

## Level Up Your Critical Thinking around AI for Speech Sound Disorders: Part 1



Nina Benway  
PhD CCC-SLP  
University of Maryland, College Park

Follow.the.Speech.Production.Lab.on.Instagram.to.find.Updates.on.this.work. @speechproductionlabsyr

### 1. What is AI and Machine Learning?

- **Artificial Intelligence (AI):** AI refers to any computerized system designed to make predictions, offer recommendations, or arrive at decisions based on goals set by humans.
- **Machine Learning:** Machine learning is one specific process by which an AI system learns to make predictions. Machine learning doesn't involve explicit step-by-step programming. Instead, the system learns through repeated trial and error, adjusting its calculations to improve its predictions.

### 2. What is Clinical AI and How Does it Differ from Other Technologies Used in Speech-Language Pathology?

- **Clinical AI in speech-language pathology** refers to AI systems specifically created to measure and analyze aspects of communication disorders. It can focus on:
  - **Low-level Measures:** Analyzing individual aspects of speech within an utterance (e.g., percentage of stuttered syllables, roughness of voice, accuracy of a single speech sound).
  - **High-level Measures:** Predicting broader clinical features based on a collection of speech measures (e.g., presence of apraxia of speech, severity of speech sound disorder).
- **Key Distinction:** The defining characteristic of clinical AI is its ability to make predictions, recommendations, or decisions without direct input from a clinician, based on what it learned during the machine learning process.
- **Examples of Clinical AI vs. Non-AI Technologies**
  - A word practice app that simply presents words in a pre-set order is non-AI. A word practice app that analyzes learner performance and adjusts word recommendations would be considered clinical AI.
  - An ultrasound biofeedback display that only shows tongue movements is non-AI. A ultrasound biofeedback display that predicts speech sound accuracy or suggests improvements is clinical AI.

### 3. How Does Evidence-Based Practice (EBP) Apply to Clinical AI?

- **EBP is Essential:** EBP is crucial in evaluating the appropriateness and effectiveness of clinical AI tools. EBP involves the integration of:
  - **Client Perspectives:** Understanding and respecting a client's values, preferences, and concerns regarding the use of AI.

- Clinical Expertise: A clinician's professional judgment, skills, and experience in assessing the potential benefits and risks of using AI for a specific client.
- External Evidence: High-quality research, particularly clinical trials, that provide evidence of the AI tool's efficacy and effectiveness.

● AI Doesn't Inherit EBP: Just because a non-AI clinical practice has proven effective when delivered by a human clinician does not automatically mean that an AI-driven version of that clinical practice will be effective. Rigorous clinical trials are needed to specifically evaluate the AI tool's performance.

#### 4. How Can Clinicians Assess the Validity of Clinical AI Tools?

● Validity is the extent to which a tool accurately measures what it is intended to measure.

● Key Considerations for validity:

- Content: Does the AI tool consider all relevant aspects of the speech being measured? (e.g., does SSD clinical AI consider productions in syllables, words, phrases, and sentences?)
- Response Type: Is the method of assessment appropriate for the target? (e.g., Analyzing utterances vs. relying on surveys).
- Conceptual Framework: Is the AI tool based on a sound and validated theoretical understanding of the communication disorder? (e.g., analyzing phonological error patterns when appropriate).
- Relation to Other Measures: Do the AI tool's measurements align with established clinical assessments or expert judgments? (e.g., High correlation with clinician ratings).
- Clinical Trial Effectiveness: Do well-designed clinical trials demonstrate that the AI tool leads to clinically meaningful improvements for clients?

● External Validity: This is a crucial aspect of validity that focuses on how well the tool generalizes to new, unseen individuals.

#### 5. How Can Clinicians Assess the Reliability of Clinical AI Tools?

● Reliability refers to the consistency of a tool's measurements. It's about whether the tool produces stable and reproducible results.

● Factors Affecting Reliability:

- Consistency Over Repeated Measures: Does the AI tool provide similar results when measuring the same speech sample multiple times?
- Consistency Across Contexts: Is the tool's performance affected by factors like the way speech is elicited or the client's attention/effort?
- Inter-Rater Reliability: Do different human experts agree with the AI tool's assessments?

● Model Performance Metrics: Different metrics are used to assess human-AI reliability depending on the type of AI task (classification, regression, speech recognition).

- Classification Metrics (e.g., accuracy, F1-score, sensitivity, specificity): These measure how well the AI tool correctly categorizes speech or language samples.
- Regression Metrics (e.g., mean squared error, correlation coefficients): These measure how closely the AI tool's predicted values match the actual values.
- Speech Recognition Metrics (e.g., word error rate, phoneme error rate): These measure how accurately the AI tool transcribes speech.

● **Test Set Performance:** Reliability should be reported based on the AI tool's performance on a "test set" of data that it has never seen before during training. This helps to predict the extent to which the tool may succeed with future users, which is very important in clinical settings.

## 6. How Can Clinicians Promote the Ethical Use of Clinical AI, Given a Specific Client's Preferences?

- **Ethical Use** involves adhering to professional standards and ensuring that AI is used responsibly and fairly.
- **Equitable Use** means ensuring that all individuals, regardless of their background or characteristics, have equal access to the benefits of AI and are not unfairly disadvantaged by it.
- **Key Steps:**
  - **Informed Consent:** Obtain clear and informed consent from clients (or their guardians) before using AI tools. This includes explaining the purpose, benefits, risks, and limitations of the technology.
  - **Respect Client Preferences:** Carefully consider client preferences regarding the use of AI, particularly concerning data privacy and the desired level of human clinician involvement.
  - **Cultural Responsiveness:** Be aware of how cultural and linguistic variations can impact the performance and interpretation of AI tools. Ensure that the AI tool is appropriate for the client's cultural and linguistic background.
  - **Acknowledge Potential Bias:** Critically evaluate whether the AI tool exhibits bias based on factors like race, ethnicity, gender, socioeconomic status, or dialect. Advocate for tools that have been developed and tested to minimize bias.
  - **Community Involvement:** Support the development of AI tools that involve the communities they are intended to serve. This includes stressing that these tools must have input from clients, families, and clinicians from diverse backgrounds.
- **Ongoing Monitoring:** Continuously monitor the AI tool's performance and impact on the client. Be prepared to adjust the treatment plan or discontinue the use of the tool if necessary.
- **Transparency:** Encourage transparency from AI developers about their data sources, training methods, and validation procedures.