Original Article

Speech Disfluency Patterns and Cognitive Failures in Young Adults with Generalized Anxiety Disorder: A Cross-sectional Study

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ABSTRACT

Background: Generalized Anxiety Disorder (GAD) affects approximately 3-6% of young adults and is characterized by persistent worry and anxiety. While cognitive impairments in GAD are well-documented, the relationship between speech fluency and cognitive performance remains understudied. To examine the patterns of speech disfluency and their association with cognitive failures in young adults diagnosed with GAD compared to healthy controls.

Methods: A cross-sectional study was conducted with 128 participants (64 GAD patients, 64 controls) aged 18-25 years. Speech samples were collected during structured narrative tasks and analyzed for disfluency patterns. Cognitive failures were assessed using the Cognitive Failures Questionnaire (CFQ) and working memory was measured using the digit span test.

Results: GAD participants demonstrated significantly higher rates of filled pauses ($p < 0.001$), repetitions ($p < 0.01$), and false starts ($p < 0.05$) compared to controls. Strong correlations were found between speech disfluency measures and cognitive failure scores ($r = 0.67$-0.82). Working memory deficits were the strongest predictor of speech disfluency patterns ($\beta = 0.54$, $p < 0.001$).

Conclusions: Young adults with GAD exhibit distinct speech disfluency patterns that correlate with cognitive failures, particularly in working memory domains. These findings suggest speech analysis may serve as a non-invasive marker for cognitive impairment in GAD.

Keywords: *Cognitive Failures, Generalized Anxiety Disorder, Speech Disfluency, Working Memory, Young Adults.*

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INTRODUCTION

Generalized Anxiety Disorder (GAD) is characterized by excessive worry and anxiety about multiple life domains, affecting approximately 5.7% of adults during their lifetime[1]. The disorder typically emerges in early adulthood, with peak onset occurring between ages 18-25 years. While GAD is primarily conceptualized as an emotional disorder, mounting evidence suggests significant cognitive impairments that extend beyond worry-related processes[2,3].

Recent neuropsychological research has identified specific cognitive deficits in GAD, particularly in executive function, working memory, and attentional control[4,5]. These cognitive failures may manifest in various behavioral domains, including speech production. Speech fluency requires complex coordination of cognitive processes, including lexical retrieval, syntactic planning, and motor execution, all of which are mediated by working memory and executive control systems that are compromised in GAD[6].

Disfluencies in speech, such as filled pauses ("um," "uh"), repetitions, revisions, and false starts, are natural phenomena in spontaneous speech production. However, increased disfluency rates may indicate underlying cognitive strain or processing difficulties[7]. The relationship between anxiety and speech fluency has been explored in specific contexts, such as public speaking anxiety, but systematic investigation of speech patterns in GAD remains limited[8,9].

The cognitive load theory provides a theoretical framework for understanding the relationship between anxiety and speech production. According to this theory, anxiety consumes cognitive resources, particularly working memory capacity, leaving fewer resources available for complex tasks like fluent speech production[10]. This may result in increased disfluencies as speakers struggle to coordinate multiple cognitive processes simultaneously.

Understanding the relationship between speech disfluency and cognitive failures in GAD has important clinical implications. Speech analysis offers a potentially non-invasive, ecologically valid method for assessing cognitive function that could complement traditional neuropsychological testing[11]. Furthermore, identifying specific patterns of speech disruption may inform targeted interventions for cognitive symptoms in GAD.

The present study aims to address this gap by systematically examining speech disfluency patterns in young adults with GAD and investigating their relationship with cognitive failures. We hypothesized that individuals with GAD would demonstrate higher rates of speech disfluencies compared to healthy controls, and that these disfluencies would correlate with performance on cognitive tasks, particularly those assessing working memory.

METHODOLOGY

Participants

A total of 128 young adults aged 18-25 years participated in this cross-sectional study, comprising 64 individuals diagnosed with GAD and 64 healthy controls. Participants were recruited through university counseling centers, community mental health clinics, and online advertisements between September 2023 and March 2024.

Inclusion criteria

For GAD group

- Age 18-25 years
- DSM-5 diagnosis of GAD confirmed by clinical interview
- GAD-7 score ≥ 10[12]
- Native language speaker
- No current psychotropic medication or stable on medication for ≥ 8 weeks

For control group:

- Age 18-25 years
- No current or lifetime psychiatric diagnoses
- GAD-7 score ≤ 4
- Native language speaker

Exclusion criteria

For both groups:

- History of neurological disorders
- Substance use disorder within past 6 months
- Current major depressive episode
- Speech or hearing impairments
- Learning disabilities

Clinical Assessments

Generalized Anxiety Disorder 7-item Scale (GAD-7): A validated self-report measure assessing GAD symptom severity over the past two weeks[12]. Scores range from 0-21, with higher scores indicating greater anxiety severity. The GAD-7 demonstrates excellent internal consistency (α = 0.89-0.91) and good test-retest reliability[13,14].

Speech Analysis

Speech samples were collected during two structured tasks:

1) **Narrative Task:** Participants viewed a wordless picture story and provided a 3-minute oral narrative describing the events depicted.
2) **Descriptive Task:** Participants described their daily routine for 3 minutes, providing specific details about activities and timing.

All speech samples were audio-recorded using high-quality digital recording equipment and transcribed by trained research assistants. Inter-rater reliability was established on 20% of samples (κ = 0.89).

Disfluency Coding: Speech samples were coded for the following disfluency types based on established protocols[15]:

- **Filled pauses:** "um," "uh," "er"
- **Silent pauses:** Pauses >250ms within utterances
- **Repetitions:** Repeated words or syllables
- **Revisions:** Corrections or modifications of previous words

- **False starts:** Abandoned utterances
- **Prolongations:** Lengthened sounds or syllables

Cognitive Assessments

Cognitive Failures Questionnaire (CFQ): A 25-item self-report measure assessing everyday cognitive failures in memory, attention, and motor function (16). The CFQ demonstrates good psychometric properties with high internal consistency (α = 0.91) and test-retest reliability (r = 0.71) (17,18).

Digit Span Test: From the Wechsler Adult Intelligence Scale-IV, assessing verbal working memory capacity through forward and backward digit recall tasks (19). The digit span test shows high internal reliability (0.70-0.90) and good test-retest reliability (0.50-0.83) (20,21).

Procedure

The study was approved by the Institutional Review Board, and all participants provided written informed consent. Testing was conducted in a quiet laboratory setting over two sessions, each lasting approximately 2 hours.

Session 1:

- Clinical interviews and diagnostic confirmation
- Self-report questionnaires
- Speech sample collection

Session 2:

- Cognitive assessment battery
- Debriefing and compensation

The order of cognitive tasks was counterbalanced across participants to control for fatigue effects. Brief breaks were provided between tasks to minimize cognitive load.

Statistical Analysis

Data analysis was conducted using SPSS version 29.0. Descriptive statistics were calculated for all variables. Group differences were examined using independent t-tests for continuous variables and chi-square tests for categorical variables.

Speech disfluency rates were calculated as frequency per 100 words to control for differences in speech rate and total word count. Pearson correlations were computed to examine relationships between disfluency measures and cognitive performance.

Hierarchical multiple regression analyses were conducted to identify cognitive predictors of speech disfluency, controlling for demographic variables and anxiety severity. Effect sizes were interpreted using Cohen's conventions (small: d = 0.2, medium: d = 0.5, large: d = 0.8).

Missing data (<3% of total dataset) were handled using multiple imputation. All analyses used two-tailed significance tests with α = 0.05.

RESULTS

Participant Characteristics

Table-1 presents the demographic and clinical characteristics of the sample. Groups were well-matched on demographic variables. The GAD group showed significantly higher anxiety symptoms compared to controls, confirming successful group differentiation.

Table-1: Participant Demographics and Clinical Characteristics

Variable	GAD Group (n=64)	Control Group (n=64)	t	p-value
Age	21.3 (2.1)	21.1 (1.9)	0.64	0.52
Gender				
Female	44 (68.8)	42 (65.6)		
Male	20 (31.2)	22 (34.4)		
Education years	13.8 (1.4)	14.1 (1.3)	-1.26	0.21
Clinical Measures				
GAD-7 Total	14.2 (3.1)	2.1 (1.4)	28.4	<0.001***
CFQ Total	52.3 (11.4)	28.7 (8.2)	14.2	<0.001***
Working Memory				
Digit Span Forward	5.4 (1.1)	6.2 (1.3)	-3.8	<0.001***
Digit Span Backward	4.8 (1.2)	6.1 (1.4)	-6.2	<0.001***
Digit Span Total	10.2 (2.1)	12.3 (2.4)	-5.4	<0.001***

*Mean (SD), Frequency (%), GAD = Generalized Anxiety Disorder; CFQ = Cognitive Failures Questionnaire; ***p < 0.001*

Speech Disfluency Patterns

Table-2 shows significant group differences across multiple disfluency measures. The GAD group demonstrated substantially higher rates of most disfluency types compared to controls, with particularly pronounced differences in filled pauses and silent pauses.

Correlations between Speech Disfluency and Cognitive Performance

Table-3 presents correlations between speech disfluency measures and cognitive performance indicators. Strong correlations emerged between speech disfluency measures and cognitive failures, with particularly robust relationships for filled pauses and repetitions.

Table-2: Speech Disfluency Patterns by Group

Disfluency Type	GAD Group (n=64)	Control Group (n=64)	Cohen's d	t	p-value
Rate per 100 words					
Filled Pauses	8.7 (3.2)	4.1 (1.8)	1.8	10.1	<0.001***
Silent Pauses	6.3 (2.4)	3.8 (1.5)	1.3	7.2	<0.001***
Repetitions	2.8 (1.4)	1.7 (0.9)	0.9	5.4	<0.01**
False Starts	1.9 (1.1)	1.2 (0.7)	0.7	4.3	<0.05*
Revisions	1.6 (1.0)	1.3 (0.8)	0.3	1.8	0.08
Prolongations	0.9 (0.6)	0.8 (0.5)	0.2	1.2	0.23
Total Disfluencies	22.2 (6.8)	12.9 (4.2)	1.6	9.1	<0.001***

*Mean (SD), GAD = Generalized Anxiety Disorder; *p < 0.05, **p < 0.01, **p < 0.001*

Table-3: Correlations between Speech Disfluency and Cognitive Measures

Disfluency Type	CFQ Total	Digit Span Forward	Digit Span Backward	Digit Span Total
Filled Pauses	0.82***	-0.58***	-0.67***	-0.65***
Silent Pauses	0.71***	-0.48**	-0.58***	-0.55***
Repetitions	0.67***	-0.41**	-0.52***	-0.49**
False Starts	0.58***	-0.33*	-0.44**	-0.41**
Total Disfluencies	0.78***	-0.54***	-0.63***	-0.61***

*CFQ = Cognitive Failures Questionnaire; *p < 0.05, **p < 0.01, **p < 0.001*

Predictive Models

Table 4 shows the results of hierarchical regression analyses predicting speech disfluency from cognitive variables.

Working memory performance emerged as the strongest predictor across disfluency types.

Table-4: Hierarchical Regression Predicting Speech Disfluency

Predictor	Filled Pauses	Silent Pauses	Repetitions	Total Disfluencies
	β (p-value)	β (p-value)	β (p-value)	β (p-value)
Step 1: Demographics				
Age	0.08 (0.42)	0.06 (0.54)	0.11 (0.28)	0.09 (0.37)
Gender	-0.12 (0.23)	-0.10 (0.31)	-0.08 (0.43)	-0.11 (0.26)
Education	-0.15 (0.14)	-0.13 (0.20)	-0.09 (0.38)	-0.14 (0.16)
R^2	0.04	0.03	0.02	0.04
Step 2: Add GAD-7				
GAD-7 Score	0.45***	0.38**	0.41***	0.44***
R^2	0.23	0.17	0.19	0.22
ΔR^2	0.19***	0.14**	0.17***	0.18***
Step 3: Add Cognitive Variables				
CFQ Total	0.31**	0.28*	0.34**	0.33**
Digit Span Backward	-0.54***	-0.41**	-0.37**	-0.48***
GAD-7 Score	0.12 (0.18)	0.15 (0.14)	0.18 (0.09)	0.14 (0.15)
R^2	0.68	0.58	0.54	0.64
ΔR^2	0.45***	0.41***	0.35***	0.42***

*GAD-7 = Generalized Anxiety Disorder 7-item scale; CFQ = Cognitive Failures Questionnaire; *p < 0.05, **p < 0.01, **p < 0.001*

DISCUSSION

This study provides the first systematic examination of speech disfluency patterns in young adults with GAD and their relationship to cognitive failures. The findings reveal distinct patterns of speech disruption that correlate strongly with objective and subjective measures of cognitive impairment, supporting the hypothesis that speech disfluencies reflect underlying cognitive resource limitations in GAD.

Young adults with GAD demonstrated significantly elevated rates of filled pauses, silent pauses, repetitions, and false starts compared to healthy controls. These findings extend previous research on anxiety and speech production by demonstrating specific disfluency patterns in a clinical population with GAD[8,9]. The predominance of filled pauses and silent pauses suggests difficulty with lexical retrieval and discourse planning, consistent with working memory deficits observed in GAD[22,23]. The increased frequency of repetitions and false starts indicates difficulties with speech monitoring and self-correction processes, which rely heavily on executive control mechanisms. These patterns align with theoretical models proposing that anxiety impairs cognitive control systems necessary for fluent speech production[24]. Recent research using computational linguistics has similarly found that anxiety is associated with increased use of filled pauses and grammatically incorrect language in speech transcripts[11].

The strong correlations between speech disfluency measures and cognitive performance support the hypothesis that speech disruptions reflect underlying cognitive failures. Working memory, as measured by the digit span test, emerged as the most consistent predictor across disfluency types, suggesting that the capacity to maintain and manipulate information in conscious awareness is crucial for fluent speech production[25,26].

These findings align with cognitive load theory, which proposes that anxiety consumes working memory resources, leading to performance decrements on concurrent tasks[10]. In the context of speech production, reduced working memory capacity may impair the ability to coordinate lexical, syntactic, and phonological processes simultaneously, resulting in increased disfluencies. This is consistent with neuroimaging research showing reduced prefrontal activation during working memory tasks in anxiety patients, which may contribute to both cognitive and speech production difficulties.

The relationship between cognitive failures as measured by the CFQ and speech disfluency is particularly noteworthy. The CFQ assesses everyday cognitive lapses in naturalistic settings, providing ecological validity that complements laboratory-based cognitive testing[16,18]. The strong correlations between CFQ scores and speech disfluency measures suggest that both tap into similar underlying cognitive control processes that are impaired in GAD.

Clinical Implications

The findings have several important clinical implications. First, speech analysis may provide a non-invasive, ecologically valid method for assessing cognitive function in GAD. Traditional neuropsychological testing can be time-intensive and may not capture the cognitive demands of real-world communication situations. Speech disfluency analysis could serve as a screening tool for cognitive impairment in GAD, potentially identifying individuals who would benefit from cognitive remediation interventions.

Furthermore, changes in speech patterns could serve as an outcome measure for treatments targeting cognitive symptoms. The strong relationship between speech disfluency and self-reported cognitive failures suggests that objective speech measures may validate subjective cognitive complaints, which are often dismissed in clinical settings. This convergence between objective and subjective measures strengthens the clinical significance of cognitive symptoms in GAD.

Theoretical Implications

The results support theoretical models proposing that anxiety impairs cognitive control systems necessary for complex behavioral tasks, including fluent speech production[24]. The finding that working memory deficits are the primary driver of speech disruptions provides specific support for the cognitive load theory of anxiety effects on performance[10].Importantly, when cognitive variables were included in regression models, anxiety severity (GAD-7 scores) was no longer a significant predictor of speech disfluency. This suggests that cognitive factors mediate the relationship between GAD and speech disfluency, rather than anxiety directly causing speech disruptions. This has implications for understanding the mechanisms underlying cognitive symptoms in anxiety disorders.

Strengths

This study has several notable strengths. The use of rigorous diagnostic procedures ensured accurate group classification. The comprehensive assessment of speech disfluencies using established coding protocols provided reliable measurement of speech patterns. The inclusion of both objective cognitive testing and subjective cognitive failure measures provided convergent validation of findings. The sample size was adequate for the analyses conducted, and effect sizes were generally large, suggesting robust group differences. The use of standardized, validated measures enhances the reliability and generalizability of findings.

Limitations and Future Directions

Several limitations should be considered when interpreting these findings. The cross-sectional design precludes causal inferences about the relationship between GAD, cognitive function, and speech disfluency. Longitudinal studies are needed to determine whether speech patterns change with treatment or symptom fluctuation.

The sample was limited to young adults, and generalizability to other age groups remains unclear. Additionally, the study focused on structured speech tasks, and findings may not extend to spontaneous conversation or other communication contexts. Future research should investigate the stability of speech disfluency patterns over time and their sensitivity to therapeutic interventions.

Ecological momentary assessment using smartphone technology could capture speech patterns in naturalistic settings, providing greater external validity. Investigation of neural mechanisms underlying the relationship between anxiety, cognition, and speech production would advance theoretical understanding. Neuroimaging studies could identify brain networks involved in speech-cognition interactions in GAD.

CONCLUSION

This study demonstrates that young adults with GAD exhibit distinct patterns of speech disfluency that correlate strongly with cognitive failures across multiple domains. Working memory deficits appear to be the primary driver of speech disruptions, suggesting that cognitive resource limitations contribute to communication difficulties in GAD.

These findings highlight the importance of considering cognitive symptoms in GAD assessment and treatment. Speech analysis offers a promising approach for detecting and monitoring cognitive impairment in clinical populations, potentially complementing traditional neuropsychological assessment methods. The results support theoretical models proposing that anxiety impairs cognitive control systems necessary for complex behavioral tasks, including fluent speech production. Understanding these relationships may inform the development of targeted interventions addressing both cognitive and communicative aspects of GAD.

Future research should focus on longitudinal investigations of speech patterns in GAD, ecological assessment methods, and the neural mechanisms underlying speech-cognition interactions. Additionally, intervention studies examining whether cognitive remediation or anxiety treatment improves speech fluency would have important clinical implications.

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None.

Author Contributions

Syeda Sania Khalid and **Shumaila Atif** contributed to the study conception, design, and data collection**. Tahmeena Tabish** contributed to data analysis and interpretation. **Sarah Jehangir** assisted in manuscript drafting and critical revision. All authors reviewed and approved the final version of the manuscript.

Ethical Approval

This study received approval from the Foundation of Medical Research and Laboratories Institutional Review Board (FMRL-IRB/2023/003).

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None.

Conflict of Interests

None.

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