intake process.

Exclusion

Participants will be excluded if they have a diagnosis of cluttering or selective mutism. Participants will also be excluded if they have significant cognitive, sensory, or language needs that would prevent them from understanding or completing the speaking tasks required for the study. Students who are not proficient enough in English to complete the study tasks will also be excluded.

Attrition

A minimum of three participants will be required for the study, with a goal of recruiting additional participants if available, up to a maximum of 10. Having more than three participants



will allow for additional replication of the effect across participants and will also help account for possible attrition. If a participant withdraws from the study, recruitment may continue as needed to maintain at least three participants.

Study Personnel

The primary investigator is a New York State licensed speech-language pathologist and ASHA member who has been practicing in the field of speech-language pathology for 12 years. The investigator has experience working with clients ranging from 18 months of age through the geriatric population. The investigator previously worked for several years in a special education preschool and currently works in a public middle school in Rockland County, New York. The investigator has also facilitated a weekly fluency group for the past four years and has experience working with middle school students who stutter.

Secondary Personnel (i.e., interrater or fidelity observer)

A second speech-language pathologist will serve as an interrater and/or procedural fidelity observer. The secondary observer will be a licensed speech-language pathologist with experience identifying and measuring stuttering behaviors. Prior to collecting interrater or fidelity data, the observer will be trained on the study procedures, operational definition of stuttering, calculation of %SS, and the procedural fidelity checklist.

Setting

The study will take place in a quiet therapy room or similar private space within the participant's school or another approved location. The room will be free from unnecessary distractions and will include a table and two chairs. The participant and primary investigator will sit across from each other at the table. All baseline and intervention activities will take place in this space. Sessions will be scheduled based on participant availability and may occur during or after the school day. The same setting will be used for each participant whenever possible.

Materials

Materials will include the ForBrain headset with delayed auditory feedback (DAF) set at a 50-millisecond (ms) delay, a computer or tablet, a timer, and audio/video recording equipment. Visual supports will be used to assist participants with the story-retell task. A different age-appropriate video clip and corresponding visual supports will be used for each session to reduce familiarity with the materials.

Data collection forms will be used to record the total number of syllables produced and the number of stuttered syllables to calculate %SS. A procedural fidelity checklist will also be used to ensure that study procedures are followed consistently across sessions.

Measures

The *Stuttering Severity Instrument–Fourth Edition* (SSI-4) will be used to determine participants' stuttering severity. Participants must have an SSI-4 completed within the previous 12 months that indicates moderate to severe stuttering. If an SSI-4 has not been completed within the previous 12 months, the primary investigator will administer the assessment as part of the screening process. Basic conversational skills will also be observed during intake to ensure that participants have the expressive language skills needed to complete the study tasks.

Design

A nonconcurrent, a priori multiple baseline design across participants will be used for this study. Baseline lengths will be predetermined and staggered across participants using a repeating sequence of 3, 4, and 5 sessions. For example, Participants 1, 2, and 3 will complete 3, 4, and 5 baseline sessions, respectively. If additional participants are recruited, the baseline sequence will repeat (3, 4, and 5 sessions). Each participant will complete 7 intervention sessions following the baseline phase.

This design is appropriate because it will allow the effect of DAF on percentage of syllables stuttered (%SS) to be examined across participants. Introducing DAF at different points across participants will allow the effect of the intervention to be replicated. Stuttering is a variable behavior and may change across speaking situations and over time. Although changes in stuttering associated with DAF may be reversible when DAF is removed, a withdrawal design was not selected. A multiple baseline design allows the effects of DAF to be examined across participants without repeatedly introducing and withdrawing the intervention.

Dependent Variable

The dependent variable for this study will be percentage of syllables stuttered (%SS). Stuttering will be defined as disruptions in the forward flow of speech, including whole-word repetitions with tension, syllable repetitions (e.g., *bu-bu-but*), sound prolongations (e.g., *mmmore*), and blocks (e.g., *g___game*). Typical hesitations, revisions, interjections, and pauses without tension will not be counted as stuttering. A speech sample will be collected during each baseline and intervention session using a story-retell task with visual supports. The entire story retell will be recorded; however, only the first 2 minutes will be used for data analysis.



The dependent variable will be measured through direct systematic observation of the recorded speech sample. The primary investigator will review the first 2 minutes of each recorded story retell and manually record the total number of syllables produced and the number of stuttered syllables on a data collection form.

The unit of measurement will be percentage of syllables stuttered (%SS). Percentage of syllables stuttered will be calculated by dividing the number of stuttered syllables by the total number of syllables produced and multiplying by 100.

$$\%SS = (\text{stuttered syllables} \div \text{total syllables}) \times 100$$

Independent Variable

The independent variable for this study will be delayed auditory feedback (DAF) delivered through the ForBrain headset. DAF allows the participant to hear their own speech after a brief time delay while speaking. For this study, the ForBrain headset will be set to a 50-millisecond (ms) delay. Participants will wear the headset during the intervention condition while completing the story-retell task.

Procedures of the Investigation

Baseline

An a priori baseline of 3, 4, or 5 sessions will be conducted for each participant. Baseline lengths will follow a repeating sequence of 3, 4, and 5 sessions across participants.

During each baseline session, the participant will view a short, silent, animated video ranging from approximately 2–5 minutes in length. Following the video, the participant will transition to a table for the story-retell task. A sequence of six pictures screen-grabbed directly from the video will be presented in color on a single US Letter (8.5 × 11-inch) page to assist with the retell. The participant will be instructed to retell the story in their own words and provide as much detail and information as possible rather than relying only on the pictures. No cues or feedback related to fluency will be provided.

The entire story retell will be audio/video recorded; however, only the first 2 minutes will be used for data analysis. The participant will not wear the ForBrain headset during baseline data collection.

Following completion of the baseline speech sample during the first three baseline sessions, each participant will receive a DAF familiarization period of up to 5 minutes. The primary investigator will fit the ForBrain headset on the participant. The participant will speak while



wearing the headset and will be allowed to explore the different delay settings during informal conversation. No data will be collected during familiarization, and the familiarization period will not be included in the calculation of %SS.

Each participant will therefore receive three DAF familiarization exposures before beginning intervention, regardless of their assigned baseline length. Participants assigned four or five baseline sessions will not complete additional DAF familiarization following their remaining baseline sessions.

Intervention

Following completion of the assigned baseline phase and three DAF familiarization exposures, each participant will complete 7 intervention sessions. Intervention sessions will follow the same procedures used during baseline, with the addition of DAF at a predetermined 50-millisecond (ms) delay.

At the beginning of each intervention session, the participant will view a short, silent, animated video ranging from approximately 2–5 minutes in length. Following the video, the participant will transition to a table for the story-retell portion of the session. A sequence of six pictures screen-grabbed directly from the video will be presented in color on a single US Letter (8.5 × 11-inch) page to assist with the retell.

Prior to beginning the story retell, the primary investigator will fit the participant with the ForBrain headset and set the DAF to a 50-ms delay. The participant will be instructed to retell the story in their own words and provide as much detail and information as possible rather than relying only on the pictures. The participant will wear the ForBrain headset for the entire story retell, and the 50-ms delay setting will remain unchanged. No cues or feedback related to fluency will be provided during the retell.

The entire story retell will be audio/video recorded; however, only the first 2 minutes will be used for data analysis. Following each intervention session, the primary investigator will review the recorded 2-minute speech sample to determine percentage of syllables stuttered (%SS).

This procedure will be followed consistently across all 7 intervention sessions for each participant.

Fidelity Measures

Procedural Fidelity



A procedural fidelity checklist will be used to ensure that baseline and intervention procedures are implemented consistently across participants and sessions. The primary investigator will follow the checklist during each session. A second New York State licensed speech-language pathologist will independently review 20% of the recorded sessions and complete the procedural fidelity checklist. The sessions selected for fidelity assessment will be distributed across participants and will include sessions from both the baseline and intervention conditions. The secondary observer will not be required to be physically present during data collection.

The checklist will include the required steps for each condition, including presentation of the silent animated video, presentation of the six-picture visual support, delivery of the story-retell instructions, audio/video recording of the story retell, and absence of fluency-related cues or feedback.

During baseline, the checklist will verify that the participant does not wear the ForBrain headset during collection of the baseline speech sample. For the first three baseline sessions, the checklist will also verify that DAF familiarization occurs only after baseline data collection and lasts no longer than 5 minutes.

During intervention, the checklist will verify that the ForBrain headset is properly fitted prior to the story retell, DAF is set at 50 ms, the participant wears the headset throughout the retell, and the delay setting remains unchanged during data collection.

Procedural fidelity will be calculated by dividing the number of correctly implemented procedural steps by the total number of planned procedural steps and multiplying by 100. verify that DAF familiarization occurs only after baseline data collection and lasts no longer than 5 minutes.

During intervention, the checklist will verify that the ForBrain headset is properly fitted prior to the story retell, DAF is set at 50 ms, the participant wears the headset throughout the retell, and the delay setting remains unchanged during data collection.

Procedural fidelity will be calculated by dividing the number of correctly implemented procedural steps by the total number of planned procedural steps and multiplying by 100.

Interobserver Agreement

Interobserver agreement (IOA) will be assessed by a second New York State licensed speech-language pathologist with experience working with individuals who stutter. Prior to completing IOA, the secondary observer will be trained on the operational definition of stuttering used in this study and the procedures for identifying and recording stuttered and total syllables.



A random 20% of the recorded speech samples will be selected for IOA, with samples selected across participants and from both baseline and intervention conditions. The secondary observer will independently review the first 2 minutes of each selected story retell and record the total number of syllables produced and the number of stuttered syllables. The secondary observer will not have access to the primary investigator's scoring while completing the measurement.

The primary investigator's and secondary observer's measurements will be compared to determine percent agreement. An agreement level of 90% or greater will be considered acceptable for this study. IOA will be calculated and reported as a percentage for the selected samples.

An IOA data collection form will be included in the Appendix.

Social Validity

Social validity will be assessed following completion of the intervention phase to determine the participants' perceptions of using DAF. Each participant will complete a brief questionnaire regarding their experience using the ForBrain headset. Questions will address the participant's comfort while wearing the device, ease of use, perception of their speech while using DAF, and whether they would consider using DAF again in the future.

Participants will respond to questions using a brief rating scale, with an opportunity to provide additional comments about their experience. Social validity data will be used to provide information about the acceptability and usability of DAF from the participants' perspective and will not be included in the calculation of the dependent variable (%SS). The social validity questionnaire will be included in the Appendix.

Threats to Internal Validity

History may be a threat if events outside of the study influence a participant's stuttering during the investigation. For example, changes in speech-language services or other events occurring during the study could affect fluency. Any changes in outside stuttering treatment that occur during participation will be documented. The staggered introduction of DAF across participants will also help determine whether changes in %SS are associated with the introduction of the intervention rather than an outside event.

Maturation may be a threat because participants' stuttering may naturally change over time independent of DAF. This threat will be reduced by the relatively short duration of the study and the staggered introduction of the intervention across participants.

Testing or practice effects may occur as participants become more familiar with the story-retell task through repeated participation. To reduce this threat, a different silent animated video and corresponding six-picture sequence will be used during each session.

Carryover effects are possible because participants will receive three brief DAF familiarization exposures during the baseline phase. Familiarization will occur only after the baseline speech sample has been collected and will be limited to a maximum of 5 minutes. Familiarization will consist of informal conversation rather than the story-retell task, and no data will be collected during this time. Baseline data will be examined for changes following DAF exposure that could indicate a possible carryover effect.

Attrition may occur if a participant withdraws from the study or is unable to complete all sessions. Recruitment may continue as needed to maintain a minimum of three participants. Missed sessions will be rescheduled whenever possible.

Data Analysis

Data will be analyzed using visual analysis and descriptive statistics. Each participant will serve as their own control, with intervention data compared to that participant's baseline data. Percentage of syllables stuttered (%SS) will be graphed across baseline and intervention sessions for each participant. Visual analysis will be used to examine changes within and between conditions.

Baseline data will be examined for stability, level, trend, and variability. Baseline stability will be evaluated using the 50/50 stability criterion. Participants will transition to intervention following completion of their predetermined baseline of 3, 4, or 5 sessions.

Descriptive statistics will include the mean, median, range, and standard deviation of %SS within each condition. Additional analyses will include absolute level of change (ALOC), relative level of change (RLOC), percentage of nonoverlapping data (PND), and the two-standard deviation band method to further examine changes within and between baseline and intervention conditions.

Changes in level, slope, trend, stability, and overlap will be examined for each participant.