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Altered Relationships between Cognitive Functions and Narrative Speech in Depressive and Generalized Anxiety Disorder

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Abstract

Depressive and generalized anxiety disorder are associated with cognitive impairments affecting language and memory. Narrative speech may reflect underlying cognitive disruptions, suggesting that cognitive-linguistic measures could inform future research on intervention targets. This study compared relationships between cognitive functions (autobiographical memory, cognitive flexibility, working memory, problem-solving, attentional control) and narrative production across depressive, anxiety, and healthy groups.

A cross-sectional study assessed 321 participants: depressive disorder (n = 146), anxiety disorder (n = 105), and healthy controls (n = 70). Diagnosis was confirmed using SCID-5. Participants completed cognitive tasks and two narrative tasks (picture description, autobiographical memory recall). Narrative responses were transcribed and analyzed across 14 linguistic features. Data were analyzed using multivariate statistics and structural equation modeling.

The depressive group showed the greatest impairments in cognition and narrative coherence, followed by the anxiety group. Healthy controls performed best across all domains. Autobiographical memory strongly predicted narrative variables in healthy individuals, but this association was reduced in clinical groups. Narrative coherence, lexical cohesion, and sentence complexity were significantly linked to cognitive flexibility and memory across groups.

The relationship between cognition and narrative speech is disrupted in depressive disorder and, to a lesser extent, in anxiety disorder. These findings highlight disrupted cognitive-linguistic integration in clinical groups, suggesting potential targets for cognitive remediation and clarifying cognitive mechanisms underlying language impairments in these disorders.

Introduction

Depression and anxiety disorder are among the most prevalent mental health conditions globally[1], affecting millions of individuals and imposing significant burdens on psychological, social, and cognitive functioning[2]. These disorders are not only characterized by emotional and behavioral symptoms[3]but also by cognitive impairments that are common, though varying in severity across subtypes, particularly in major depression and various anxiety disorder[4] leading to deficits in daily functioning and quality of life [5], including communication and discourse[6, 7]. In this study, we distinguish between cognitive deficits (fundamental shortages in processing capacity) and impairments (resulting reductions in functional performance) to precisely delineate their roles in narrative production.

Individuals with depression frequently exhibit cognitive impairments that profoundly impact their daily functioning[8]. One of the most well-documented deficits is in memory, particularly working memory[9] and autobiographical memory[10]. Working memory, the cognitive system responsible for temporarily holding and manipulating information, is often compromised in depression, leading to difficulties in maintaining and organizing information during complex tasks [11]. Autobiographical memory, which

involves the recall of personal experiences and events, is similarly affected, with depressed individuals showing reduced specificity and coherence in memory retrieval [12]. These deficits hinder the ability to construct narratives that are rich in detail and logically structured, as autobiographical memory provides the foundational content for personal storytelling[13–15].

For instance, depressed individuals may struggle to sequence events logically or maintain a consistent narrative thread, resulting in fragmented or incomplete stories[16–18]. This disruption often leads to reduced narrative coherence, as individuals may include irrelevant information or fail to maintain focus on the narrative's purpose. Collectively, these cognitive impairments contribute to challenges in producing structured, meaningful, and coherent narratives, which can exacerbate social and communicative difficulties in depressed individuals[19–21].

Similarly, individuals with anxiety disorders experience cognitive impairments[22] that affect their ability to produce coherent narrative speech[23]. Anxiety disorders encompass a heterogeneous group of conditions, such as generalized anxiety disorder (GAD), social anxiety disorder, and panic disorder, each with distinct cognitive profiles; for instance, GAD is more strongly associated with working memory deficits under high cognitive load, while social anxiety may disproportionately impair attentional control toward social cues, underscoring the varying impacts on cognitive resources [4, 24, 25].This heterogeneity is particularly evident in associated deficits in working memory[24], especially under conditions of high cognitive load. The heightened arousal and worry characteristic of anxiety disorders can overwhelm cognitive resources, impairing the ability to maintain and manipulate information [26]during narrative tasks. This is particularly evident in tasks requiring sustained cognitive effort, such as storytelling, where anxious individuals may struggle to integrate multiple pieces of information into a cohesive narrative[27–29].

Anxiety disorders often lead to rigid thinking patterns, making it difficult for individuals[30] to adapt their storytelling strategies, which can result in less structured and less engaging narratives[31].

Conclusion

Both depressive disorder and generalized anxiety disorder are associated with impairments in executive functions, particularly in problem-solving and cognitive flexibility. In depressive disorder, these deficits manifest as difficulties in organizing thoughts, setting goals, and adapting strategies, which are essential for constructing coherent narratives[32–36]. Similarly, in anxiety disorders, reduced cognitive flexibility and problem-solving abilities under cognitive load contribute to challenges in adjusting narrative structure and incorporating new information[37, 38]. Additionally, attentional control disruptions, such as impaired inhibition in depression and hypervigilance in anxiety, further compromise narrative coherence by introducing irrelevant details or hindering sustained focus[39–41].

These patterns vary across subtypes; for example, hypervigilance is more pronounced in social anxiety disorder than in specific phobias[42].

Recent natural language processing (NLP) research has examined speech and narrative features as markers of depression and anxiety disorders. For example, machine learning models analyzing acoustic and linguistic patterns in spoken narratives have detected depressive symptoms with high accuracy[43]. NLP techniques have also identified anxiety indicators, such as reduced lexical diversity and coherence in speech data from clinical samples [44]. These methods provide automated tools to support early detection and complement cognitive assessments [45, 46].

In healthy individuals, narrative speech is intricately linked to cognitive functions such as memory, problem-solving, and attention, which work in concert to produce coherent and structured verbal accounts. Robust working memory enables individuals to hold and manipulate information, facilitating the organization of narrative content[41]. Autobiographical memory plays a crucial role in providing the raw material for narratives, allowing individuals to draw on personal experiences to create meaningful and detailed stories[47]. Executive functions such as problem-solving, cognitive flexibility, and attentional control collectively support coherent narrative production by helping individuals organize ideas, adapt to conversational demands, and maintain focus on the story's purpose[48, 49]. The strong interplay between these cognitive functions and narrative speech in healthy populations provides a critical benchmark for understanding deviations in clinical populations, such as those with depression and generalized anxiety disorder.

Despite the well-established links between cognitive functions and narrative speech, significant gaps remain in understanding how specific cognitive impairments in depression and anxiety disorder differentially impact the various dimensions of narrative speech. Previous research has primarily focused on cognitive deficits in these disorders or on narrative speech in healthy populations, but few studies have systematically examined the effects of cognitive impairments on specific narrative dimensions—such as lexical cohesion, substitution, omission, and overall coherence—in clinical populations accounting for the heterogeneity within generalized anxiety disorder. Moreover, the relative contributions of specific cognitive functions, such as problem-solving through flexibility, executive control, or attentional inhibition, to narrative production in depression and anxiety remain underexplored.

This research gap is particularly significant given the importance of narrative speech in clinical settings, where storytelling is often used in therapeutic interventions, such as narrative therapy or cognitive-behavioral approaches, to facilitate emotional processing and communication. Understanding how cognitive impairments shape narrative production in depression and anxiety can inform the development of targeted interventions to improve communication and cognitive functioning, ultimately enhancing therapeutic outcomes. Furthermore, comparing these clinical populations to healthy controls can highlight specific areas of disruption and provide insights into the mechanisms underlying cognitive-linguistic interactions.

This study aims to address these gaps by investigating the dimensions of narrative speech in individuals with depression and anxiety, with a focus on the influence of cognitive functions such as memory, problem-solving, and attention. By leveraging a comprehensive dataset that includes measures of

narrative speech variables (e.g., lexical cohesion, substitution, overall coherence) and cognitive function variables (e.g., working memory, cognitive flexibility, attentional control), we seek to elucidate how cognitive impairments shape narrative production across these groups. The study compares individuals with depression and anxiety to healthy controls to identify specific areas of disruption and quantify the relative contributions of cognitive functions to narrative speech. The findings will contribute to the growing body of literature on cognitive-linguistic interactions and provide practical implications for clinical interventions aimed at enhancing narrative abilities in mental health disorders.

Based on the theoretical background and previous empirical evidence reviewed above, the following directional hypotheses were proposed. Individuals with depressive and generalized anxiety disorder were expected to demonstrate lower levels of narrative coherence, cohesion, and sentence complexity compared to healthy controls. Cognitive functions including problem-solving, cognitive flexibility, working memory, and attentional control were hypothesized to positively predict narrative performance across all groups, with stronger associations anticipated in the healthy group relative to the clinical groups. It was further expected that autobiographical memory would show a stronger positive association with narrative speech variables in healthy individuals than in those with depressive or anxiety disorder. Among executive functions, problem-solving and cognitive flexibility were hypothesized to exhibit the highest predictive effects on narrative coherence and overall narrative quality.

This study aims to quantify and compare the relationships between specific cognitive functions (autobiographical memory, working memory, cognitive flexibility, problem-solving, and attentional control) and specific dimensions of narrative speech (e.g., coherence, cohesion, complexity) across individuals with depressive disorder, anxiety disorder, and healthy controls. Using Structural Equation Modeling (SEM), we seek to test the hypothesis that these cognitive-linguistic relationships are strongest in healthy individuals and differentially weakened in depressive disorder and anxiety disorder.

Methods

Study Design

This research employed a cross-sectional methodology to examine the classification of generalized anxiety disorder, depressive disorder and healthy mental states using a data-based classification approach. The investigation combined cognitive task performance and narrative speech features to examine group differences and cognitive-linguistic associations. A total of 321 participants were included, distributed across three groups: individuals diagnosed with depressive disorder (n = 146), those with generalized anxiety disorder (n = 105), and healthy controls (n = 70).

The sample characteristics were as follows: In the depressive disorder group (n = 146), there were 70 males and 76 females. The anxiety disorder group (n = 105) consisted entirely of individuals diagnosed with generalized anxiety disorder (GAD), with 60 males and 45 females. The healthy control group (n = 70) included 35 males and 35 females.

Diagnostic assessments were conducted using the Structured Clinical Interview for DSM-5 (SCID-5), administered by trained clinical psychologists to ensure diagnostic precision.

The study protocol was approved by the Institutional Review Board of the Institute for Cognitive Science Studies, Tehran, Iran (code number: IR.ICS.REC.1403.2430). All research procedures involving human participants were conducted in compliance with the ethical standards of the institute. All participants provided written informed consent before the start of the data collection session.

Recruitment

Participants were enrolled via clinical referrals and community outreach methods (e.g., online advertisements, digital forms, and social media platforms) in Tehran. Referrals were obtained from psychiatric outpatient services and mental health facilities. Community recruitment involved advertisements displayed on university bulletin boards, community centers, and online platforms, such as social networks and mental health forums, targeting individuals aged 25–45 years with a minimum education level of high school diploma. All recruitment materials emphasized the voluntary nature of participation and the scientific purpose of improving mental health diagnostic methods. Initial eligibility was evaluated through telephone interviews based on inclusion and exclusion criteria to ensure a representative distribution across diagnostic categories. The screening assessed demographic information, psychiatric history, and participants' capacity to complete study procedures.

Participant Demographics

The study sample included 321 individuals distributed as follows:

- depressive disorder group: 146 participants (mean age = 34.2 ± 6.1 years)
- generalized anxiety disorder group: 105 participants (mean age = 33.8 ± 5.9 years)
- healthy controls: 70 participants (mean age = 32.9 ± 5.7 years)

Screening and Final Sample Selection

A total of 381 participants were initially screened. Of those, 60 participants (20 from each potential group) were excluded due to not meeting inclusion criteria, primarily the presence of comorbid diagnoses (e.g., co-occurring depression and anxiety, n = 35). The final sample consisted of 321 participants.

All participants had at least completed high school, with 68% possessing a bachelor’s degree or higher. The sample primarily consisted of Persian speakers, in accordance with the cultural and linguistic context of Iran. Eligibility criteria required participants to be between 25 and 45 years of age, possess a SCID-5-based diagnosis of depression or anxiety for clinical groups, and be willing and able to complete

two experimental sessions. Exclusion criteria encompassed neurological conditions, developmental disorders, current use of psychotropic medication (e.g., benzodiazepines, antipsychotics), substance abuse within the prior six months, comorbid psychiatric diagnoses, and inability to complete study tasks. Demographic information, including age, sex, and education, was collected via a standardized form to ensure group comparability.

Data Collection Procedures

Data were collected during a single session lasting approximately 60–90 minutes in a sound-attenuated lab at a psychiatric facility in Tehran. Task order was counterbalanced to minimize order effects. The protocol included standardized cognitive tasks, narrative speech analysis, and clinical assessment tools. Clinical participants completed the SCID-5 and Beck Depression Inventory (BDI), while healthy participants completed the Beck Anxiety Inventory (BAI) and BDI.

Cognitive flexibility was measured using the computerized Wisconsin Card Sorting Test; working memory was assessed via the computerized n-back task. Problem-solving and planning abilities were evaluated using the Tower of Hanoi and Tower of London tasks. Attentional control and inhibition were measured with the computerized Semantic Stroop Task.

Narrative performance was assessed using Ghayoumi's narrative discourse tool, and everyday memory was evaluated using the Everyday Memory Survey (EMS). Autobiographical memory was measured using the Autobiographical Memory Test (AMT). All assessments were conducted by a trained researcher.

EMS:

The EMS was a 40-item self-report tool measuring memory issues over the preceding three months. The Persian version of the instrument showed a Cronbach's alpha of 0.92, composite reliability of 0.721, and an average variance extracted of 0.564. Each item offers five response options ranging from "very often" to "never." Developed by Hall[50] this measure has demonstrated moderate positive correlations with depression screening tools ($r = 0.61$ and $r = 0.63$), supporting its validity.

AMT:

Participants were presented with 24 cue words—8 positive, 8 negative, and 8 neutral—sourced from the Aasi vocabulary database and matched for emotional valence and frequency. Participants were asked to recall and describe a specific autobiographical event for each cue word, with 45 seconds allotted per response. Responses were recorded and transcribed, and memories were scored for specificity using a Persian-adapted coding system. A score of 1 was given to specific memories tied to a defined time and place; otherwise, a score of 0 was assigned. The test demonstrated high reliability in Iran ($\alpha = 0.96$)[51–53].

Persian Narrative Discourse Assessment:

Participants described a six-scene picture sequence depicting a family event, and provided autobiographical memories in response to 24 cue words. Each response was recorded and transcribed. Narrative competence was assessed using 14 linguistic indicators across two expressive language tasks: a picture description and an autobiographical memory recall.

The 14 linguistic indicators included: (1) pronunciation errors in picture description (PEIPD), (2) pronunciation errors in memory recall (PEIMR), (3) cohesion relations in picture description (CRIPD), (4) lexical cohesion in picture description (LCIPD), (5) substitution and omission in picture description (SAOIPD), (6) overall coherence in picture description (OCIPD), (7) general coherence in picture description (GCIPD), (8) sentence complexity in memory recall (SCIMR), (9) referential coherence in memory recall (REFCIMR), (10) relational coherence in memory recall (RELCIMR), (11) lexical coherence in memory recall (LCIMR), (12) substitution and omission in memory recall (SAOIM), (13) overall coherence in memory recall (OCIMR), and (14) general coherence in memory recall (GCIMR). Detailed descriptive statistics and operational definitions for these indicators are provided in Table 1.

Responses were evaluated for length, syntactic complexity, coherence, and cohesion (e.g., lexical cohesion, reference cohesion, ellipsis, substitution, and overall coherence). Scoring was conducted by two trained raters blind to participant group. The instrument demonstrated factor loadings between 0.76 and 0.82 and has been validated for use among Persian-speaking adults[54].

Structured Clinical Interview for DSM-5 (SCID-5):

The Persian version, standardized by Shabani[55] for individuals aged 16–70, was used to confirm DSM-5-based diagnoses. Interviews were conducted by trained personnel. Inter-rater reliability was high ($\kappa > 0.80$) for most disorders, with the exception of anxiety ($\kappa = 0.34$). Sensitivity indices generally exceeded 0.80, supporting diagnostic validity.

Beck Depression Inventory-II (BDI-II):

This 21-item self-report tool evaluates cognitive, emotional, and somatic symptoms of depression. Psychometric analyses by Ghassemzadeh[56] showed a Cronbach's alpha of 0.87 and test–retest reliability of 0.78.

BAI:

The BAI consists of 21 items measuring various dimensions of anxiety. Khesht-Masjedi[57] reported a reliability coefficient of 0.83 and a construct validity index of 0.72 for Iranian samples.

Wisconsin Card Sorting Test (WCST):

Developed by Heaton[58], the WCST evaluates executive functioning, specifically set-shifting and cognitive flexibility. The Persian computerized version has shown adequate reliability and validity[59]

Participants sorted cards according to changing rules related to color, shape, or number. The primary measure was the number of perseverative errors.

Tower of Hanoi:

This task assesses executive planning and flexibility through the relocation of disks following specific rules. The Persian computerized version has been validated with favorable psychometric results[60]. The primary measure was the number of problems solved using the minimum number of moves.

Tower of London:

This problem-solving task involves rearranging colored disks to match target configurations. The Persian version has been validated and is considered reliable for use in Iranian populations[61]. The primary measure was the number of problems solved in the minimum moves.

N-back Working Memory Task:

The n-back task assesses working memory by requiring participants to identify stimuli presented n trials prior. Test–retest reliability ranges from 0.54 to 0.84. The Persian computerized version has demonstrated sound psychometric properties[62]. The primary measure was the accuracy rate.

Semantic Stroop Task:

Originally developed by Stroop, this task measures selective attention and cognitive inhibition through incongruent color-word stimuli. The Persian version has been culturally adapted and validated, showing strong construct and convergent validity [63]. The primary measure was the Stroop interference score (reaction time difference between incongruent and neutral trials).

For all computerized cognitive tasks (WCST, n-back, Semantic Stroop, Tower of London, and Tower of Hanoi), the primary outcome measures were automatically calculated by the software. This automated scoring provided objective, precise, and continuous variables for data analysis, ensuring accuracy and eliminating potential rater bias.

Statistical Analysis

Data analysis was conducted using IBM SPSS AMOS version 26 to evaluate the relationships between cognitive functions, memory, and narrative speech across healthy, depressed, and anxious groups. The statistical approach included descriptive statistics, correlation analyses, normality assessments, reliability and validity analyses, and structural equation modeling (SEM) to test the proposed measurement and structural models. Model fit was evaluated using established indices, including χ^2/df, Comparative Fit Index (CFI), Standardized Root Mean Square Residual (SRMR), Root Mean Square Error of Approximation (RMSEA), and PClose. Detailed results of model fit are reported in the Results section.

Descriptive Statistics

Descriptive statistics, including means and standard deviations, were computed for all research variables across the three groups (healthy, depressed, and anxious). For the 14 narrative speech variables, these statistics are presented in Table 1. These statistics provided an overview of the central tendencies and variability of the data.

Correlation Analysis

Pearson correlation coefficients were calculated to examine the relationships between narrative speech, autobiographical memory, and cognitive function across the three groups. This analysis aimed to identify the strength and significance of associations between these constructs, with results reported in Table 2. The correlations were assessed separately for each group to highlight group-specific patterns.

Normality Assessment

To ensure the appropriateness of parametric statistical methods, the normality of data distribution was evaluated using skewness and kurtosis indices for all research variables. Variables with absolute skewness and kurtosis values less than 3 and 10, respectively, were considered normally distributed, respectively (for detailed results, see Table S1 in the Supplementary Materials). This confirmed the suitability of parametric tests and SEM for subsequent analyses.

Reliability and Validity Analysis

The reliability of the measurement models was assessed using composite reliability (CR) and average variance extracted (AVE) for the constructs of narrative speech, memory, and cognitive function. Factor loadings for individual items were examined to ensure strong correlations with their respective constructs (for detailed results, see Table S2 in the Supplementary Materials). Convergent validity was confirmed with AVE values greater than 0.5 and CR values exceeding 0.7(for detailed results, see Table S4 in the Supplementary Materials). .

Structural Equation Modeling (SEM)

Structural equation modeling was performed using AMOS to test the measurement and structural models. The measurement model was evaluated using confirmatory factor analysis (CFA) to assess the fit of observed variables to their latent constructs (narrative speech, memory, and cognitive function).

To further explore group differences, post-hoc analyses were conducted to compare the path coefficients between groups, focusing on the differential impact of cognitive functions and memory on narrative speech. These analyses provided insights into the relative contributions of specific cognitive subcomponents (e.g., cognitive flexibility, attentional control) to narrative production across clinical and non-clinical populations.

All analyses were conducted with a significance level of $\alpha = 0.05$, and results were interpreted in the context of the research hypotheses, emphasizing the differential effects of cognitive impairments on

narrative speech in depression and anxiety compared to healthy controls.

Results

In this section, the descriptive and inferential findings related to narrative speech, autobiographical memory, and cognitive function across the healthy, anxious, and depressed groups are presented. The results are reported through descriptive statistics, correlation analyses, normality tests, and structural modeling to provide a comprehensive understanding of the relationships between memory, cognition, and narrative production. Additionally, the impact of specific cognitive subcomponents, such as problem solving, working memory, and cognitive flexibility, on narrative speech is examined to highlight group differences and underlying mechanisms.

Operational Definitions

In this section, the narrative responses were analyzed based on 14 predefined linguistic indicators derived from the validated Persian Narrative Discourse Assessment tool. These indicators were scored by two trained raters who were blind to the participants' group membership. The detailed description, operational definition, scoring method, and descriptive statistics for each of these 14 indicators are provided in Table 1 below.

Table 1
Operational Definitions

Linguistic Indicator	Task	Definition and Operationalization	Scoring Method & Numerical Representation	Descriptive Statistics (Mean ± SD)
1. Pronunciation Errors in Picture Description	Picture Description	The number of mispronounced words while describing the picture sequence.	**Count**: Total number of errors. **Calculation**: (Total Errors) / (Number of C-Units).	Depressed: 1.24 ± 0.89 Anxious: 1.18 ± 0.92 Healthy: 0.95 ± 0.78
2. Pronunciation Errors in Memory Recall	Memory Recall	The number of mispronounced words during autobiographical memory narration.	**Count**: Total number of errors. **Calculation**: (Total Errors) / (Number of C-Units).	Depressed: 1.35 ± 0.95 Anxious: 1.28 ± 0.97 Healthy: 1.02 ± 0.85
3. Cohesion Relations in Picture Description	Picture Description	The use of grammatical cohesive devices (**reference, conjunction, substitution, ellipsis**) to link ideas.	**Frequency**: Total number of correct cohesive ties. **Calculation**: (Total Cohesive Ties) / (Number of C-Units).	Depressed: 2.85 ± 0.76 Anxious: 3.02 ± 0.81 Healthy: 3.45 ± 0.72
4. Lexical Cohesion in Picture Description	Picture Description	The use of lexical relationships (**repetition, synonymy, antonymy, hyponymy, meronymy, collocation**) to create texture.	**Frequency**: Total number of lexical cohesive ties. **Calculation**: (Total Lexical Ties) / (Number of C-Units).	Depressed: 2.92 ± 0.80 Anxious: 3.10 ± 0.84 Healthy: 3.52 ± 0.75
5. Substitution and Omission in Picture Description	Picture Description	Instances where a word/phrase is incorrectly replaced (**substitution**) or left out (**omission**), affecting meaning. Substitution is replacing an element with another, while omission is the deletion of an element with zero substitution.	**Frequency**: Total number of substitution and omission errors. **Calculation**: (Total Errors) / (Number of C-Units).	Depressed: 1.85 ± 0.88 Anxious: 1.72 ± 0.85 Healthy: 1.45 ± 0.79
6. Overall Coherence in	Picture Description	The global logical structure and thematic unity of the entire picture	**Rating Scale**: Scored on a scale. The total	Depressed: 2.78 ± 0.82

Linguistic Indicator	Task	Definition and Operationalization	Scoring Method & Numerical Representation	Descriptive Statistics (Mean ± SD)
Picture Description		description narrative. It refers to the integrity of the discourse topic and the semantic connections of each communication unit with the main topic.	score is divided by the number of C-Units.	Anxious: 3.05 ± 0.79 Healthy: 3.48 ± 0.74
7. General Coherence in Picture Description	Picture Description	The local connectedness between adjacent C-units and the clarity of internal logic.	**Rating Scale**: Scored on a scale. The total score is divided by the number of C-Units.	Depressed: 2.81 ± 0.79 Anxious: 3.08 ± 0.82 Healthy: 3.50 ± 0.76
8. Sentence Complexity in Memory Recall	Memory Recall	The syntactic complexity of utterances, measured by the ratio of clauses to C-units. A complex sentence contains one independent clause and at least one dependent clause.	**Calculation**: (Number of Clauses) / (Number of C-Units).	Depressed: 2.75 ± 0.85 Anxious: 3.00 ± 0.80 Healthy: 3.42 ± 0.73
9. Referential Coherence in Memory Recall	Memory Recall	The clear and consistent use of references (e.g., pronouns, demonstratives) to identify characters and objects. It deals with the connection between words (or phrases) and other words (or phrases) in the discourse.	**Frequency**: Total number of correct referential ties. **Calculation**: (Total Referential Ties) / (Number of C-Units).	Depressed: 2.68 ± 0.88 Anxious: 2.95 ± 0.85 Healthy: 3.38 ± 0.78
10. Relational Coherence in Memory Recall	Memory Recall	The use of connectives and logical relations (**additive, adversative, causal, temporal**) to link events. Conjunctions link two whole clauses together.	**Frequency**: Total number of correct conjunctive ties. **Calculation**: (Total Conjunctive Ties) / (Number of C-Units).	Depressed: 2.70 ± 0.86 Anxious: 2.98 ± 0.83 Healthy: 3.40 ± 0.77
11. Lexical Coherence in Memory Recall	Memory Recall	The appropriateness and variety of vocabulary used to express ideas in the memory narrative.	**Frequency**: Total number of lexical cohesive ties. **Calculation**: (Total Lexical Ties) / (Number of C-Units).	Depressed: 2.72 ± 0.84 Anxious: 3.29 ± 1.39

Linguistic Indicator	Task	Definition and Operationalization	Scoring Method & Numerical Representation	Descriptive Statistics (Mean ± SD)
				Healthy: 3.42 ± 1.42
12. Substitution and Omission in Memory Recall	Memory Recall	Instances of substitution and omission errors during the memory recall task.	**Frequency**: Total number of substitution and omission errors. **Calculation**: (Total Errors) / (Number of C-Units).	Depressed: 1.80 ± 0.90 Anxious: 1.68 ± 0.87 Healthy: 1.40 ± 0.80
13. Overall Coherence in Memory Recall	Memory Recall	The global logical structure and thematic unity of the entire autobiographical memory narrative. It refers to the integrity of the discourse topic.	**Rating Scale**: Scored on a scale. The total score is divided by the number of C-Units.	Depressed: 2.80 ± 0.83 Anxious: 3.10 ± 0.79 Healthy: 3.52 ± 0.74
14. General Coherence in Memory Recall	Memory Recall	The local connectedness between adjacent C-units in the memory narrative.	**Rating Scale**: Scored on a scale. The total score is divided by the number of C-Units.	Depressed: 2.83 ± 0.81 Anxious: 3.12 ± 0.78 Healthy: 3.55 ± 0.72

Correlation Between Variables Across Groups

Table 2
Correlation Between Variables Across Groups

Group	Variable	1	2	3
Healthy	1. Narrative speech	1		
	2. Autobiographical memory	**0.758**	1	
	3. Cognitive function	**0.378**	0.259	1
Anxious (GAD)	1. Narrative speech	1		
	2. Autobiographical memory	**0.281**	1	
	3. Cognitive function	**0.139** ^ns^	0.354	1
Depressed	1. Narrative speech	1		
	2. Autobiographical memory	**0.176**	1	
	3. Cognitive function	**0.036** ^ns^	0.334	1

As shown in Table 2, the healthy group exhibited a strong positive correlation between narrative speech and autobiographical memory ($r = 0.758$, $p < 0.01$), as well as a moderate correlation with cognitive function ($r = 0.378$, $p < 0.05$). In the anxious (GAD) group, the correlation between narrative speech and autobiographical memory was weaker but still significant ($r = 0.281$, $p < 0.05$), while the correlation with cognitive function was not significant ($r = 0.139$, $p > 0.05$). In the depressed group, the correlation between narrative speech and autobiographical memory was weak but significant ($r = 0.176$, $p < 0.05$), and the correlation with cognitive function was negligible and non-significant ($r = 0.036$, $p > 0.05$). These patterns indicate a progressive disruption of cognitive-linguistic integration from healthy to anxious to depressed individuals

Normality of Data Based on Skewness and Kurtosis

The skewness and kurtosis values of all variables fell within the acceptable range (absolute skewness < |3|, absolute kurtosis < |10|), confirming the normality of the data distribution (for detailed results, see Table S1 in the Supplementary Materials). Therefore, parametric methods and structural equation modeling were confidently applied.

Reliability of Measurement Models

Variables Number of Components Items Factor Loading

All factor loadings are above 0.5, indicating a strong correlation between items and their respective constructs (memory, cognitive function, narrative speech) (for detailed results, see Table S2 in the Supplementary Materials). The high factor loadings for narrative speech (ranging from 0.76 to 0.82) suggest a high degree of coherence and structure in this scale within the studied sample.

Results of Measurement Model Fit Indices

Model fit was evaluated using multiple indices, including the chi-square statistic (CMIN), degrees of freedom (DF), CMIN/DF, Comparative Fit Index (CFI), Standardized Root Mean Square Residual (SRMR), Root Mean Square Error of Approximation (RMSEA), and PClose (for complete details, see Table S3 in the Supplementary Materials)[64–67]. Acceptable thresholds for these indices were based on established guidelines (e.g., CMIN/DF < 3, CFI > 0.95, SRMR < 0.08, RMSEA < 0.06, PClose > 0.05), as outlined in Appendix A, Table A1.

The structural model tested the hypothesized relationships between cognitive function, autobiographical memory, and narrative speech across the three groups. Path coefficients were estimated to quantify the impact of cognitive function and its subcomponents (e.g., problem-solving through modeling and strategic thinking, cognitive flexibility, working memory, and attentional control) and autobiographical memory on narrative speech. Group-specific path analyses were conducted to compare the strength of these relationships across healthy, depressed, and anxious groups, with results reported in Tables 8,9,S1,S2,S3,S3 Standardized path coefficients and coefficient differences were calculated to highlight significant group differences.

Model Fit Indices.

The measurement model demonstrated a good fit to the data. The chi-square statistic was significant (χ^2 = 302.789, df = 186, p < .001); however, this statistic is known to be sensitive to large sample sizes. Therefore, reliance was placed on a suite of alternative fit indices to evaluate model fit. All fit indices met established thresholds for acceptability (CMIN/DF = 1.628, CFI = 0.978, SRMR = 0.031, RMSEA = 0.040, PClose = 0.974; see Table S3 in the Supplementary Materials for complete details). These results indicate that the proposed model accurately represents the relationships between observed and latent variables. The structural models for each group (healthy, depressed, and anxious) were visualized in Figs. 2—4, with subcomponent analyses presented in Figs. 5—7.

The measurement model demonstrated a good fit to the data. All fit indices met established thresholds for acceptability: CMIN/DF = 1.628, CFI = 0.978, SRMR = 0.031, RMSEA = 0.040, and PClose = 0.974 (for detailed results, see Table S3 in the Supplementary Materials).

Figure 1 illustrates the standardized confirmatory factor analysis (CFA) model, providing a visual representation of the measurement structure of the study and showing that observed variables are well-loaded onto latent variables, indicating consistency between the theoretical structure and the data.

Convergent Validity of Construct

The convergent validity of all constructs was confirmed, with AVE values exceeding 0.5 and composite reliability values exceeding 0.7 (see Table S4 in the Supplementary Materials). The high composite reliability value for narrative speech (0.958) indicates that the items related to this construct effectively cover the intended conceptual characteristics.

Impact of Cognitive Function on Narrative Speech

Table 3
Impact of Cognitive Function on Narrative Speech Across Healthy, Depressed, and Anxious Groups

Path	Healthy	Anxious	Depressed	Δ (Healthy vs Anxious)	Δ (Anxious vs Depressed)
Cognitive Function → Narrative Speech	0.421	0.319	0.288	0.102 (p = 0.001)	0.031 (p = 0.001)

Reference group: Healthy.

The path coefficient for the effect of cognitive function on narrative speech was highest in the healthy group (0.421), followed by the anxious group (0.319), and lowest in the depressed group (0.288). All group differences were significant (p = 0.001), confirming a progressive reduction in the cognitive-narrative association from healthy to anxious to depressed individuals.

Table 4
Impact of Autobiographical Memory on Narrative Speech Across Healthy, Depressed, and Anxious Groups

Path	Healthy	Anxious	Depressed	Δ (Healthy vs Anxious)	Δ (Anxious vs Depressed)
Autobiographical Memory → Narrative Speech	0.480	0.367	0.182	0.113 (p = 0.001)	0.185 (p = 0.001)

Reference group: Healthy.

Autobiographical memory had the greatest impact on narrative speech in the healthy group (0.480), followed by the anxious group (0.367), and the least impact in the depressed group (0.182). All group differences were significant (p = 0.001), supporting the hypothesis that memory-related cognitive-linguistic associations are progressively disrupted in clinical groups.

Table 5
Impact of Problem Solving through Modeling and Strategic Thinking on Narrative Speech Across Healthy, Depressed, and Anxious Groups

Path	Healthy	Anxious	Depressed	Δ (Healthy vs Anxious)	Δ (Anxious vs Depressed)
Problem Solving through Modeling and Strategic Thinking → Narrative Speech	0.32	0.21	0.19	0.11 (p = 0.001)	0.02 (p = 0.001)

Reference group: Healthy.

The path coefficient for problem solving through modeling and strategic thinking on narrative speech was highest in the healthy group (0.32), followed by the anxious group (0.21), and lowest in the

depressed group (0.19). Multigroup comparisons showed significant differences between healthy and anxious groups (Δ = 0.11, p = 0.001) and between anxious and depressed groups (Δ = 0.02, p = 0.001). These findings indicate that strategic problem-solving abilities are progressively disrupted from healthy to anxious to depressed individuals.

Table 6
Impact of Problem Solving through Flexibility and Executive Control on Narrative Speech Across Healthy, Depressed, and Anxious Groups

Path	Healthy	Anxious	Depressed	Δ (Healthy vs Anxious)	Δ (Anxious vs Depressed)
Problem Solving through Flexibility and Executive Control → Narrative Speech	0.36	0.26	0.23	0.10 (p = 0.001)	0.03 (p = 0.001)

Reference group: Healthy.

The path coefficient for problem solving through flexibility and executive control on narrative speech was highest in the healthy group (0.36), followed by the anxious group (0.26), and lowest in the depressed group (0.23). All group differences were statistically significant: healthy vs anxious (Δ = 0.10, p = 0.001) and anxious vs depressed (Δ = 0.03, p = 0.001). This pattern suggests that executive flexibility plays a key role in narrative production, and its contribution is most preserved in healthy individuals.

Table 7
Impact of Cognitive Flexibility on Narrative Speech Across Healthy, Depressed, and Anxious Groups

Path	Healthy	Anxious	Depressed	Δ (Healthy vs Anxious)	Δ (Anxious vs Depressed)
Cognitive Flexibility → Narrative Speech	**0.19**	**0.17**	**0.14**	0.02 (p = 0.001)	0.03 (p = 0.001)

Reference group: Healthy.

The path coefficient for cognitive flexibility on narrative speech was 0.19 in the healthy group, 0.17 in the anxious group, and 0.14 in the depressed group. Although these coefficients are smaller than those observed for other executive functions, all group differences were significant: healthy vs anxious (Δ = 0.02, p = 0.001) and anxious vs depressed (Δ = 0.03, p = 0.001). This suggests that cognitive flexibility contributes to narrative production, but its effect is relatively weaker compared to problem-solving and attentional control.

Table 8
Impact of Working Memory on Narrative Speech Across Healthy, Depressed, and Anxious Groups

Path	Healthy	Anxious	Depressed	Δ (Healthy vs Anxious)	Δ (Anxious vs Depressed)
Working Memory → Narrative Speech	0.25	0.22	0.18	0.03 (p = 0.001)	0.04 (p = 0.001)

Reference group: Healthy.

The path coefficient for working memory on narrative speech was highest in the healthy group (0.25), followed by the anxious group (0.22), and lowest in the depressed group (0.18). Multigroup comparisons confirmed significant differences between healthy and anxious (Δ = 0.03, p = 0.001) and between anxious and depressed (Δ = 0.04, p = 0.001). This indicates that working memory is an important cognitive resource for narrative production, and its contribution is progressively reduced in clinical groups.

Table 9
Impact of Attentional Control and Cognitive Inhibition on Narrative Speech Across Healthy, Depressed, and Anxious Groups

Path	Healthy	Anxious	Depressed	Δ (Healthy vs Anxious)	Δ (Anxious vs Depressed)
Attentional Control→ Narrative Speech	**0.34**	**0.29**	**0.24**	0.05 (p = 0.001)	0.05 (p = 0.001)

Reference group: Healthy.

The path coefficient for attentional control and cognitive inhibition on narrative speech was 0.34 in the healthy group, 0.29 in the anxious group, and 0.24 in the depressed group. All group differences were statistically significant: healthy vs anxious (Δ = 0.05, p = 0.001) and anxious vs depressed (Δ = 0.05, p = 0.001). These findings highlight the strong role of attentional control in narrative production, with a clear gradient of impairment from healthy to anxious to depressed individuals.

Across all cognitive subcomponents (Problem Solving through Modeling and Strategic Thinking

, problem solving through flexibility, cognitive flexibility, working memory, and attentional control), a consistent pattern emerged: healthy individuals showed the highest path coefficients, followed by anxious individuals, with depressed individuals showing the lowest. The largest effects were observed for problem solving through flexibility and attentional control, while cognitive flexibility showed relatively smaller effects. All pairwise group differences were significant at p = 0.001, confirming that the relationship between executive functions and narrative production is progressively disrupted from healthy to anxious to depressed individuals.

Figure 1 depicts the standardized confirmatory factor analysis (CFA) model.

Discussion

This study examined how cognitive impairments associated with depressive disorder and generalized anxiety disorder affect narrative speech production, with specific focus on dimensions such as lexical cohesion, substitution and omission, sentence complexity, and coherence. Our results indicated that individuals with depressive disorder exhibited the most significant impairments across all narrative domains, followed by those with generalized anxiety disorder, whereas healthy controls demonstrated the highest narrative performance. These findings align with existing literature showing that depression and anxiety are both associated with cognitive impairments in cognitive domains essential for narrative construction, particularly autobiographical memory, executive functioning, and attentional control.

Consistent with prior research, we observed that autobiographical memory had the strongest predictive value for narrative coherence in healthy individuals, but this relationship was significantly weakened in those with depression (path coefficient = 0.182). These findings corroborate the work of Dalgleish and Werner-Seidler, who reported that depression is characterized by over general autobiographical memory retrieval, limiting specificity and richness of narratives, which are crucial for coherence and lexical cohesion in discourse[68]. Similarly, Williams and Broadbent found that depressed individuals often struggle to recall specific life events, which impairs their capacity to construct structured narratives[51]. These disruptions may explain the observed reductions in lexical coherence (LCIMR) and overall coherence (OCIMR) in the depressed group in our study. The stronger correlation between autobiographical memory and narrative speech in the healthy group (r = 0.758) compared to the depressed group (r = 0.176) suggests that disruptions in autobiographical memory processes may impair narrative production in depression. This aligns with prior research, such as Williams and Broadbent (1986), who noted that overgeneral autobiographical memory in depression limits narrative specificity and coherence.

Contrary to a simple deficit model, our SEM results revealed that the statistical relationships between cognitive functions and narrative speech were notably stronger in the healthy control group compared to both clinical groups. This pattern may be explained by a floor effect in the clinical populations. In depression and anxiety, significant impairments can cause both cognitive and narrative performance to cluster at the lower end of their respective ranges, thereby restricting variability and attenuating correlation coefficients. In contrast, the full, healthy range of functioning in the control group allows for stronger associations to emerge, reflecting a more integrated and efficient cognitive-linguistic system.

In terms of executive functioning, our findings are consistent with meta-analytic evidence showing broad deficits among individuals with depression [69, 70]. Deficits in executive domains particularly cognitive flexibility and problem-solving were strongly associated with reduced narrative coherence in depression. These impairments likely disrupt goal-directed planning, sequencing of information, and the integration of ideas during speech production, resulting in less organized and less cohesive narratives. Similar

findings have been reported by Snyder (2013) and Diamond (2013), who emphasized that reduced flexibility and ineffective problem-solving interfere with the ability to construct coherent discourse [36, 69–74].

Structural modeling further confirmed that these executive functions had stronger predictive effects on narrative performance in the healthy group than in the clinical groups, highlighting that efficient utilization of cognitive flexibility and problem-solving abilities supports logical and adaptive narrative structuring. In contrast, individuals with depressive disorder showed weaker integration of these functions, consistent with evidence of disrupted executive control and impaired cognitive–linguistic integration.

The structural models (Figs. 2–4) reveal stronger path coefficients in the healthy group compared to the depressed and anxious groups, suggesting that cognitive and memory functions are more effectively integrated in narrative production among healthy individuals. In the depressed group, weaker coefficients indicate disruptions in cognitive-linguistic integration, consistent with Snyder (2013). The anxious group shows moderate effects, suggesting partial preservation of narrative coherence (Eysenck et al., 2007). The subcomponent analyses (Figs. 5–7) further highlight that healthy individuals utilize cognitive resources like executive control and flexibility more efficiently, while depressed individuals show significant declines in these functions, impacting narrative production

Regarding generalized anxiety disorder, our results showed intermediate narrative impairments. This finding is consistent with prior studies suggesting that while anxiety also disrupts executive functioning, particularly under cognitive load, the effects may be less severe than those observed in depression [24, 25]. The moderate deficit in working memory (WM) and impairments in attentional control and cognitive inhibition (ACACI) observed in the anxious group likely contributed to decreased sentence complexity (SCIMR) and cohesion (RELCIMR) in narrative tasks. These findings are consistent with Attentional Control Theory, which posits that anxiety impairs the ability to maintain focus and inhibit distractions during complex cognitive tasks, including speech production. Cisler and Koster (2010) proposed that individuals with anxiety disorder experience increased distractibility due to impaired attentional inhibition and difficulty disengaging from threat-related stimuli, which may contribute to challenges in maintaining narrative structure and coherence[72].

Furthermore, the differences observed in substitution and omission errors (SAOIM, SAOIPD) suggest that both clinical groups struggle with lexical access and discourse-level editing, further impairing narrative quality. Prior findings by Bishop suggest that anxiety is associated with hypervigilance and attentional bias toward threat-related information, which can interfere with the narrative's thematic integrity [42]. This is particularly relevant in autobiographical recall tasks, where anxious individuals may prioritize emotionally salient or threatening elements over narrative coherence.

Our results also align with studies demonstrating that effective narrative production depends on the integration of multiple cognitive processes—working memory, autobiographical recall, problem-solving, and attention—which are often disrupted in clinical populations [36, 73, 74]. The weaker path coefficients

between cognitive functions and narrative speech observed in the clinical groups provide empirical support for the theoretical models proposed by Kintsch and van Dijk, emphasizing the role of executive processes in narrative coherence and integration[75]. Moreover, our findings build on previous work by King et al., who highlighted that impairments in episodic and contextual memory significantly reduce narrative specificity in clinical populations[76].

However, our findings contrast with Coles et al., who found relatively preserved memory processes in individuals with social anxiety[77]. This discrepancy may be due to differences in task demands; our narrative assessments required continuous cognitive load, speech production, and emotional processing, which may exacerbate deficits not captured in simpler memory tasks. Additionally, while some studies report minimal cognitive impairment in anxiety, our inclusion of attentional control and planning measures may have captured deficits more comprehensively.

Finally, these results support the use of narrative-based assessments in clinical evaluations and interventions. Given the importance of storytelling in therapy (e.g., narrative therapy), identifying specific cognitive deficits that impair narrative production can inform personalized treatment strategies. As Angus and McLeod emphasized, narrative construction is not only a cognitive act but a therapeutic tool essential for meaning-making and emotional regulation in clinical contexts [78].

Conclusion

This study provides compelling evidence that cognitive impairments in depressive disorder and generalized anxiety disorder significantly disrupt narrative speech production. Through structural equation modeling, we found that healthy individuals exhibit strong associations between key cognitive functions such as autobiographical memory, cognitive flexibility, and attentional control, and narrative coherence. In stark contrast, individuals with depressive disorder displayed the weakest associations, indicating profound disruptions in cognitive-linguistic integration. The generalized anxiety disorder group showed intermediate impairments. These findings highlight narrative speech as a sensitive correlate of cognitive dysfunction and underscore the potential of integrating cognitive and narrative assessments to better understand the cognitive profiles of these psychiatric disorders, paving the way for more targeted cognitive remediation interventions.

Abbreviations

PEIPD
Pronunciation errors in picture description PEIMR:Pronunciation errors in memory recall CRIPD:Cohesion relations in picture description LCIPD:Lexical cohesion in picture description SAOIPD:Substitution and omission in picture description OCIPD:Overall coherence in picture description GCIPD:General coherence in picture description SCIMR:Sentence complexity in memory recall REFCIMR:Referential coherence in memory recall RELCIMR:Relational coherence in memory recall LCIMR:Lexical coherence in memory recall SAOIM:Substitution and omission in memory recall OCIMR:Overall coherence in memory recall

GCIMR:General coherence in memory recall EMS:Everyday memory survey AM:Autobiographical Memory PMAST:Problem solving through modeling and strategic thinking PFAEC:Problem Solving through Flexibility and Executive Control CF:Cognitive Flexibility WM:Working Memory ACACI:Attentional Control and Cognitive Inhibition NSV:Narrative speech variables ANSV:Average of narrative speech variables AMV:Autobiographical Memory Variables CFV:Cognitive function variables

DSCID-5

Structured Clinical Interview for DSM-5

BDI-II

Beck Depression Inventory-II

BAI

Beck Anxiety Inventory

WCST

Wisconsin Card Sorting Test

AMT

Autobiographical Memory Test

SEM

Structural Equation Modeling

CFA

Confirmatory Factor Analysis

CMIN

Chi-square statistic

DF

Degrees of Freedom

CFI

Comparative Fit Index

SRMR

Standardized Root Mean Square Residual

RMSEA

Root Mean Square Error of Approximation

PClose

P-value for Close Fit

NFI

Normed Fit Index

RFI

Relative Fit Index

IFI

Incremental Fit Index

RMSR

Root Mean Square Residual

PNFI

Parsimonious Normed Fit Index
PCFI
Parsimonious Comparative Fit Index
AGFI
Adjusted Goodness of Fit Index

Declarations

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Author contributions

H.D. and M.S. conceived and designed the study. H.D. performed the investigation, formal analysis, and wrote the original manuscript. M.S. supervised the project and administered the study. A.M. validated the findings. M.R. contributed to methodology and resources. A.P.R. curated the data. All authors reviewed and approved the final manuscript.

Data availability statement
The datasets generated and/or analyzed during the current study are not publicly available due to ethical restrictions and participant confidentiality agreements but are available from the corresponding author upon reasonable request. Anonymized data will be shared with researchers who provide a methodologically sound proposal and obtain appropriate ethical approval.

Funding status

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80. Appendix, A. Commonly Accepted Thresholds for Model Fit Indices.

Figures

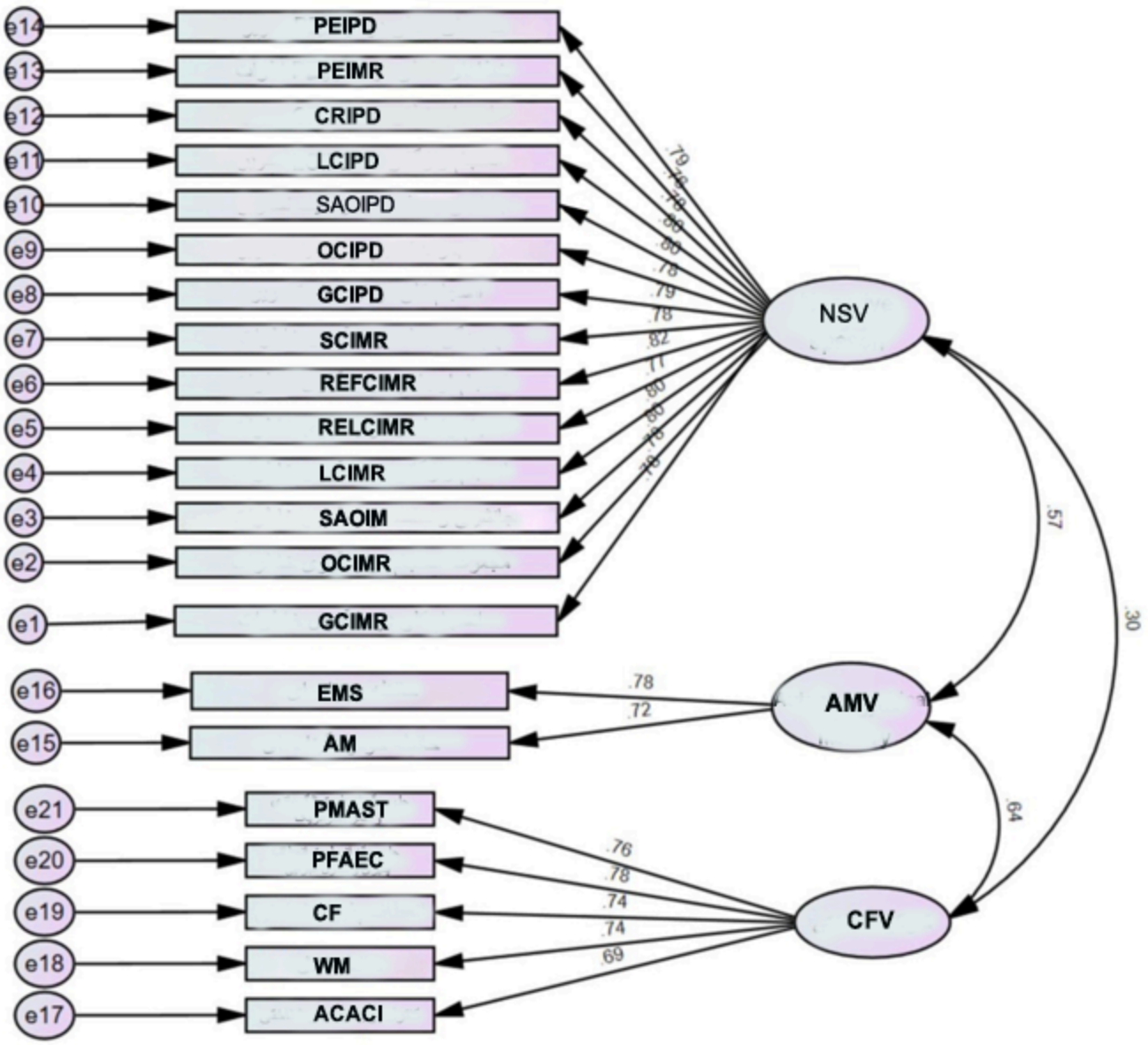


Figure 1

Standardized CFA Model

This model provides a visual representation of the conceptual measurement structure of the study, demonstrating that observed variables are well-loaded onto latent variables, indicating consistency between the theoretical structure and the data.

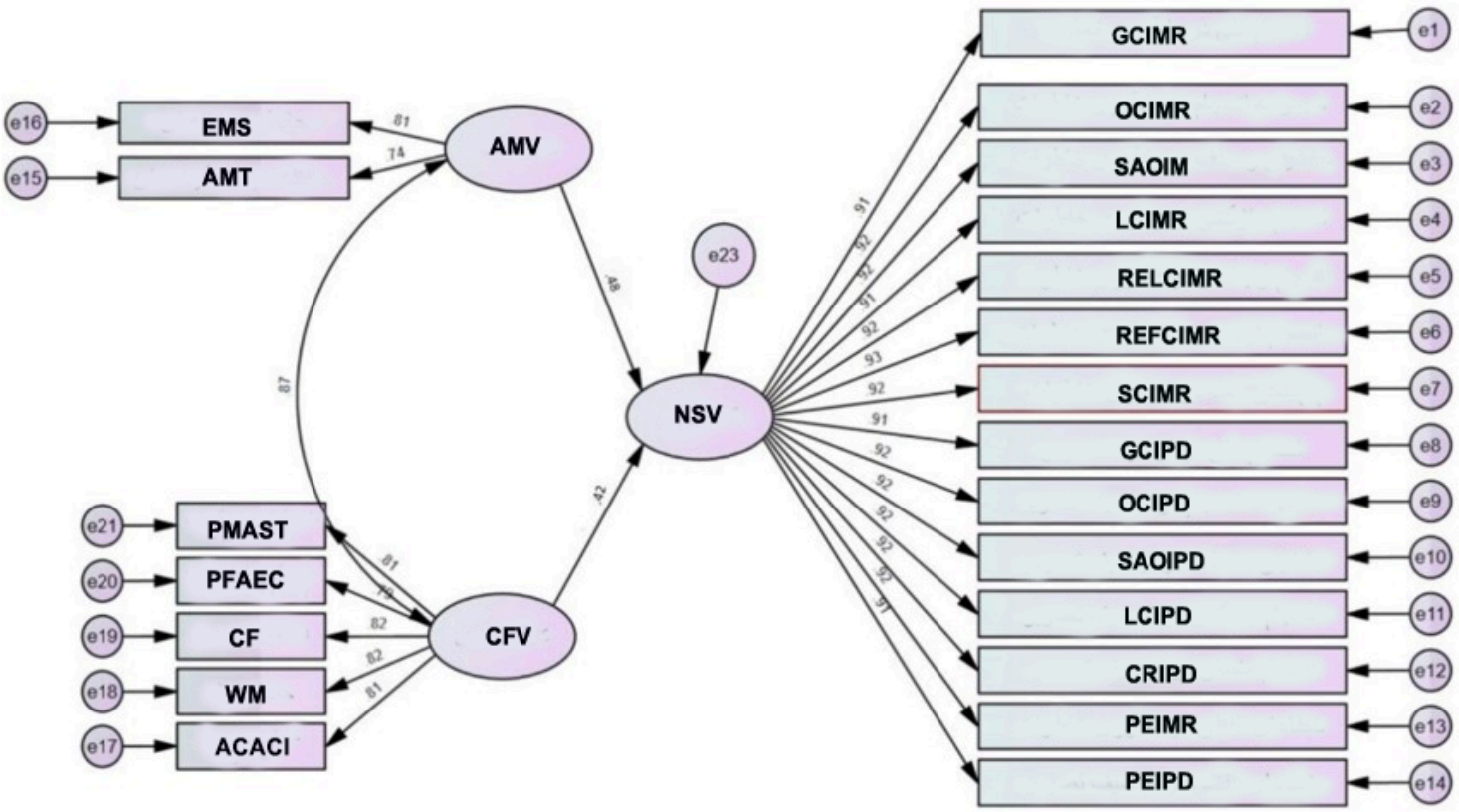


Figure 2

Structural Model for the Healthy Group

This diagram illustrates the relationships between memory, cognitive function, and narrative speech in the healthy group.

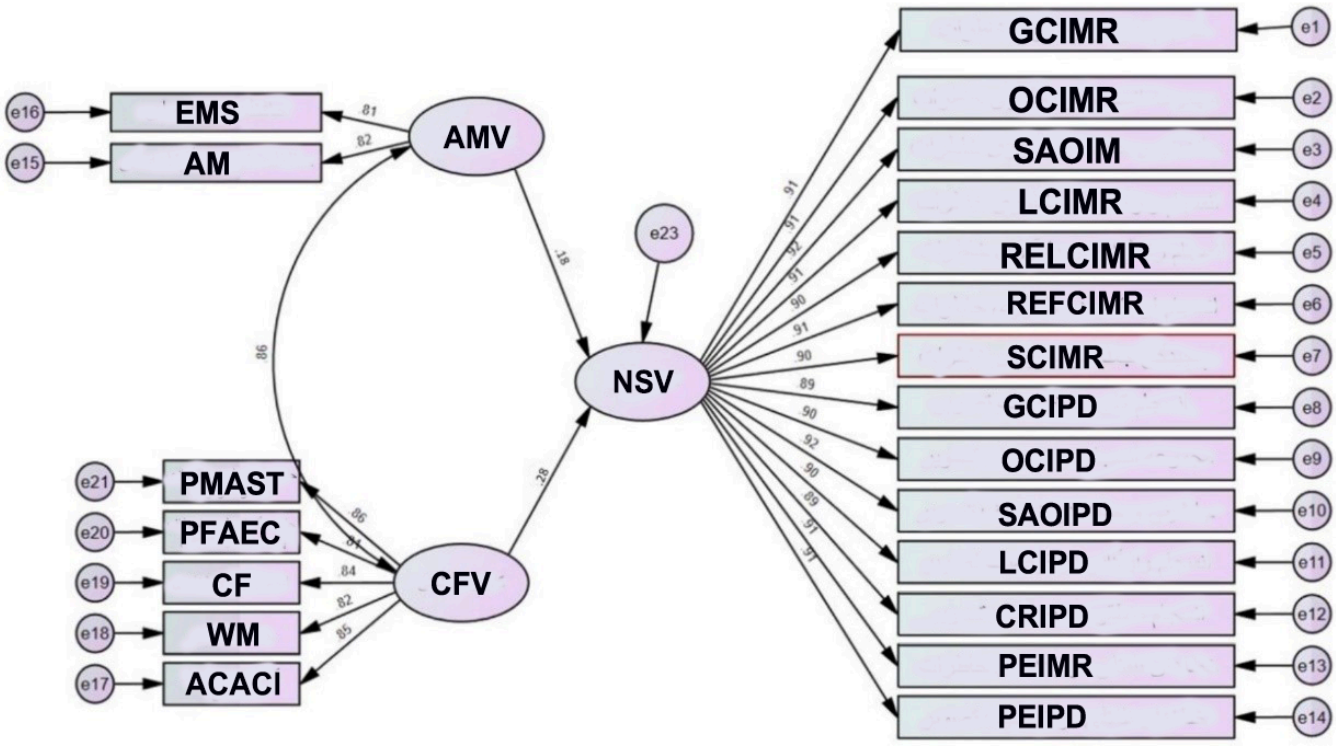


Figure 3

Structural Model for the Depressed Group

This diagram shows the relationships between memory, cognitive function, and narrative speech in the depressed group.

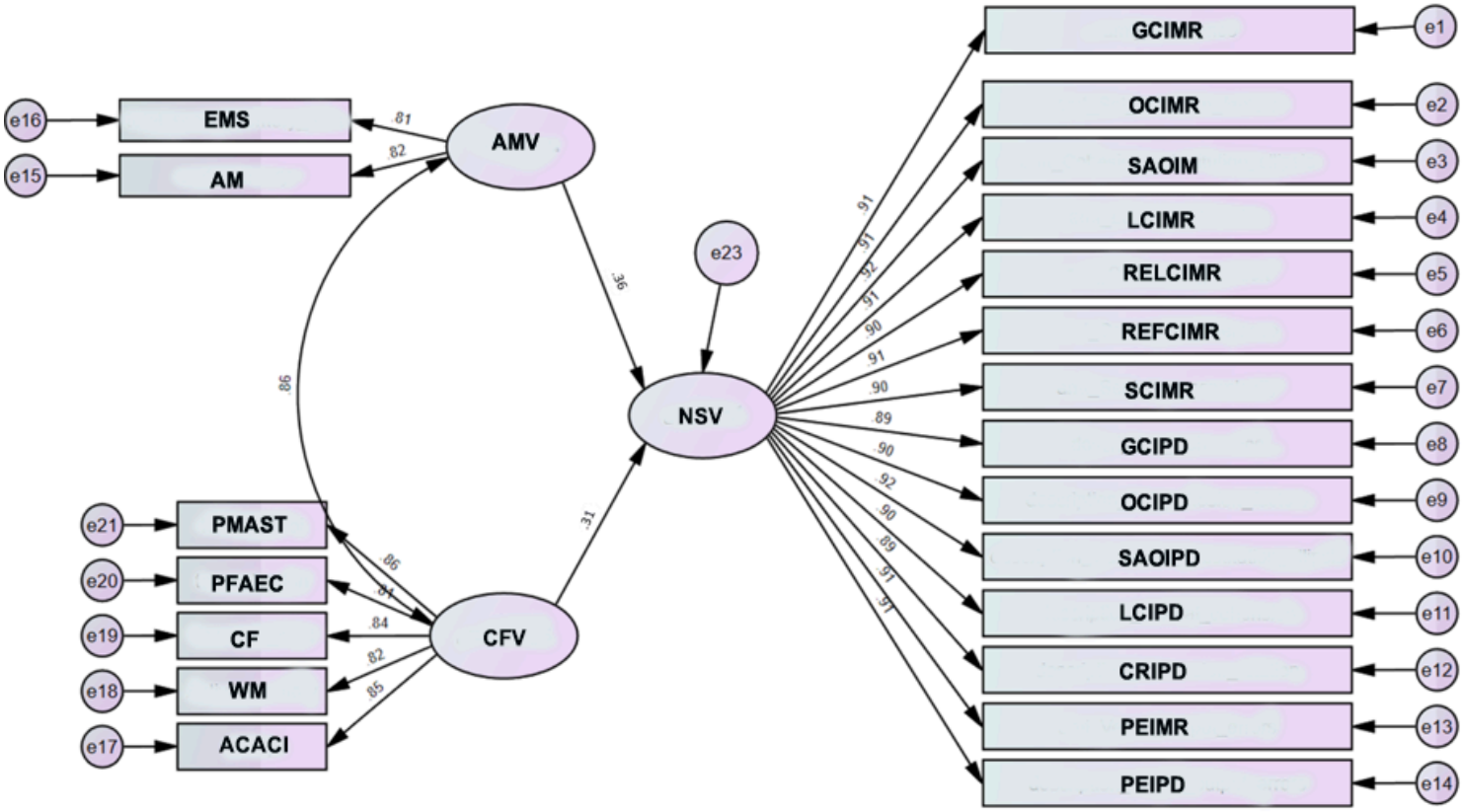


Figure 4

Structural Model for the Anxious Group

This diagram shows the relationships between memory, cognitive function, and narrative speech in the anxious group.

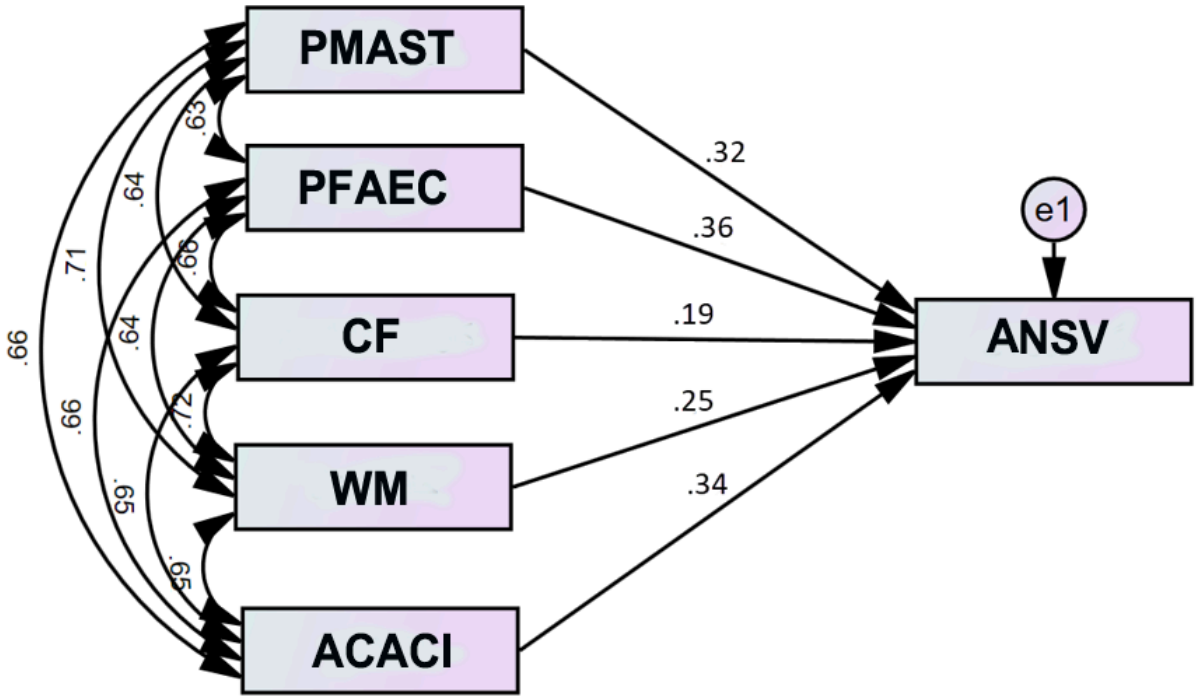


Figure 5

Subcomponents of Cognitive Function in the Healthy Group

This figure shows the path coefficients for cognitive function subcomponents in the healthy group.

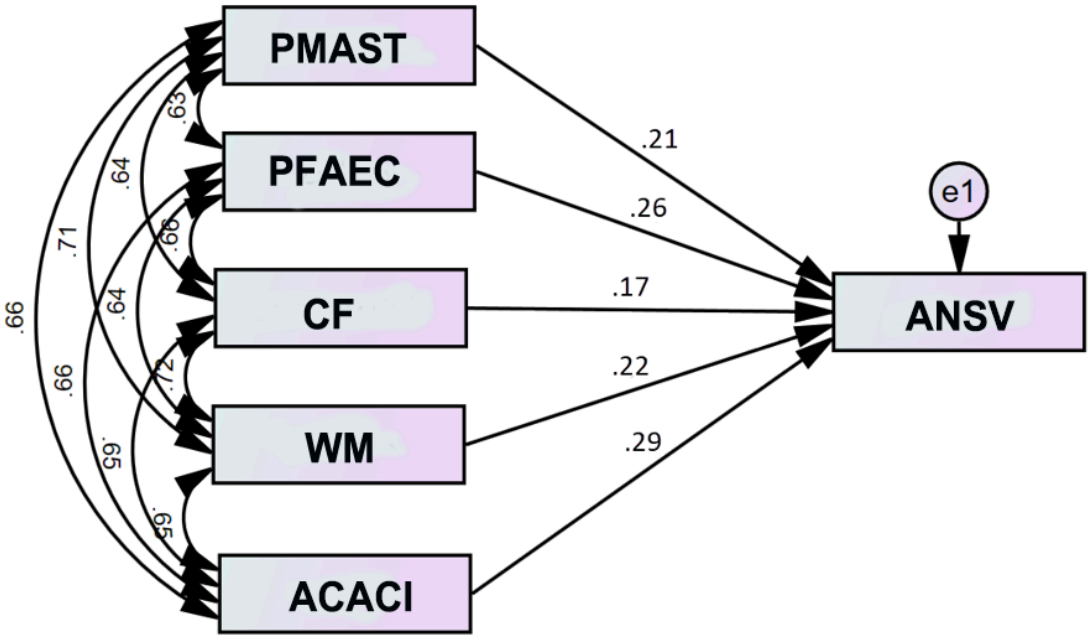


Figure 6

Subcomponents of Cognitive Function in the Anxious Group

This figure shows the path coefficients for cognitive function subcomponents in the anxious group.

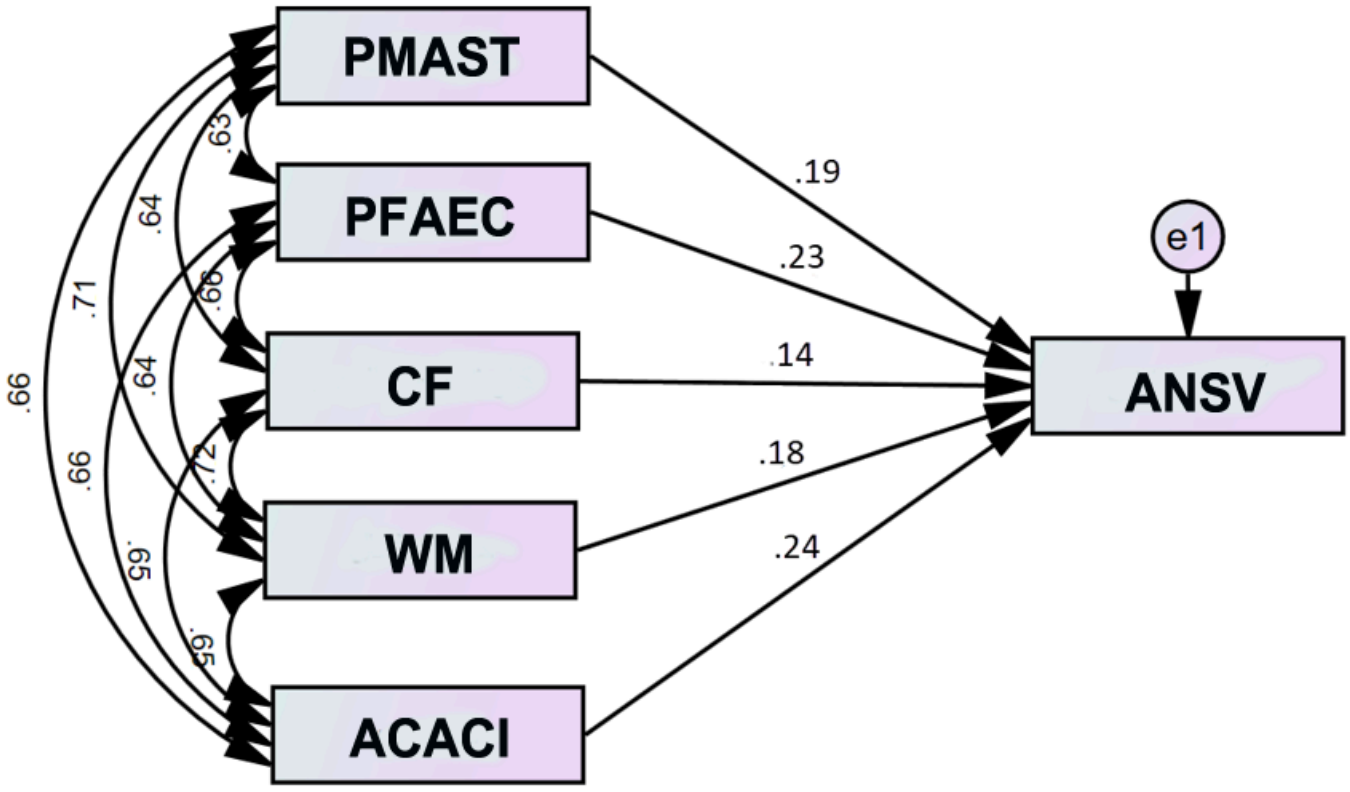


Figure 7

Subcomponents in the Depressed Group

This figure shows the path coefficients for cognitive function subcomponents in the depressed group.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementaryfile.docx
- Appendix1.docx