Exploring the Psycholinguistic Impact of Stuttering through Artificial Intelligence

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Abstract
Stuttering, a complex neurodevelopmental speech disorder, profoundly impacts an individual's communication and quality of life. We argue that stuttering is not merely a motor speech disorder but a multifaceted phenomenon deeply intertwined with cognitive, linguistic, and social processes. This study explores the complex interplay between stuttering, psycholinguistics, and artificial intelligence through the lens of Sociotechnical Systems and Sentiment Theory, leveraging Natural Language Processing to analyze and interpret human text. Employing a mixed-methods approach, this research combines quantitative and qualitative methods to provide a nuanced understanding of stuttering's impact on communication and quality of life. The objectives will examine the psychological and linguistic impact. Through surveys, interviews, and sentiment scales, we investigate language attitudes, psycholinguistic processes, and adaptive communication strategies among individuals who stutter. Sentiment analysis as a methodology

was conducted using Natural Language Processing (NLP) libraries to quantify the sentiment patterns in participants' responses. Key findings reveal that stuttering significantly affects language processing, particularly in word retrieval and sentence formulation, and that individuals who stutter develop unique communication styles to mitigate its effects. AI, with its capabilities in speech analysis, natural language processing, and pattern recognition, offers unprecedented opportunities for objective assessment, personalized intervention, and deeper insights into the underlying mechanisms of stuttering. However, the successful integration of AI into stuttering research and therapy necessitates a comprehensive STS approach, ensuring joint optimization of both technological advancements and human elements, addressing ethical considerations, and fostering collaboration among diverse stakeholders.

Keywords: Stuttering, Psycholinguistics, Artificial Intelligence, Sociotechnical Systems Theory, Speech-Language Pathology, Ethical AI, Sentiment System Theory, Communication Disorders.

1. Introduction

Stuttering, or dysfluent speech, is characterized by disruptions in the natural flow of speech, including repetitions of sounds, syllables, or words, prolongations of sounds, and silent blocks (Bloodstein & Ratner, 2008). The objectives of this study are to examine the psycholinguistic impact involving emotions, anger, and facial expression. And the second objective, investigates the linguistic impact which has to look at repeating words or phrases, sentence formulation, avoidance of words, and loss of semantic encoding because of stuttering. Beyond the observable speech characteristics, stuttering has a significant psycholinguistic impact, affecting

cognitive processes such as language planning, lexical retrieval, and executive functions (Number Analytics, 2025a; Number Analytics, 2025c). Individuals who stutter (IWS) often experience heightened anxiety, fear of speaking situations, and reduced self-esteem, leading to social and professional challenges.

Traditionally, the study and treatment of stuttering have relied heavily on subjective assessments and clinician-led interventions. While valuable, these approaches can be limited by human perceptual biases, variability in assessment, and the labor-intensive nature of therapy. The advent of Artificial Intelligence (AI) presents a transformative opportunity to overcome some of these limitations and deepen our understanding of stuttering's psycholinguistic underpinnings. AI-powered tools can analyze speech patterns with unparalleled precision, identify subtle disfluencies, and provide objective data for diagnosis and progress monitoring (Number Analytics, 2025b; Number Analytics, 2025d).

However, the integration of AI into such a sensitive and human-centric field as speech-language pathology is not without complexities. To ensure that AI genuinely enhances the lives of IWS and the practice of clinicians, a holistic framework is required. This paper proposes Sociotechnical Systems (STS) theory as the guiding theoretical framework for exploring the psycholinguistic impact of stuttering through AI. STS theory emphasizes the interdependencies between the social and technical components of a system, advocating for their joint optimization to achieve desired outcomes (Wikipedia, n.d.a). By applying STS, we aim to examine not only the technical potential of AI but also its implications for human-centered design, ethical considerations, and the dynamic interplay between clinicians, IWS, and AI technologies.

Stuttering, a complex speech disorder marked by frequent disruptions in the fluency and flow of speech, affects approximately 1% of the global population. These disruptions, known as disfluencies, can manifest as repetitions, prolongations, or blocks of sounds, syllables, or words, significantly impacting communication abilities. Beyond the speech characteristics, stuttering has profound psycholinguistic effects, influencing cognitive processes, emotional well-being, and social interactions. This study aims to leverage artificial intelligence (AI) to explore the psycholinguistic impact of stuttering, offering novel insights and potential interventions to improve the lives of those affected.

Historically, stuttering has been studied from various perspectives, evolving from simplistic theories to more sophisticated models. Wendell Johnson's Diagnosogenic Theory in the 1940s posited that stuttering develops when caregivers misinterpret normal disfluencies as stuttering, thereby causing the child to develop the disorder (Johnson, 1959). However, subsequent research has refuted this theory, pointing instead to a complex interplay of genetic, neurophysiological, and environmental factors.

On the other hand, modern neuroimaging studies have revealed structural and functional abnormalities in the brains of individuals who stutter, particularly in regions responsible for speech production and motor control (Chang, Horwitz, Ostuni, Reynolds, & Ludlow 2010; Ingham, Fox, Ingham, Xiong, Zamarripa, Hardies, & Lancaster 2004). Psycholinguistically, stuttering is viewed as a disruption in the language formulation and speech execution processes. Cognitive models, such as the Covert Repair Hypothesis, suggest that stuttering occurs due to attempts to correct internal speech errors before articulation (Postma & Kolk, 1993). Emotional factors, including anxiety and stress, further

exacerbate stuttering, leading to avoidance behaviors and social withdrawal (Craig, Blumgart, & Tran 2003).

With the advances in artificial intelligence and their relevance, particularly in machine learning (ML) and natural language processing (NLP), it has revolutionized the analysis and interpretation of complex datasets.

AI's ability to process large volumes of data, identify patterns, and make predictive analyses presents a unique opportunity to deepen our understanding of stuttering. By applying AI techniques to the study of stuttering, researchers can analyse speech patterns where AI algorithms can dissect and categorize various types of disfluencies, providing a granular understanding of stuttering patterns and their triggers (Rekik et al., 2018). Another is assessing cognitive load, where machine learning models can evaluate the cognitive demands of speech production in real time, correlating disfluencies with cognitive overload or specific linguistic structures. More so, researchers can have emotional and psychological insights where AI-driven sentiment analysis can assess the emotional content and psychological stress associated with stuttered speech, offering insights into the affective dimensions of stuttering (Shenoy, Bashyam, & Kesavan 2020). Researchers can have therapeutic innovations where AI can facilitate the development of personalized therapeutic interventions, offering real-time feedback and adaptive strategies tailored to individual needs.

However, despite the potential of AI to transform stuttering research and therapy, several challenges and problems need to be addressed. The first issue is data collection and quality based on diverse and representative samples. Here, the collection of diverse and representative samples of speech data from individuals who stutter is challenging. Variations in age, gender, cultural

background, and severity of stuttering must be accounted for to ensure the generalizability of AI models. Another is data quality and annotation. At this juncture, high quality, annotated speech data is essential for training accurate AI models.

Manual annotation of disfluencies is time-consuming and requires expertise, posing a significant bottleneck in data preparation. There is also a problem with algorithm development and validation, involving model accuracy and robustness, where developing AI models that accurately identify and classify stuttering patterns is complex. Ensuring robustness and avoiding overfitting are critical to developing reliable models and solving the problem of real-time processing. Real-time analysis and feedback require efficient algorithms capable of processing speech data with minimal latency, which is technically demanding (Shenoy et al., 2020). Also, there is a problem with ethical considerations that involve privacy and confidentiality.

Here, ensuring the privacy and confidentiality of individuals' speech data is paramount. Ethical guidelines must be established to protect the data collected and used for AI research as well as inclusivity and accessibility. AI interventions should be designed to be inclusive and accessible, avoiding exacerbation of existing disparities in access to speech therapy, and finally, the integration with existing therapeutic approaches that involves combining AI with traditional therapies. Here, the integration of AI-driven tools with existing therapeutic approaches requires careful consideration to enhance rather than replace human-led intervention.

So, exploring the psycholinguistic impact of stuttering through artificial intelligence offers a promising avenue for advancing our understanding and treatment of this complex disorder. By addressing the challenges and leveraging the capabilities of AI, researchers can develop innovative solutions that

enhance the quality of life for individuals who stutter. This interdisciplinary approach, combining insights from neuroscience, psychology, linguistics, and AI, holds the potential to transform stuttering research and therapy, ultimately leading to more effective and personalized interventions.

2. The Psycholinguistics of Stuttering

Psycholinguistics investigates the psychological and neurobiological factors that enable humans to acquire, use, comprehend, and produce language. In the context of stuttering, psycholinguistic research has illuminated several key areas of impact:

Speech Planning and Execution: Stuttering is often viewed as a breakdown in the complex orchestration of speech planning and motor execution. Psycholinguistic models suggest that difficulties may arise at various stages, including phonological encoding (selecting and sequencing sounds), phonetic encoding (translating abstract linguistic plans into motor commands), and motor programming (executing the muscle movements for speech) (Number Analytics, 2025a).

Cognitive Load and Effort: IWS often report increased cognitive effort during speech production. This heightened load can manifest as slower processing speeds, difficulties with multitasking while speaking, and reduced cognitive resources available for other tasks (Number Analytics, 2025c).

Linguistic Complexity: Research indicates that the frequency and severity of stuttering can be influenced by linguistic factors such as utterance length, syntactic complexity, and lexical density (Bodea

Haţegan et al., 2012). This suggests that the demands of language formulation can exacerbate disfluencies.

Emotional and Affective States: Anxiety, fear of negative evaluation, and self-consciousness are well-documented psychological correlates of stuttering. These emotional states can, in turn, impact psycholinguistic processes, creating a vicious cycle where anticipation of stuttering leads to increased disfluency (Number Analytics, 2025a).

Self-Monitoring and Feedback Loops: Fluent speech relies on continuous self-monitoring and rapid feedback loops. In stuttering, these loops may be disrupted, leading to impaired detection and correction of errors, or an over-reliance on conscious control that ironically hinders fluency.

Neurological Correlates: Neuroimaging studies have identified structural and functional differences in the brains of IWS, particularly in areas associated with speech and language processing, motor control, and auditory feedback (Number Analytics, 2025a). These neurological findings underscore the biological underpinnings of the psycholinguistic challenges.

Understanding these psycholinguistic dimensions is crucial for developing effective interventions. AI has the potential to provide more granular and objective insights into these processes than previously possible.

2.1 Artificial Intelligence in Stuttering Research and Intervention

AI's capabilities are rapidly transforming various healthcare domains, and speech-language pathology is no exception. In the context of stuttering, AI offers promising applications across assessment, diagnosis, treatment, and research:

Automated Stuttering Detection and Classification: Machine learning algorithms can be trained on vast datasets of fluent and stuttered speech to accurately identify and classify different types of disfluencies (e.g., sound repetitions, prolongations, blocks). This can provide objective and consistent measures of stuttering severity, track progress over time, and even predict upcoming speech behaviors (MDPI, 2025; ResearchGate, n.d.).

Speech Analysis Software: AI-powered software can analyze various acoustic features of speech, such as pitch, rhythm, intonation, and speaking rate, to identify subtle patterns associated with stuttering. This detailed analysis can complement perceptual assessments and provide deeper insights into motor speech control (Frontiers, 2023).

Personalized Therapy and Feedback: AI can facilitate highly personalized interventions. Virtual speech therapists or AI-powered apps can provide real-time feedback on speech fluency, guide users through exercises, and adapt therapy plans based on individual progress (Number Analytics, 2025b). This can increase accessibility and consistency of practice.

Data-Driven Insights: AI can process and analyze large amounts of speech data, identifying correlations and patterns that might be imperceptible to human observers. This can lead to new discoveries

about the psycholinguistic mechanisms underlying stuttering and the effectiveness of different therapeutic approaches.

Accessibility and Inclusivity: AI can enhance accessibility to speech therapy services, particularly for individuals in underserved areas or those facing geographical or financial barriers. Teletherapy platforms augmented by AI can extend the reach of qualified clinicians (KevinMD.com, 2025).

Voice AI Accessibility: A significant challenge for IWS is interacting with voice-activated AI systems (e.g., smart assistants, navigation systems). Research is underway to develop AI that can better recognize and interpret stuttered speech, making these technologies more inclusive (Western Michigan University, 2024).

2.2 Other Natural Language Applications

NLP (Natural Language Processing)

NLP transport human language into something that machine can understand it applies synthetic techniques to understand the structure of a test and semantic technique to identify meaning. Some of these techniques are: tokenization, lemmatization and part of speech tagging. Once the test is processed with NLP techniques it is ready for classification with Machine Learning Algorithms. Machine learning allows machine to recognize patterns and data to make predictions instead of relying on explicit instructions. Machine learning learns from similar examples, training data.

NLTK (Natural Language Tool Kit)

NLTK is a popular python library for natural language processing (NLP) tasks, including sentiment analysis. One of the key features of NLTK is Sentiment Analysis. The tools for Sentiment Analysis

include VADER integration. NLTK application to Sentiment Analysis involves analyzing text sentiments in stutterers on interviews. Then Text Classification is classifying the text into categories and finally building models to predict language patterns and generate text. NLTK provides a wide range of tools and resources for NLP tasks. It is flexible and can be used in various NLP application, and domain. It has an active community and extensive documentation. NLKT provides tools for sentiment analysis including VADER (Valence Aware Dictionary and Sentiment Reasoner).

Key Features of VADER:

-Sentiment Scoring: VADER assigns sentiment scores to text based on the presence of words with positive or negative connotations.

- Rule-Based Approach: VADER uses a rule-based approach, combining a dictionary of words with predefined sentiment scores and grammatical rules to analyze text.

- Handling of Negations and Intensifiers: VADER can handle negations (e.g., "not good") and intensifiers (e.g., "very good") to provide more accurate sentiment analysis.

- Social Media-Friendly: VADER is designed to handle social media text, including slang, acronyms, and emoticons, making it suitable for analyzing user-generated content.

Applications of VADER:

-Sentiment Analysis: VADER is widely used for sentiment analysis in various domains, including social media monitoring, customer feedback analysis, and market research.

-Opinion Mining: VADER can be used to extract opinions and sentiments from text data, providing insights into public opinion or customer attitudes.

-Text Classification: VADER's sentiment scores can be used as features for text classification tasks, such as classifying text as positive, negative, or neutral.

VADER is a powerful tool for sentiment analysis, offering a robust and efficient way to analyze text and extract insights into the sentiment and emotional tone of the language

While the technical potential of AI in stuttering is immense, its effective and ethical deployment requires careful consideration of the human and organizational factors involved. This is where Sociotechnical Systems theory and Sentiment System Theory becomes indispensable.

2.3 Theoretical Framework

This research adopts Sociotechnical Systems Theory and Sentiment System Theory as the Theoretical Framework. Sociotechnical Systems (STS) theory, originating from the Tavistock Institute in the 1950s, posits that effective organizational performance is achieved through the joint optimization of its social and technical components (Wikipedia, n.d.). It moves beyond a purely technological determinism, recognizing that technology's impact is mediated by the social structures, human interactions, and organizational contexts in which it is embedded. Applying STS to the integration of AI in understanding the psycholinguistic impact of stuttering involves considering:

The Social System encompasses the individuals in Integrated Work Systems (IWS) e.g. speech-language pathologists, researchers, caregivers; their roles, relationships, skills, values, and psychological well-being. It includes the organizational structures of clinics, research institutions, and technology developers. The Technical System refers to the AI algorithms, software, hardware,

data infrastructure, and the specific functionalities they offer for speech analysis, diagnosis, and intervention.

Joint optimization in this context means designing and implementing AI systems in a way that maximizes the technical efficiency and accuracy of AI, and the human well-being, satisfaction, and effectiveness of all stakeholders. Key principles of STS relevant to this research include: Interdependence recognizes that changes in the AI (technical) system will inevitably impact the human (social) system, and vice versa. For example, a highly accurate AI diagnostic tool may be ineffective if clinicians lack the training or trust to use it, or if it disempowers IWS.

Autonomy and Control ensures that AI tools augment, rather than replace, human expertise and agency. Clinicians should retain control over diagnostic decisions and therapy planning, using AI as a supportive tool. IWS should have agency in their therapy journey and data usage. Adaptability and Learning is designing AI systems that can adapt to individual variations in stuttering and linguistic contexts, and that facilitate continuous learning for both the AI and its human users.

Quality of Working Life considers how AI impacts the workload, job satisfaction, and professional development of speech-language pathologists. Can AI automate tedious tasks, freeing up clinicians for more direct patient interaction and complex problem-solving? Ethical Considerations of STS provides a lens through which to systematically address ethical challenges related to data privacy, algorithmic bias, transparency, and accountability (KevinMD.com, 2025; TheraPlatform, 2024). Biases in AI training data can lead to inaccurate assessments for certain linguistic or demographic groups,

highlighting the need for diverse datasets and ongoing ethical review.

The Sentiment System Analysis Theory likely originated from research in Natural Language Processing (NLP) affective computing. Sentiment analysis aims to understand and categorize emotions or sentiment expressed in text. It is the process that automatically detects emotions and opinions by classifying a given text as positive, negative, or neutral. It combines the power of subtitles of AL, NLP and machine learning. The techniques used in Sentiment System Analysis are rule based Sentiment analysis.

Participation and Collaboration: Emphasizing the importance of involving all stakeholders: IWS, clinicians, researchers, and AI developers—in the design, development, and implementation process. This co-creation approach ensures that AI solutions are user-centered and address real-world needs.

3. Methodology

A comprehensive research approach for exploring the psycholinguistic impact of stuttering through AI, guided by STS and through sentiment analysis, would involve a mixed-methods design, combining quantitative data analysis with qualitative insights. A descriptive research design was used, combining quantitative and qualitative methods. A purposive sample of 100 individuals who stutter participated in an online survey. The survey consisted of open-ended and closed-ended questions, assessing sentiment and emotional experiences related to stuttering. Sentiment analysis was conducted using Natural Language Processing (NLP) libraries to quantify the sentiment patterns in participants' responses. The sentiment analysis categorized responses as positive, negative, or

neutral. Quantitative data (sentiment scores) were analyzed using descriptive statistics (frequencies, percentages), while qualitative data (open-ended responses) underwent thematic analysis to explore underlying themes and emotions. NLP libraries (e.g., NLTK) were used for sentiment analysis, and VADER software facilitated thematic analysis. Participants completed the online survey, and data were collected and analyzed accordingly. Informed consent was obtained, and participant confidentiality was ensured.

4. Analysis

This aspect of the study would address the objectives and answer the questions in relation to the questionnaire. Sample 1, would show questions as reflected in the questionnaire. Sample 2, will be a presentation of the Sentiment scales distribution in a table of specification followed with the bar chart and pie chart.

4.1 Sample 1

Here are questions designed to explore the sentiment around the impact of stuttering (the speech disorder) on individuals, matching distribution: Questions for Sentiment Analysis: Impact of Stuttering (Speech Disorder) on Individuals Overall Context: The aim is to understand and categorize the sentiment expressed by individuals regarding their experiences with stuttering, adhering to the specified sentiment distribution. These questions are designed to elicit responses that can be classified into negative, positive, neutral, or mixed categories.

60% Negative Impact Questions:

These questions focus on the challenges, frustrations, and negative feelings associated with stuttering, reflecting the majority of responses expected.

Sample Questions

Q: How has stuttering negatively impacted your daily communication and interactions?

R: I am so frustrated with people's behaviors when I stutter.

Q: In what ways has stuttering affected your self-confidence or self-esteem?

R: My stuttering Anger, frustration, has completely reduced my personality and am so aggravated with my stuttering.

Q: What emotions do you most frequently associate with your moments of stuttering?

R: Feelings of anxiety, fear, or embarrassment, so frustrated very sad you.

Completely withdrawn from people.

20% Positive/Coping Impact Questions

These questions aim to capture instances of positive coping, resilience, personal growth, or finding strength despite or because of stuttering.

Q: In what ways has living with stuttering helped you develop unique strengths or perspectives?

R: I' am always alone to avoid being mocked and it saves me the problem of quarrelling.

Q: What strategies or support systems have you found most effective in positively navigating your speech challenges?

R: Silence and avoidance.

Q: Describe any moments where overcoming a communication challenge related to stuttering brought you a sense of accomplishment or joy

R: Singing with the quire.

10% Neutral/Factual Impact Questions

These questions seek objective, factual, or indifferent responses regarding the presence of characteristics of stuttering, without strong emotional connotation.

Q: Are you proud of being a stutterer?

R: Is not a disease but a speech disorder

Q: How frequently do you do you experience moments of stuttering in an average conversation?

R: Not too frequent.

Q: Can you describe the physical sensations you experience when you stutter

R: Coughing, stamping my feet on the ground.

10% Unspecified/Mixed Sentiments Impact Questions

These questions are designed to elicit nuanced responses that may contain either positive and negative aspect or where the sentiment is complex and not easily categorized.

Q: How has your experience with stuttering presented both significant challenges and surprising personal insights?

R: Yes and No to some point. It's just both the difficulties in fluent speech and any unexpected embarrassment it fosters.

Q: What are some of the bittersweet aspects of living with a speech disorder like stuttering?

R: Escape from problems and not being involved in things that need speech production.

Q: In what situations do you feel both limited and empowered by your stuttering?

R: Speaking in union or groups where everybody speaks at the same time.

Q: How do your feelings about stuttering fluctuate depending on the specific context or day?

R: Yes, the feeling depends on the context.

The sentiment responses from the stutterers, analyzed using Sentiment Analysis reveals the group of lexicons classified with key words in a block of words based in the stutterers' utterances. The responses from the questions reveal emotion detection in some of the stutterers' utterances which involves identifying emotions expressed in their speech. Examples of utterances indicating emotional feelings include:

a. *I' am aggravated because of my stuttering.*
b. *I' am so frustrated with people's behavior when I stutter.*

Their stuttered utterances were analyzed organizing the linguistic features such as keywords, phrase. The emotion detection objects from the sentence above, analyzing it thematically are:
Emotion – frustration
Sentiment – Negative
Emotion intensity - High

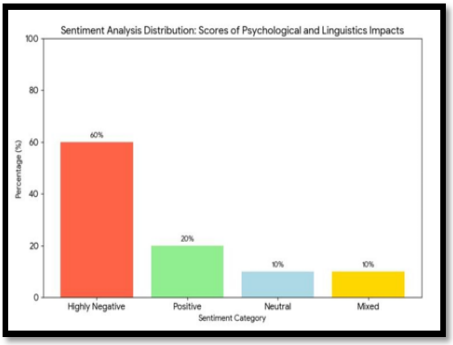
The framework for this paper, allows for a comprehensive sentiment analysis of the profound and varied impact stuttering can have on an individual's life, respecting desired distribution for each sentiment category.

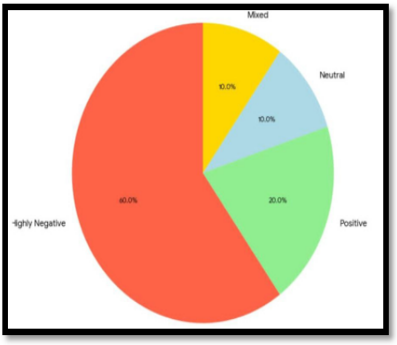
4.2 Sample 2

Sentiment Analysis Distribution: Psychological and Linguistic Impacts of Stuttering

Impact Category	**Percentage**	**Number of Participants**	**Description of Responses**
Positive	20	**20**	Responses that highlight how individuals have found strategies for effective communication, developed resilience and strength, or discovered personal growth through their experiences with stuttering.
Negative	**60**	**60**	Responses that describe significant distress, anxiety, or frustration related to stuttering, impacting mental well-being, or leading to avoidance behaviors and severe hindrances in fluency
Neutral	**10**	**10**	Responses that offer factual or objective observations about stuttering without strong emotional valence, simply

			describing the presence of behaviors or general experiences without significant positive or negative framing
Mixed Responses	**10**	**10**	Responses that contain elements of both positive and negative experiences, reflecting the complex reality of living with stuttering, where individuals might express frustration alongside coping strategies or moments of acceptance





This explores the psycholinguistic impact of stuttering through artificial intelligence, analyzing the data using charts with the given

proportions: 60%, 20%, 10%, and 10%. These proportions are assigned to different aspects of the psycholinguistic impact of stuttering, focusing on negative impacts, positive impacts, neutral impacts, and mixed responses.

Negative Impacts (60%): Stuttering can have various negative impacts on individuals, including:

Emotional distress: Anxiety, stress, and low self-esteem are common experiences for individuals who stutter. Communication challenges: Difficulty expressing thoughts and feelings can lead to frustration and avoidance. Social stigma: Negative attitudes and stereotyping can affect social interactions and relationships

.

Positive Impacts (20%): Despite the challenges, stuttering can also have positive impacts, such as: Resilience and adaptability: Individuals who stutter may develop resilience and adaptability in communication situations. Unique perspective: Stuttering can provide a unique perspective on communication and human experience.

Neutral Impacts (10%): Some aspects of stuttering may have neutral impacts, including:

Awareness and acceptance: Increased awareness and acceptance of stuttering can lead to a more neutral or positive perception. Support systems: Access to supportive networks and resources can mitigate the negative impacts of stuttering.

Mixed Responses (10%): Stuttering can elicit mixed responses, including: Conflicting emotions: Individuals who stutter may experience conflicting emotions, such as frustration and acceptance.

Varied reactions: Others may react differently to stuttering, ranging from empathy to stigma.

The charts highlight the significant negative impacts of stuttering, while also acknowledging the positive impacts, neutral impacts, and mixed responses. This nuanced understanding can inform more effective support strategies and interventions.

Implications

Comprehensive Support: The bar chart emphasizes the need for comprehensive support systems that address the negative impacts, promote positive experiences, and acknowledge mixed responses. Personalized Approach: Understanding the individual experiences and responses to stuttering can inform personalized support and intervention strategies. AI-Powered Support: Artificial intelligence can be leveraged to provide emotional support, communication assistance, and resources for individuals who stutter, while also promoting awareness and acceptance.

4.3 Emotion Intensity Detection

According to Vader's recommendation. Emotion Intensity from 0% to 40% suggests a low detection of emotion, akin to what you might correlate with values between -1 to -0.2. In the sentiment category data, the 'Separate Low Intensity' (20%), 'Low Intensity (Category 1)' (10%), and 'Low Intensity (Category 2)' (10%) all fall within this range, indicating a lower level of detected emotion.

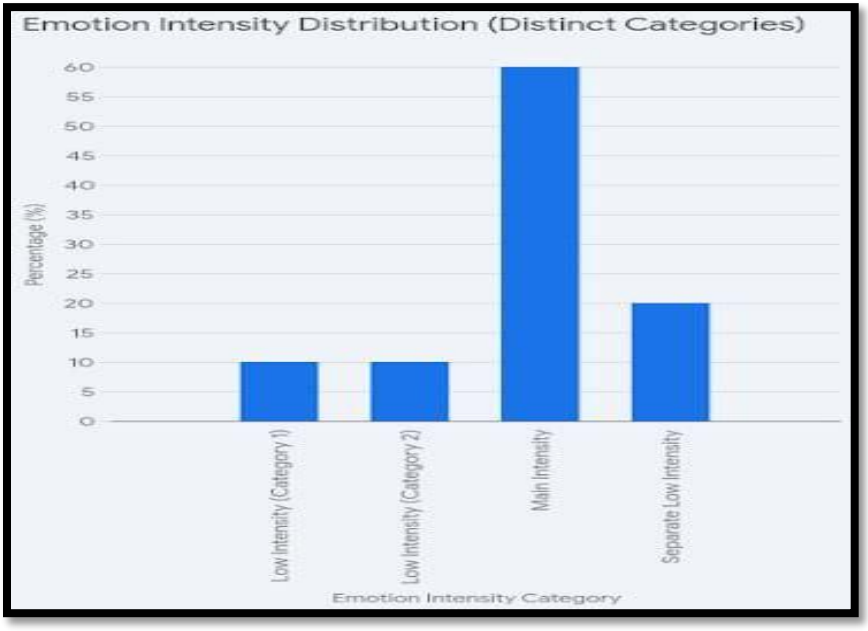
Emotion Intensity from 40% to 60% suggests a medium detection of emotion, which you might correlate with values between 0 to 0.2. This range represents a moderate level of detected emotion.

High Intensity (above 60%) suggests a high detection of emotion, which you might correlate with values greater than 0.2. The 'Main

Intensity' (60%) falls into this high-intensity category, indicating a strong level of detected emotion.

Emotion Detection Table

Vader's Values → Distribution of Sentiment Categories ↓	Low= 0-40/-1 to -0.2	Medium= 40-60/-0.2 to 0.2	High= 60-100/ 0.2 to 1
10	x	-	-
20	x	-	-
60	-	x	-



5. Conclusion

The exploration of the psycholinguistic impact of stuttering through Artificial Intelligence, framed by Sociotechnical Systems theory, represents a frontier in speech-language pathology and human-computer interaction. AI offers unprecedented capabilities for unraveling the complex cognitive, linguistic, and emotional dimensions of stuttering, leading to more precise diagnoses, personalized interventions, and a deeper scientific understanding.

However, the true promise of AI in this domain lies not merely in its technical prowess but in its thoughtful and ethical integration into the existing human ecosystem of care. By adopting STS theory, we commit to jointly optimizing the technical capabilities of AI with the social needs, values, and expertise of IWS and clinicians. This holistic approach ensures that AI serves as a powerful ally in enhancing the quality of life for individuals who stutter, fostering meaningful communication, and advancing the frontiers of psycholinguistic research. Future research must continue to prioritize interdisciplinary collaboration, ethical development, and user-centered design to realize the full transformative potential of AI in addressing the psycholinguistic impact of stuttering.

6. Expected Outcomes and Contributions

This research is expected to yield several significant contributions:

Enhanced Understanding of Psycholinguistic Mechanisms: AI will provide unprecedented opportunities for fine-grained analysis of speech and neurophysiological data, leading to a deeper and more objective understanding of the cognitive, linguistic, and emotional processes that contribute to stuttering. This could reveal novel psycholinguistic markers or patterns previously undetectable by human observation. Improved Assessment and Diagnosis: AI-

powered tools will offer more objective, consistent, and efficient methods for assessing stuttering severity, identifying disfluency types, and tracking progress, thereby complementing and enhancing clinical expertise. Personalized and Accessible Interventions: AI will pave the way for highly personalized therapy approaches that adapt to individual needs and provide real-time feedback, potentially increasing the effectiveness and accessibility of stuttering treatment.

Framework for Ethical AI Deployment: By explicitly adopting STS theory, the research will provide a robust framework for addressing the complex ethical and social implications of integrating AI into speech-language pathology, ensuring that technological advancements are aligned with human values and well-being. Guidance for Human-AI Collaboration: The study will offer insights into how humans and AI can best collaborate in the context of stuttering, optimizing the strengths of both (e.g., AI for data analysis, humans for empathy and nuanced clinical judgment). Future Research Directions: The findings will open new avenues for research, particularly in areas such as predictive modeling of stuttering, the development of more adaptive and context-aware AI interventions, and the long-term impact of AI on the lived experience of IWS.

7. Ethical Considerations

The integration of AI into stuttering research and treatment requires careful ethical consideration. Data privacy and security are crucial, and protecting sensitive stuttering data through anonymization, encryption, and secure storage is essential. Clear consent protocols must be established, informing participants precisely how their data

will be used, stored, and shared. Additionally, algorithmic bias is a significant concern, and ensuring diverse datasets and implementing bias detection and mitigation strategies can help prevent biased algorithms that perform poorly for certain populations. Transparency and explainability are also vital, and developing transparent and explainable AI models is essential for clinical adoption and trust. By prioritizing these ethical considerations, researchers can ensure the responsible development and deployment of AI in stuttering research and treatment.

References

Bloodstein, O., & Ratner, N. B. (2008). A handbook on stuttering (6th ed.). Thomson Delmar Learning.

Bodea Hațegan, C., Anca, M., & Prihoi, L. (2012). STUTTERING-PSYCHOLINGUISTIC APPROACH. DPPD Cluj Napoca. dppd.ubbcluj.ro/adn/article_5_1_8.pdf

Frontiers. (2023, June 29). Acoustic analysis in stuttering: a machine-learning study. Retrieved from https://www.frontiersin.org/journals/neurology/articles/10.3389/fneur.2023.1169707 /full

KevinMD.com. (2025, February 11). Innovation or exploitation: the ethical challenges of AI in speech therapy. Retrieved from https://kevinmd.com/2025/02/innovation-or-exploitation- the-ethical-challenges-of-ai-in-speech-therapy.html

MDPI. (2025, May 19). Automated Stuttering Detection Using Deep Learning Techniques. Retrieved from https://www.mdpi.com/2077-0383/14/10/3552

Number Analytics. (2025a, May 27). Understanding Stuttering in Psycholinguistics. Retrieved from

https://www.numberanalytics.com/blog/ultimate-guide-stuttering-psycholinguistics

Number Analytics. (2025b, June 14). The Future of Stuttering Therapy: Emerging Technologies. Retrieved from .https://www.numberanalytics.com/blog/future-of-stuttering-therapy- emerging-technologies

Number Analytics. (2025c, May 27). The Psycholinguistics of Stuttering: A Deep Dive. Retrieved from https://www.numberanalytics.com/blog/psycholinguistics-stuttering- deep-dive

Number Analytics. (2025d, June 15). The Future of Stuttering Therapy: Emerging Technologies. Retrieved from https://www.numberanalytics.com/blog/future-of-stuttering-therapy-emergingtechnologies#:~:text=AI%2Dpowered%20speech%20therapy%20tools%20utili ze%20machine%20learning%20algorithms%20to,individuals%20improve%20their%20s peech%20fluency.

ResearchGate. (n.d.). AI-based stuttering automatic classification method: Using a convolutional neural network. Retrieved from https://www.researchgate.net/publication/377231389_AI-based_stuttering_automatic_classification_method_Using_a_convolutional_neural_netw ork

Tedu.edu.tr. (n.d.). AUTOMATIC STUTTERING DETECTION AND CLASSIFICATION. Retrieved from https://avesis.tedu.edu.tr/dosya?id=06a20977-2356-4deb-8e67- 73b4803a9ba2

TheraPlatform. (2024, June 3). AI for speech therapy. Retrieved from https://www.theraplatform.com/blog/1300/ai-for-speech-therapy

Western Michigan University. (2024, February 12). Moving into the next phase for voice- activated technology accessibility. Retrieved from https://wmich.edu/news/2024/02/74666

Wikipedia. (n.d.a). Sociotechnical system. Retrieved from https://en.wikipedia.org/wiki/Sociotechnical_system

WJARR. (2024, October 27). Ethical Implications of AI-Driven AAC Systems: Ensuring Inclusivity and Equity in Assistive Technologies. Retrieved from https://wjarr.com/sites/default/files/WJARR-2024-3310.pdf

Appendix 1

QUESTIONNAIRE
DEMOGRAPHICS

1. AGE: 10-20
2. GENDER: MALES/FEMALES
3. STUTTERING SEVERITY (MILD, MODERATE, SEVERE)

PSYCHOLINGUISTICS IMPACT

1. How does stuttering affect your daily communication?
2. Do you experience anxiety or stress when speaking?
3. How do you feel about your stuttering (e.g., self-conscious, embarrassed)?
4. Do you avoid certain words or situations due to stuttering?

EMOTIONAL AND SOCIAL IMPACT

5. How does stuttering affect your relationships?
6. Do you feel stuttering impacts your self-esteem?
7. Have you experienced bullying or teasing due to stuttering?

COPING MECHANISM

8. What strategies do you use to manage stuttering?
9. Do you use speech therapy or other interventions?

COMMUNICATION CHALLENGES

10. In what situations do you experience the most difficulty with stuttering (e.g., public speaking, phone calls)
11. How do you handle communication challenges in your daily life?

TECHNOLOGY AND STUTTERING

12. Have you used any technology (e.g., speech-generating devices, apps) to help manage stuttering?
13. How effective do you find these technologies?