

## Research Paper

## Investigating the Relationship Between Local and Global Coherence and Cognitive Processes in Persian-speaking Elderly Population

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**ABSTRACT**

**Objective:** Many studies have suggested a relationship between coherence and cognitive processes. This study aims to investigate this hypothesis by assessing the relationship between cognitive variables and coherence in the discourse of 2 groups of Persian-speaking young adults and the elderly.

**Methods:** To evaluate our participants' cognitive capabilities, we employed the cognitive tests of the mini-mental status test, the Stroop-color task, the digit symbol copy task, the clock-drawing task, and the backward digit span. On the other hand, the specific tasks to evaluate the discourse properties of the participants were the single task of talking and the dual task of talking while walking.

**Results:** The results demonstrated that the dual task did not impact local coherence while global coherence was significantly disrupted in both tasks. However, the global coherence scale was more negatively affected in the dual task compared to the single task. While the relationship between global coherence and cognitive variables was significant in both tasks, the relationship between global coherence and working memory measures was only significant in the dual task. Furthermore, no relationship was observed between the scale of local coherence and either cognitive or working memory measures.

**Conclusion:** Our findings corroborate previous findings that local and global coherence is manipulated by different cognitive processes and the maintenance of global coherence requires more demanding cognitive processes and is disrupted before local coherence occurs.

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## Highlights

- The elderly face numerous challenges in generating the dual task of talking while walking.
- Cognitive functions of concentration, inhibition, and attention as well as working memory explain the generation of poor global coherence in the healthy elderly.
- Local coherence is not affected in both the single and the dual task.

## Plain Language Summary

As people get older, their cognitive memory and some language abilities gradually diminish. The problems of this population worsen when they are to conduct dual tasks. In this study, throughout the conduction of the single task of talking while sitting and the dual task of talking while walking, we aimed to see whether the above abilities could affect spontaneous language generation in the healthy elderly. Our results demonstrated that this population could not maintain the main idea of their speech (global coherence), especially in the dual task. Meanwhile, cognitive factors, especially attention, concentration, and inhibition of irrelevant responses would culminate in the elderly's poor language generation. Our findings could assist clinicians and speech therapists to find more appropriate and simpler strategies while talking to the elderly, thereby improving their quality of life.

### 1. Introduction

**D**iscourse is a multifaceted type of language, the accurate and satisfactory production of which entails the coordination of different types of cognitive processes, namely, the selection of appropriate information from the memory, the exclusion of unnecessary information, the plausible prediction of the upcoming utterance, reasonable planning, discussion, and topic maintenance (Hjelm, 2021). As Van Dijk (2020) asserted, discourse mastery is regarded as encompassing cognitive elements or macrolinguistic functions which integrate both linguistic and non-linguistic knowledge. The two important manifestations of these macrolinguistic functions in discourse include global and local coherence. While in local coherence, the speaker should be steadfast in the maintenance of the meaning of every single discourse relative to its neighboring utterance, the speaker/writer should preserve the topic during the whole discourse in global coherence (Leaman & Edmonds, 2021; Seixas-Lima et al., 2020).

The maintenance of coherence properties in the dual tasks of talking and walking in the elderly might be more challenging because of two reasons. Firstly, as people get older, their cognitive resources decrease. Secondly, the negative effect of conducting two things simultaneously while concentrating on one of them might be more cognitive-demanding for this population. Our main objective in this study is to investigate the relationship be-

tween two important types of coherence, namely global and local, and the cognitive processes in the two groups of Persian-speaking young adults and the elderly during a dual task.

The majority of related studies have analyzed the effects of dual tasks on the style of walking (Hunter; Hunter et al., 2020; Nenna, Protzakm, & Gramann, 2021; Schneider et al., 2021); however, in only a few studies the opposite pattern was observed. That is, they either analyzed the effects of dual tasks on the discourse generation of post-stroke patients or the different linguistic elements of the use of language, such as sentence complexity, fluency, grammaticality, number of words per minute, and the speed of speech (Arslan, Devers, & Ferreira, 2021; Linnik, Bastiaanse, & Höhle, 2016). In particular, in these studies, the participants were required to perform, for example, phonemic verbal fluency and executive tasks while preserving their balance in walking or in other motor tasks. On the other hand, some studies analyzed the impact of dual tasks on the discourse generation of demented patients, such as people suffering from Alzheimer.

The results demonstrated that in these subjects the parameters of discourse coherence, organizing, planning, executive function, working memory, and long-term memory would diminish more compared to their healthy counterparts (Pompili, Abad, Matos, & Martins, 2020; Laske et al., 2015; Oh, 2021; Thies et al., 2020). However, regarding the performance of healthy elderly people, there have been only a few studies that investi-

gated the impact of other motor tasks on the discourse production of the elderly (Ismail et al., 2022; Kemper et al. 2014). For example, it was demonstrated in two studies that the elderly produced a shorter and less complex type of discourse compared to younger adults while the rate of their speech in the dual task decreased when compared to the single task (Kandana et al., 2022; Kintz, Fergadiotis, & Wright, 2016).

Accordingly, this interference effect in the dual tasks of walking while talking was significant. In addition, some studies analyzed global coherence as an important component of macrolinguistic functions. The results of these studies demonstrated that the property of off-topic verbosity was the predominant linguistic characteristic of normal aging (Yin & Peng, 2016). On the other hand, some studies attempted to present theoretic explanations for their findings and asserted that the type of off-topic speech observed in the discourse of older adults was related to executive malfunction, more specifically, the cognitive variable of inhibition (Barnett & Coldiron, 2021). Also, it was corroborated that the elicitation method or task by which examiners analyzed the discourse sample of the participants played an important role (Ellis, et al., 2016; Gollan & Goldrick, 2019). Meanwhile, only a few studies investigated a macrolinguistic analysis (global coherence) of discourse characteristics during the dual task in post-stroke groups and reported a strong deficit in the global coherence and attention component of executive function (Obermeyer, et al., 2021; Plummer et al., 2020). However, there was a gap in the literature as the investigation of the direct correlation between macrolinguistic functions (global as well as local coherence) and diverse cognitive variables have not yet been scrutinized in the elderly.

In the current study, following the narratives of Plumer and his colleagues (Plummer-D'Amato et al., 2008), regarding utilizing macro linguistic measures, we aimed to investigate the relationship between both global and local coherence and cognitive parameters in the elderly. We postulated that the performance of our participants in the dual task condition (walking while speaking) was more challenging than the single task condition (sitting) because the former would require the recruitment of more cognitive resources compared to the latter. In other words, in the dual task, cognitive resources should compete (Hassan et al., 2022; Muci, et al., 2022). Furthermore, similar to the scenario observed in post-stroke patients (Obermeyer et al., 2021; Plummer et al, 2020 ), we postulated that the global coherence was more negatively affected than local coherence in both dual and single tasks because while the accurate performance of

the latter would require the participants to maintain local coherence between neighboring utterances, the satisfactory manipulation of the former would entail the prolonged maintenance of topic over a stretched string of utterances, thus imposing more cognitive challenges on the participants. In this regard, we assumed that global coherence was more negatively disrupted by the dual task compared to the single task because the conduction of talking concurrently with motor tasks would entail additional cognitive demand. Our predictions were based on the previous literature which declared that as people age, their cognitive resources would gradually diminish (Wilson, et al., 2020). Also, to attest to the psychological reality of the assertion that discourse coherence would entail cognitive resources, we examined the relationship between coherence (local and global) on one hand, and the executive function, vocabulary, and working memory measures on the other. To the best of our knowledge, this study in the Persian-speaking setting is the first to explore the correlations between local and global coherence in a group of healthy elderly.

## 2. Materials and Methods

### Study participants

we selected our participants via the convenient sampling method. In doing so, we used the inclusion/exclusion strategy to select our target population. The participants included 20 (10 males and 10 females) age- and education-matched healthy monolingual individuals. Our rationale for controlling the variables of age and education was because these two variables had been closely correlated with the cognitive abilities of the elderly (Mungas et al, 2021; Wilson, et al., 2020). Also, the mean age of our participants was 76 years (age range: 72 to 80 years). All participants were native Persian speakers. The exclusion criteria were the lack of prior focal brain damage or any neurodegenerative disease, having no addiction to alcohol or drug, and not being previously afflicted with any kind of neuropsychiatric diseases, such as depression or anxiety.

All of the participants were capable of walking without any physical assistance, and performing 3- or 4-step commands was an easy task for them. In addition, their auditory and verbal capabilities were intact; therefore, they could react to auditory or verbal stimuli satisfactorily. They had not already been afflicted with orthopedic problems which might affect their walking ability. Also, they did not have severe dysarthria; therefore, responding to auditory stimuli was easy for them. Those participants whose Mini-Mental State Examination (MMSE)

grades were less than 25 were excluded from the main study. Our research was conducted following the ethical guidelines in human research and was approved by the Research Ethics Committee of the University of Gonabad (permission number: 2021/52201/2820/120). Furthermore, the participants signed a consent letter and all took part in the study voluntarily.

### Study instruments

#### General cognitive assessment

We utilized the Persian version of MMSE (Foroughan et al., 2008). As a brief easy-to-conduct cognitive test, MMSE is suitable to evaluate diverse cognitive parameters, including attention, calculation, language, orientation, arithmetic, and delayed memory. The participants who scored lower than 25 are suffering from cognitive impairment. The brief format of this test is its major advantage. Most physicians prefer to use this test instead of lengthy ones (McGurn et al., 2022).

#### Executive function assessment

##### Clock drawing task

Designed by Schulman and his colleagues in 1993, this test evaluated executive functions, including long attention, concentration, decision-making as well as memory, and frustration tolerance (Cova et al., 2022). Visuo-special capabilities of the patients are also measured by this test. Having a strong concurrent validity with MMSE, this test could also be utilized by clinicians. It was also confirmed that the nationality and language of the patients do not have any impact on the participants' performance. This test could be a suitable complementary test for MMSE as it would measure those cognitive components which could not be evaluated by MMSE. Furthermore, its efficiency was corroborated in the evaluation of healthy old individuals suffering from cognitive impairment. Two major advantages of this test are its shortness as well as its easy administration (Dion et al., 2020). In this test, the examiner would give a sheet to participants, on which the shape of a circle was designed. Then, the examinee was asked to draw clock hands demonstrating 10 min past 11:00. The results of the test were calculated based on the six-grade scale in which higher grades were indicative of more errors committed by participants.

##### Trail-making test

We used the validated Persian version of the trail-making test in our study (Nejati, 2010). As an attention-measuring instrument, this test is composed of two sec-

tions. In the first section, we have 25 circles distributed in the page sheet. The circles are numbered from 1 to 25. The examinee is supposed to connect these numbers in an orderly ascending manner. In the second section, the examinee is expected to connect a series of numbers (from 1 to 13) and letters (from "A" to "L") in an alternative manner without lifting the pen or pencil. The time needed to complete the test is recorded.

#### The Stroop color task

To assess the inhibition/suppression component of executive function, we utilized the Persian version of the Stroop color task (Azad, 2020). The satisfactory performance of the participants would require them to suppress the habitual tempting response. In the color-naming section, the participants are required to correctly name the color of the printed shapes within 45 s. Also, in the reading color-word matching subtest, they are required to mention the name of the color when it is matched with the color words. However, in the incongruence condition, our participants were required to name the color while it mismatches with the printed words. The main rationale for the selection of this test is its accurate performance which entails the participant inhibiting the extraneous unnecessary information throughout the test and preserving this capability during the test administration. The performance of the participants is assessed based on the number of errors they commit in the interference condition.

#### Working memory assessment

To investigate whether working memory plays a role in the maintenance of local coherence, we also conducted working memory assessment tools. As a test of working memory, the backward digit span test was chosen because its design and performance are easy (Nejati, 2010). Confronted with lists of numbers becoming longer successively and gradually, the participants are required to repeat them in the reversed order. A trial composed of two items in each list was also performed. The test was scored based on the number of digits that were recalled correctly. Another working memory test was the memory subtest of Goldman and his colleagues which was utilized to measure working memory function (Bao, et al., 2016). In this test, the participants are required to listen to diverse words and count the number of repeated words. The major rationale for selecting this test was its simplicity for the elderly population compared to other working-memory assessment tests.

### Vocabulary assessment

In the Persian vocabulary subtest of Wechsler abbreviated scales of intelligence (Jafari, et al., 2015), the participants were required to explain the meaning of the words while hearing them, and their performance was scored 0, 1, or 2.

### Study main tasks

Our main tasks included the single task of talking while sitting and the dual task of sitting while talking. Our major rationale for the conduction of these two tasks was to understand whether our participants could still preserve the topic and maintain their coherence while they were generating a spontaneous discourse.

### Study procedure

The study took place in the center of Saraye Mehr which belongs to the municipality of Amol City, Iran from September 10 to December 10, 2020. Initially, the cognitive tests were administered in an orderly manner for all participants. Afterward, with an interval of one week, our major discourse tasks were administered. We considered a 1-week interval to neutralize the negative impact of tiredness on the participants' performance. As mentioned, the first task to elicit discourse properties of the participants was the single task. In this task, the participants were asked to talk while sitting comfortably. However, in the second challenging dual task, they were supposed to walk for about 4 min while their discourse properties were retrieved. They could also utilize their assistive devices when performing the task. They were told nothing about the priority of talking or walking, and to reduce the impact of tiredness on the subjects, they were supposed to conduct the single task before the dual one. The tested topics were related to their previous occupation or personal lives which seemed important to them (for example, "would you please talk about your children?" or "what is your idea about your wife?") The topics that the participants were tested in either the single or the dual task conditions were different to reduce the impact of the familiarity of the topics on our subjects' performance. We recorded our subjects' utterances via a digital sound recorder. In case they demonstrated lengthy pauses or stopped talking, we tried to encourage them to talk using some linguistic prompts.

All of the discourse samples and the prompts were transcribed without any intervention. One of our colleagues corroborated the accuracy of the transcripts after listening to the recordings and investigated for any probable

errors. We utilized the inter-rater reliability measure in which we asked one of our colleagues with special expertise in discourse analysis to measure the coherence properties. The point-to-point comparison demonstrated an inter-rater reliability of 89.52% for global coherence and 92.22% for local coherence.

### Data analysis

Following the systematic analysis of language transcripts, all the utterances were divided into the shortest independent clauses or "T" units and related dependent clauses (Feenaughty, 2022). The average spoken utterance per transcript by our participant was 28.12 (Mean±SD), ranging from 8 to 47.

To measure the coherence, we adopted the previous standard framework (Linnik, et al., 2022). Based on the scores of 5, 3, and 1, we coded each unit for local and global coherence. Regarding global coherence, the score of 5 demonstrated that the utterance was strongly related to the main topic, verifying the complete global coherence. A score of 3 was indicative of the probable relation of the utterance to the topic. And, a score of 1 corroborated that the utterance was thoroughly irrelevant to the main topic, demonstrating a gross violation of global coherence. On the other hand, concerning local coherence, when an utterance was related to the previous utterance, it scored 5. A score of 3 highlights a slight topic shift or marked the vagueness of the referents. A score of 1 showed we have a drastic topic shift or that the produced utterance was completely related to the main idea of the former utterance. In Table 1 and Table 2, the coherence scoring is presented.

### 3. Results

In Table 3, the results of our participants' performance in cognitive tests are presented. The statistical significance of all tests was considered at  $P < 0.05$ . The calculation of the global and the local coherence was based on the total score of each type of coherence for each T-unit divided by the number of T-units. Moreover, to determine the effects of task (single and dual) on coherence type (local and global), a 2 X 2 within-subjects repeated measures analysis of variance was administered. The results demonstrated the main effect of the task ( $F_{1,14} = 6.84$ ;  $P = 0.02$ , Partial  $\eta^2 = 0.43$ ). Also, the main effect of the coherence type was significant as the global coherence score was significantly lower than local coherence ( $F_{1,14} = 6.74$ ;  $P = 0.0312$ ; Partial  $\eta^2 = 0.42$ ). Table 4 presents the mean grade of the participants with standard deviations.



**Table 1.** A sample of impaired global coherence relative to the local coherence

Lines	Topic: "Well, let's talk about your children."	Global	Local
1-6	Talks about his grandchildren	-	-
7	well, I'm fond of my grandchildren.... Uh ...I'm satisfied with them.	5	3
8	I have two daughters and two sons. They are all educated.	1	1
9	My youngest boy is a medical student in Tehran.	1	5
10	Tehran is a populous city and is more expensive compared to other cities.	1	5
11	However, nowadays, the expenses are high everywhere, even in small cities.	1	5
12	The sky has the same color everywhere, dear.	1	5
16	Because, wherever you are, you should have a high income.	1	5

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In Tables 5 and Table 6, the correlations between the two types of coherence and cognitive variables are presented respectively in two single and dual tasks. As the Spearman nonparametric correlation indicated, we did not observe any correlation between the results of MMSE in addition to those of local and global coherence in the total two tasks ( $rest < 0.17$ ). The correlation between local and global coherence was not observed both in the single task ( $rest = 0.45$ ,  $P = 0.06$ ), and the dual task ( $rest = 0.51$ ,  $P = 0.51$ ).

Regarding the relationships between global coherence and cognitive variables, the results were as follows. There was a negative correlation between global coherence and the Stroop color interference measure in both single ( $rs = -0.04$ ,  $P = 0.005$ ) and dual tasks ( $rs = -0.006$ ,  $P = 0.001$ ). Accordingly, fewer errors in the word-color interference condition were related to more global scores. There was a negative correlation

between global coherence and clock-drawing measure in both the single task ( $rs = -0.41$ ,  $P = 0.03$ ) and the dual task ( $rs = -0.015$ ,  $P = 0.002$ ). That is, higher global scores were related to lower scores in the clock-drawing task. The same trend was observed between global coherence and scores of the trail-making task in both single ( $rs = -0.74$ ,  $P = 0.004$ ) and dual-task conditions ( $rs = -0.91$ ,  $P = 0.001$ ). This finding demonstrates that higher scores in the global coherence scale were associated with faster times to connect numbers in an ascending alternative manner in the cognitive task.

However, regarding the relationship between global coherence and working memory measures, the opposite pattern was observed in the two tasks. That is, in the single task condition, the relationship between global coherence and backward digit span task was not significant ( $rs = -0.521$ ,  $P = 0.8$ ). Also, the relationship between global coherence and memory subtest of Goldman et al.

**Table 2.** A sample of impaired local coherence relative to the global coherence

Line	Topic: "Would you please talk about your birthplace?"	Global	Local
1-4	Well, Amol, um... It is difficult for us to live here.	5	1
5	Well, Amol is a tourist city.	5	5
6	However, I am fond of its people. that is, everyone would be fond of it.	5	1
7	The spring, here, is awesome.	5	1
8	Seems like its population increases every day.	5	1
9	However, over the past 40 years, the houses have changed drastically ... um .... for example ....)	5	3
10	The old beautiful houses are replaced with apartments.	1	5

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**Table 3.** Performance of the participants in cognitive tests

Tests	Participants' Performance (Mean±SD)	No.
MMSE	26.69±2.73	105
P-WASI vocabulary	47.05±9.25	207
Backward digit span	6.46±1.33	207
Stroop color	11.46±2.65	207
Clock drawing	12.78±2.63	56
Goldman memory subtest	7.87±1.67	107
Trail making task	12.56±2.21	101

MMSE: Mini-Mental State Exam; P-WASI: Persian-Wechsler Abbreviated Scale of Intelligence; SD: standard deviation.

was not significant ( $r_s=0.71$ ,  $P=0.17$ ). However, during the dual task, there was a correlation between global coherence and the backward digit span test ( $r_s=-0.8$ ,  $P=0.005$ ). The same positive trend was also observed between the memory subtests of Goldman et al. and global coherence ( $r_s=-0.31$ ,  $P=0.041$ ).

Regarding the local coherence macro linguistic component, our results corroborated the lack of correlation between cognitive local coherence and cognitive measures in both tasks. In particular, we found no relationship between local coherence and the clock drawing test in both the single ( $r_s=0.19$ ,  $P=0.67$ ) or the dual task conditions ( $r_s=0.28$ ,  $P=0.81$ ). We also did not observe any relationship between local coherence and the Stroop interference either in the single ( $r_s=0.09$ ,  $P=0.82$ ) or the dual task ( $r_s=0.41$ ,  $P=0.45$ ). The same pattern was also observed between local coherence and trail-making measure in the single ( $r_s=0.26$ ,  $P=0.91$ ) and the dual task ( $r_s=0.412$ ,  $P=0.75$ ).

Furthermore, the relationship between local coherence and working memory measures confirmed the lack of correlation between the two measures. In particular, no correlation was observed between the performance of our participants in the local coherence and the backward digit span test in both the single ( $r_s=0.16$ ,

$P=0.37$ ) and the dual task condition ( $r_s=0.241$ ,  $P=0.69$ ). Our results also confirmed the lack of correlation between local coherence and memory subtest of Goldman et al. in both the single ( $r_s=0.35$ ,  $P=0.2$ ) and the dual task ( $r_s=0.512$ ,  $P=0.21$ ). Our vocabulary measure also did not correlate with either the cognitive or the working memory measures in both tasks.

#### 4. Discussion

In this study, we aimed to investigate the impact of the dual task of talking while walking in healthy elderly individuals. Our prediction that coherence would be more negatively affected in the dual task compared to the single task of sitting while talking was grounded on two important reasons. Firstly, simultaneous discourse production and walking demands more cognitive resources and executive functions as participants were required to inhibit irrelevant ideas related to external events. Secondly, the participants were required to concentrate on the accurate generation of the discourse and pay attention to the main topic of the discourse. The byproduct of this hypothesis was that cognitive measures that assess attention, concentration, and inhibition/suppression was more negatively affected compared to working memory measures or lexical comprehension capabilities. Furthermore, as global coherence entailed topic maintenance

**Table 4.** Coherence results in each task

Tasks	Mean±SD	
	Local Coherence	Global Coherence
Single task	5.68±0.47	5.37±0.68
Dual task	3.73±0.64	3.43±1.12

**Table 5.** Correlations among coherence, age, and cognitive variables during single task

Variables	2	3	4	5	6	7	8	9
Mean global coherence	0.45	0.13	-0.04	-0.41	-0.74	0.71**	0.521**	0.17
Mean local coherence		0.06	0.09	0.19	0.26	0.35	0.16	0.31
MMSE			-0.52	0.11	-0.25	0.49	-0.24	
Stroop color interference				0.432	0.27	-0.17	0.12	0.29
Clock drawing					0.78*	-0.62*	0.43	0.26
Trail making task						-0.45	0.36	0.34
Memory subtest of Goldman et al.							-0.72**	-0.31
Backward digit span								0.26
Vocabulary subtest of P-WASI								

MMSE: Mini-Mental State Exam; P-WASI: Persian-Wechsler Abbreviated Scale of Intelligence

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\*P&lt;0.05; \*\*P&lt;0.01

throughout the whole discourse, we also predicted that global coherence would be more negatively affected compared to local coherence. The results corroborated our hypotheses. Accordingly, it was demonstrated that global and local coherence were more negatively affected in the dual task compared to the single task, and in both tasks, global coherence was more negatively affected. In addition, it was demonstrated that global coherence compared to local coherence had a significant correlation with the cognitive variables of attention, concentration, and inhibition. Furthermore, in both tasks, although global coherence was related only to cognitive

measures, in the dual task condition, it was also related to working memory assessment tools. All the results corroborate our prediction and demonstrated that the dual task condition was more challenging for our participants compared to the single task condition.

Considering that our subjects performed in local and global coherence scales more poorly in the dual task condition compared to the single task is inconsistent with previous research on healthy elderly which emphasized subjects' poorer performance in the maintenance of global coherence than local coherence, regardless of the

**Table 6.** Correlations among coherence and cognitive variables during dual task

Variable	2	3	4	5	6	7	8	9
Mean global coherence	0.51	0.15	-0.006	-0.015	-0.91	0.31**	0.8**	0.36
Mean local coherence		0.08	0.41	0.28	0.412	0.512	0.241	0.54
MMSE			-0.581	0.232	-0.125	0.38	-0.315	
Stroop color interference				0.53	0.59	-0.26	0.241	0.49
Clock drawing					0.817*	-0.92*	0.63	0.86
Trail making task						-0.55	0.81	0.614
Memory Subtest of Goldman et al.							-0.791**	-0.63
Backward digit span								0.91
Vocabulary subtest of P-WASI								

MMSE: Mini-Mental State Exam; P-WASI: Persian-Wechsler Abbreviated Scale of Intelligence

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\*P&lt;0.05; \*\*P&lt;0.01



task condition (Ismail et al., 2022). In dementia, which is automatically concomitant with cognitive decline, many studies in the past have highlighted participants' poorer performance in the maintenance of global coherence compared to local coherence (Oh, 2021; Pompili et al., 2020). Although there has been some research divulging the aphasics rather poorer performance in local coherence maintenance than global coherence maintenance, it should be asserted that in these brain-damaged patients, the major culprit of deficiency was in the lexical and morpho-syntactic malfunction rather than cognitive disorders. However, although our participants' performance in the maintenance of global coherence was poorer in the dual task compared to the single task, we observed harmony in that preserving global coherence was more challenging than local coherence.

As we found a strong correlation between global coherence and the clock drawing and trail-making tasks, our hypothesis that cognitive tests were strongly correlated to global coherence was supported. In other words, our participants' poor performance on attention-demanding tasks was associated with their poor performance on global coherence. Likewise, we observed a strong relationship between our participants' performance on the Stroop task measuring cognitive inhibition and global coherence. therefore, our hypothesis that inhibition malfunction could culminate in impaired global coherence was supported. Sustained attention, processing speed, concentration, and planning as assessed by the trail-making task, and inhibition/suppression assessed by the Stroop task could culminate in the participants' weak performance in preserving the global coherence in their discourse (Ismail et al., 2022; Pompili et al., 2020).

In the dual task, we also found a relationship between the memory subtest of Goldman-Fristoe-Woodcock and the backward digit span test on one hand, and the measure of global coherence on the other which corroborates a correlation between global coherence and working memory. This finding was in contrast with most studies in the literature which had reported the lack of relationship between working memory and local and global coherence in the discourse characteristics of healthy young adults (Ellis et al., 2016; Linnik et al., 2022). This result demonstrates that, in the dual task, working memory disruption along with executive functions, in particular the components of attention, suppression, and concentration, could culminate in the disrupted global coherence in the process of discourse generation.

As Linnik and his colleagues (2022) asserted global and local coherence, standing at two different ends of

a macro linguistic continuum, seem to be controlled by diverse cognitive mechanisms. Their conclusion was based on the observation that patients with neurodegenerative diseases, such as Alzheimer had poorer performance in global coherence than local coherence. This dissociation between local and global coherence was not found in Wernicke's aphasia because their performance in both local and global coherence was approximately the same. Therefore, in line with previous research, this dissociation between local and global coherence was more vivid in the dual task in our study.

Our results also demonstrated that global coherence, compared to local coherence, was a more challenging task cognitively. So, it could be concluded that global coherence would break down initially and local coherence deteriorates whenever global coherence is severely affected. Accordingly, a body of research on the field has shown that the elderly and patients suffering from dementia are more prone to producing incoherent speech compared to healthy young people and their performance could be attributed to cognitive decline (Hunter et al., 2020; Laske et al., 2015). The above studies have unanimously asserted that global coherence, compared to local coherence, is more prone to disruption and in diverse age-related diseases, such as Alzheimer, global coherence is initially affected negatively.

Our research has some rehabilitative implications. As demonstrated in detail in previous sections, because of the existence of dissociation between global and local coherence in the discourse production of the participants, speech therapists could utilize diverse rehabilitation strategies when faced with participants who have different coherence problems. That is, if the major problem of the participants is because of the malfunction of global coherence which is commonly observed in neurodegenerative diseases or elderly groups, the necessity of resorting to a top-down processing treatment approach seems obligatory. In this respect, as Obermeyer et al. (2021) asserted, some techniques, such as attentive reading and constrained summarization could be performed. On the other hand, when the main problem of the patients lies in their inability to connect neighboring utterances and create a local coherence, it would be more rational to use more bottom-up processing strategies for rehabilitation. As elaborated in the preceding lines, this situation seems to be one of the main landmarks of progressive aphasia patients in that while these patients stick to their topic throughout their discourse, as soon as they decide to build a connection between adjacent sentences, their problems evince. For instance, they tend to use vague referents in their discourse (it is not exactly clear who/

what they are talking about) or they sometimes utilize improper coordinates (and, or, but) as well as subordinate conjunctions (so, because, afterward, secondly, although). In other words, in this situation, if the therapist concentrates more on the morphosyntactic properties of the language along with cohesive devices, to use Halliday and Hasan's terminology, more satisfactory result could be achieved (Halliday & Hasan, 2014).

Moreover, our prediction that performing the dual task would impose more cognitive demands on the participants compared to the single task was also confirmed. Accordingly, the relationship between global coherence and working memory measure was only observed in the dual task and not the single task. This finding demonstrates the main effect of the task on the discourse performance of our participants. In addition, this finding was in contrast with the results of previous studies which had already emphasized the lack of task effect on participants' performance (Rogalski et al., 2010). This difference that was observed in the results might be because, unlike the previous research, the topic which we chose to test our participants was all homogeneous.

Our findings regarding poor global coherence of elderly individuals, and strong correlation of global coherence with attention and inhibition, and executive measures in the dual task, and the lack of correlation between local coherence and cognitive and working memory measures in both tasks, reinforced the theoretical challenge proposed by previous scholars (Linik et al., 2022). Accordingly, this difference might be a qualitative one as global and local coherence are manipulated by different neural mechanisms. Both types of coherence were manipulated by the same cognitive route, and it is the global type of coherence in which the severity of cognitive decline is vivid.

## 5. Conclusion

The healthy old individuals participating in this study were confronted with numerous challenges to maintain the global coherence of their discourse and their problems escalated while they attempted to conduct the dual task of sitting while talking. Confirmation of our conclusion came from the existence of the relationship between cognitive/executive components of attention, concentration, and inhibition as well as working memory measures, on one hand, and global coherence in the dual task on the other. Conducting diverse neuropsychological and neuropsychiatric tests in different languages in the future with the major mission of tracking specific cortical mechanisms respon-

sible for the maintenance of global and local coherence could shed more light on the issue.

For future studies, it is recommended that researchers concentrate on utilizing more comprehensive assessment tools to evaluate participants' performance. The conduction of qualitative techniques, such as the researchers' attitudes about the existence of coherence in the participants' discourse along with the quantitative ones could culminate in more plausible and reliable outcomes.

## Ethical Considerations

### Compliance with ethical guidelines

All ethical principles were considered in this article. The participants were informed about the purpose of the research and its implementation stages. They were also assured about the confidentiality of their information and were free to leave the study whenever they wished, and if desired, the research results would be available to them.

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### Conflict of interest

The author declare no conflict of interest.

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