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Subcortical Role in Figurative Processing by Persian-Speaking Alzheimer and Parkinson's Patients

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ABSTRACT

Introduction: The production of figurative expressions, particularly idioms, and proverbs, is negatively affected by damage to the left hemisphere and subcortical area of the brain. Alzheimer patients, thanks to the preservation of basal ganglia, can produce these expressions. In contrast, compared to Alzheimer's patients, Parkinson's patients cannot produce these expressions due to the malfunction of the basal ganglia. This study attempts to compare the linguistic and cognitive performance of Persian-speaking patients with Alzheimer's disease, Parkinson's disease, and healthy counterparts regarding the production and comprehension of these figurative expressions.

Materials and Methods: In doing so, by selecting a sample of participants composed of 10 Alzheimer's patients, 10 Parkinson's patients, and 10 healthy individuals matched with each other regarding age and education. Then, different tests, including Arizona battery for communication disorders of dementia, famous names, and face test, structured conversation, figurative expression completion, elicitation of response based on situational context, Northridge evaluation of idioms and proverbs in situational context, conventional and figurative expression evaluation were condcuted to analyze their performance.

Results: The results of Arizona battery for communication disorders of dementia indicated that Alzheimer's patients were in the middle stage of the disease while Parkinson's participants were classified as non-dementia patients. Although the result of the Renown face and name recognition test demonstrated a significant difference between Alzheimer's patients and the healthy group regarding cognition and confidence levels, the same result was not observed between healthy control and Alzheimer's patients. Furthermore, in the test of structured conversation, the proportion of produced words by Alzheimer's patients was more than that of Parkinson's patients. However, the results of sentence and figurative expression completion tests corroborated the weaker performance of Alzheimer's patients compared to their Parkinson and healthy counterparts. Furthermore, notwithstanding in the test of Elicitation of response based on Situational Context, Parkinson's patients performed more poorly than their Alzheimer and healthy counterparts, in the tests of conventional and figurative expression evaluation, Alzheimer's patients' pattern of performance was different from that of other groups as they performed more weakly than Parkinson patients.

Conclusion: The observed dissociation in the performance of Alzheimer as well as Parkinson's patients in the linguistic production and comprehension tests shed light on the significant role of the subcortical area of the brain in the production of idioms and proverbs.

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1. Introduction

Proverbs and idioms are considered varieties of language that have pre-determined and fixed meanings [1, 2]. The common characteristic of these expressions is that they possess non-literal meaning and are closely bound to their situational context. These expressions, at least, in some layers of their mental representations, are unified and renowned for possessing conventional meaning [3]. Furthermore, these expressions can be enriched with idiosyncratic discourse functions, including empathy and affinity among speakers of a language [4, 5]. Consequently, due to their distinctive features as well as their critical roles in efficient communication, these linguistic units have always been an interesting topic of investigation by researchers in the fields of aphasiology, dementia, and neuropsychology.

As Van Lancker pointed out, the initiation of preliminary studies about the processing of these expressions in aphasiology dates back to Jackson's research [6]. Since then, specialists in the field of aphasia have emphasized the intactness of these expressions among those patients whose left hemisphere were damaged [7-10]. For example, In 2006, Van Lancker demonstrated that the proportion of the production of figurative expressions in patients whose right hemispheres were damaged was significantly less than their production in healthy individuals while in those patients whose left hemispheres were damaged, the opposite pattern was observed [11]. On the other hand, in a separate clinical observation of Parkinson's patients, it was demonstrated that damage to the basal ganglia of the brain results in the reduction of idiomatic expression [12]. The gist of this research culminated in the formation of a model of the brain, which confirms that the production of idiomatic expressions is modulated and guided by the right and subcortical areas of the brain. Moreover, the implicit implication of this research is that the production and comprehension of conventional and ordinary expressions on the one hand, and the production and comprehension of figurative expressions, on the other hand, entail the recruitment of different mental and neurological processes [13, 14].

Meanwhile, in other separate studies, the extensive use of proverbs and idioms by aphasics was also emphasized [11, 15]. Furthermore, it has been shown that the production of automated speech and chunks was prompted in those patients with left hemisphere damage while the extent of this production was remarkably decreased in those patients with right hemisphere damage. In these studies, a decrease in the production of figurative expressions was assigned to the deficit in the subcortical area of the brain [16, 17]. Other clinical studies also confirm the role of the subcortical area of the brain in the production of figurative expressions [18, 19]. On the other hand, in many studies, it has been stressed that the production as well as comprehension of figurative expressions, particularly proverbs, and idioms, entail the recruitment of different mental processes [20, 21].

Also, extensive psychological studies represented different functions of the brain regarding the production and comprehension of figurative expressions as well as conventional speech which corroborate the unified and holistic configuration of proverbs and idioms in the linguistic competence of native speakers compared to the compositional processing of conventional and ordinary expressions. The outcomes of these studies corroborated diverse challenges that Alzheimer's patients confronted concerning the processing of figurative expressions while Parkinson's patients demonstrated a rather satisfactory processing capability [22, 23].

In Iran, a few studies have analyzed the processing of figurative expressions, particularly idioms in those patients with subcortical areas damage. In these studies, some crucial issues were tackled, including different types of challenges that Persian-speaking Alzheimer's and Parkinson's patients would face regarding the retrieval of figurative meaning of idioms and proverbs, the deficit in the executive system of the brain, and also the disruption of cohesive devices [24-26]. On the other hand, the conduction of so many studies on the processing of figurative expressions in healthy individuals has proven the widespread usage of these expressions in the speech of ordinary people depending on the type and style of their discourse [27]. However, as of now, no study has particularly analyzed the performance of dementia patients and has not yet investigated the role of the subcortical area of the brain in the processing of figurative expressions.

The main reasons and rationale for conducting this research are multifold. First, as asserted, regarding the particular discursive function of these expressions and their vital roles in communication, it seems crucial to understand their mental and neurological processing for the aim of the linguistic assessment of the patients. In doing so, the appropriate rehabilitative cures and therapies can be utilized.

Secondly, there has been a gap in the literature, because, to the best of our knowledge, there has not yet been a particular study in the Persian setting that compares the production as well as comprehension of

proverbs and idioms by Persian-speaking Alzheimer and Parkinson's patients. The importance and necessity of conducting such studies becomes clear when we understand that the structural as well as semantic characteristics of the Persian language are quite different from other Indo-European languages. For example, syntactically, Persian proverbs and idioms are longer than their English counterparts, and the frequency of passive constructions in Persian idioms and proverbs is less than their English counterparts. Furthermore, semantically speaking, while there are abundant three-valency predicates in Persian, in English, two-valency predicates are more extensively utilized [14].

Thirdly, as Alzheimer and Parkinson are regarded as the most widespread types of dementia afflicting a great majority of people in our country, the scrutiny of their figurative performance seems essential as it could pave the way for the selection of appropriate therapies by speech pathologists and neurologists boosting the efficient communications of these patients.

Therefore, regarding the importance of the issue of scrutinizing the required mechanism for the processing of a figurative expression, our study aimed at comparing figurative speech production and comprehension in Alzheimer's and Parkinson's patients in the Persian setting to shed more light on the role of the subcortical area of the brain. In this regard, the hypotheses were formulated. First, it was predicted that those patients with subcortical areas damage would produce proportionally fewer figurative expressions compared to healthy individuals. This hypothesis was evaluated via the analysis of natural expression generation in Persian-speaking patients afflicted with Parkinson in whom one predominant characteristic is the inappropriate function of the basal ganglia.

However, our second hypothesis asserted that those patients in whom cortical areas of the brain were damaged (Alzheimer's patients) would represent different linguistic patterns compared to Parkinson's patients. In other words, the second hypothesis asserted that those patients with cortical areas damage would produce much fewer idioms and proverbs compared to healthy individuals. This hypothesis is grounded on the fact that the basal ganglia of the brain are intact till the ultimate stage of Alzheimer's disease while as the disease progresses, the destructive mechanism of the cortical area of the brain exacerbates too [28]. The above-mentioned hypotheses were examined via the conduction of different types of different tests of figurative speech comprehension and production.

2. Materials and Methods

Participants

This research was conducted in three groups of Persian-speaking participants, including 10 Parkinson's patients (a Mean±SD age of 69.7±1.9), a Mean±SD of 16.7±1.3, 10 Alzheimer's patients (a mean age of 70.9 and a mean education of 14.3) and 10 healthy individuals (a mean age of 69.6 and a mean education of 15.4). Therefore, all three groups were approximately matched with each other according to age and education. The rationale for controlling the variable of age was that according to the previous studies, "age" was a determining factor in figurative processing in individuals belonging to different age groups [29, 30]. Furthermore, to neutralize the probable impact of education, this variable was also controlled.

A simple random sampling method to choose healthy participants was utilized. These healthy individuals were chosen from participants referring to the health center from April 1, 2019 to December 29, 2020. They did not suffer from any neuropsychiatric diseases, such as depression and no reports of addiction to drugs or alcohol were observed in their medical history. Also, they did not suffer from neurodegenerative diseases, such asdementia.

Furthermore, to select the patients, a convenient sampling method was used on those visited the clinic for brain rehabilitation and neurological diseases two weeks apart. Noteworthy to mention, the preliminary selection of the participants was administered via consultation with neurological specialists and also after the review of the medical profile of the patients and the evaluation of their general cognitive abilities.

The inclusion criteria were: having Alzheimer and Parkinson's diseases whose cognitive status would still allow them to participate satisfactorily in the task. To evaluate the cognitive status of these patients, the Persian version of the clinical dementia rating (P-CDR) was used [31]. As this test did not rely on complex topics and evaluates general information, its administration is easier for elderly people. As a result, it was preferred to mini-mental state examination (MMSE). This test included 75 questions about 6 fields, including memory, judgment and problem-solving, social affairs, home and amusement as well as personal affairs. The total number ranged from 0 to 18. In this number range, obtaining a higher number corroborated more severe cognitive decline. The cut-off point of 3/75 was chosen to differentiate the dementia patients from the healthy group. Following this procedure, only those in the early and mild

stages of the disease were included. As another inclusion criterion, it should be pointed out that no other neurological deficit except the mentioned diseases was observed and all were right-handed.

Meanwhile, the patients with a history of drug or alcohol addiction, neuropsychiatric diseases, such as depression and anxiety, visual or auditory problems, lack of cooperation and willingness were excluded. Ultimately, 10 participants were selected from each category. Before the experiment commences, a written commitment to voluntary participation was obtained from the participants. Furthermore, the conduction of all tests took place in two stages in the patients' homes or in the office of the specialist. In this way, the linguistic production and function of the participants were recorded.

Stimulus materials and procedure

As one of the most predominant characteristics of the figurative expression is its familiarity and recognizability, famous names and faces test [32] were used to evaluate the required cognitive capability. To standardize the test in Persian and determine its reliability and validity, a pilot study was conducted on 50 healthy native speakers of Persian matched with the main participants regarding age and education and were asked to assert to what extent the target image corresponded the word stimulus. Familiarity of the name and image was determined based on four-choice alternatives from 4 highly familiar to 0 very unfamiliar. Therefore, 20-word stimuli with their corresponding images designated as highly familiar were selected. Furthermore, to achieve the reliability of the test, two autonomous graphic designer were asked to express their opinions about the degrees of word image matching. A 100% agreement was reached between raters, which corroborated the high reliability of the test.

In the main test, all stimuli were read by the researcher and the participants were required to select the appropriate correct pictorial alternative among four represented pictorial stimuli. For example, the examiner uttered the word "Ali Da'i" and the participant was expected to select the appropriate picture corresponding to this famous person. The participants' answers were numbered from "0 which meant I have no idea" to "4 which meant I completely agree". Furthermore, for the cognitive evaluation of the patients and their visual acuteness, Arizona battery for communication disorders of dementia was utilized [33]. Before conducting this battery, which is composed of four subtests (story retelling, comparative questions, repetition, and generative naming semantic category), its validity and reliability were corroborated. The test validity was evaluated based on the relevance of the test to the assessment of cognitive capability and fluent translation. The test was validated by professionals in the field of psychiatry, neurology, and psycholinguistics. Furthermore, two independent psycholinguists were asked to express their judgments regarding the reliability of the battery. The correlation coefficient of 93, 91, 87, and 94 proved high internal consistency of sub-tasks of story retelling, comparative questions, repetition, and generative naming semantic category, respectively. In the subtest of story retelling, our participants should retell the story already narrated by the examiner. This subtest was composed of 17 informational units. For each correct answer in each section, the examinee received grade 1. The percentage of correct answers produced by our participants was based on the proposed standards in the storytelling test [34]. In the subtest of comparative questions, the students should have presented logical answers by comparing two intended cases. For example, our participants were expected to decide whether the category "A" is taller than the category "B"? Following the above-mentioned procedure, the percentage of correct answers produced by the participants was estimated. In the sub-test of the repetition, the participant was required to immediately repeat 5-word groups composed of at least 6 syllables and 5 sentences composed of at least 9 syllables. All examples encompassed the real words composed based on the syntactic pattern of Persian yet did not have specific meanings. The accuracy of the repetition was estimated based on the number of correct repeated syllables while the maximum grade of 75 was considered for this purpose. Ultimately, in the subtest of generative naming semantic category, the participant was asked to produce the maximum number of instances within each category including animals during one minute. The participants' grades were estimated based on the number of produced instances within this time.

The next utilized test was structured conversation. In this test, the researcher, via asking questions about diverse issues of a person's life, paved the way for the production of discursive instances by the participant. To this end, the researcher usually utilized open-ended types of questions. For example, the participant was requested to "explain a little bit about her personal life" or "enumerate "the vital memories of her school years". All participants were invited to answer the questions frankly and naturally. In the next stage, all responses were recorded by two independent Persian-speaking speakers who specialized in phonemic transcription. If inconsistencies were observed in the phonemic transcription of these experts, it was corrected by a third independent transcription specialist. To estimate the quantity of all words produced by

the participant, two separate experts of Persian phonemic transcription specialists recognized diverse proverbs and idioms in each text, and if some disagreements exist concerning the quality of figurative categories among evaluators, the consensus was reached through consultation and negotiation. The criteria for the recognition and selection of proverbs and idioms were based on the Najafi Dictionary of colloquial Persian knowledge [35] as well as the linguistic intuition of native speakers and also formal and functional standards for the designation of figurative expressions elaborated [36]. The proportion of words in these figurative expressions was estimated via the division of words in these expressions by the number of words in each participant's speech.

However, the other recruited test was figurative expression completion, which was conducted alongside the structured interview test. In this respect, the researcher requested the participant to recall some old proverbs or idiomatic expressions. To this end, the researcher expressed the initial section of these expressions, and the participants should have recalled the final word or the last two words of these expressions. For example, the researcher uttered the expression "Ashpaz ke do ta she ……..." rendered in English as "If we had two chefs ……" and asked the participant to complete this figurative expression. Before the administration of this structured test, a pilot study was conducted in which 50 healthy participants, matched according to age and education with the main participants, and were asked to participate in the figurative expression completion test. Cronbach's alpha was used to measure the internal consistency and reliability of the responses. A value of +.85 proved the high internal consistency of the responses. Thirty familiar proverbs and idiomatic expressions were utilized to evaluate the linguistic capability of the participants. The standard for grading in this test was a two-grade measure based on which those participants who did not reply or presented false answers received a grade 0, if their answers were relatively correct, they received 2, and ultimately, when their answers were thoroughly correct, they received 2. The accuracy and suitability of all responses were corroborated by two autonomous specialists of Persian literature with a unanimous view.

After the administration of the figurative expression completion test, through conducting the test of elicitation of response based on situational context and via the presentation of diverse situational contexts, the participants were asked to express their answers. For example, they were asked, "what would they do if they lost their important documents just as soon as they wanted to depart the airport?" Or "what would they do if they lost their car keys just the moment they wanted to travel?" Therefore, following this procedure, the researcher introduced 12 situational contexts, and after the responses were recorded, their accuracy and appropriateness were estimated based on a two-grade measure in which the number 0 represented the wrong answer, number one was indicative of an approximately correct answer and number 2 was indicative of a thoroughly correct answer. Again, in this stage, the criteria for the accuracy of the responses were analyzed by two autonomous Persian language specialists, and if some disagreements existed on grading, the consensus was reached through negotiation and consultation.

The other utilized test in this research was Northridge evaluation of idioms and proverbs in situational context [37]. However, although the procedure was used because the typological and linguistic characteristics of English and Persian were different, the stimuli were modified. The proverbs and idioms were extracted from Moeen's Persian dictionary [38]. All these expressions were controlled according to length (3.4 words). Two autonomous university professors who specialized in Persian literature were asked to express their opinions regarding the internal consistency of the responses. A consensus was reached, if disagreement was observed between our experts. The Cronbach alpha of +0.91 corroborated the high reliability of the test. In this test, the participants' abilities to comprehend and recognize idioms and proverbs in two different varieties (sentence completion test and multiple choice test) were evaluated. In the sentence completion test, the examinee listened to the oral presentation of the interviewer in each social context and was asked to complete the figurative expression. For example, "Daneshsmuze tanbali bud ke hich talashi baraye movaffaqiyat az khod neshan nemidad va dar tamamiye darshayash nomre payyn migereft. Pas az modadatha bahs va moshajereye pedar ba ʔu, belakhare fahmid ke baraye movaffaqiyat bayad talash kard. Natije in shod ke nomarate paeen u be nomarate khub badal shod. Pedar be ʔu goft "naborde ranj ……..." rendered in English as " once upon a time, a lazy student existed who did not demonstrate any attempt for success and received low grades in all his lessons. After a long dispute with his father, he ultimately understood that he had to work hard to succeed. As a result, his low grades were transformed into good grades. His father told him. "no efforts", but in the multiple-choice subtest, the examinees were exposed to a situational context similar to that of figurative expression completion, however, in this subtest, they were asked to select the correct answer from four oral alternatives presented by the researcher. For example, the alternatives related to the above example included, "haqiqat

peyda nemishavad" rendered in English as " the reality could not be found", "ganj moyassar nemishavad" rendered as " jewelry could not be reached", "kushesh bedast nemiayad" rendered as " attempt could not be reached" and mozd be dast nemiayad" rendered as " salary would not be accessible". It is quite clear that the alternative "b" is the correct answer. Concerning the order of the administration of these two subtests, it should be asserted that initially the participants were asked to complete the sentence completion test and then execute the multiple choice test because if the order of tests administration was reversed, the participants' familiarity with the recruited words in multiple choice test may have affected their performance in sentence completion test.

The other administered test in this research was the test of conventional and figurative expression evaluation whose procedures were extracted from Rassiga and her colleagues [22]. In this test, after the oral expression of figurative or conventional expressions, the researcher asked the participant to exactly designate which present pictorial stimuli would best represented the meaning of the intended expression. However, it should be pointed out that in this research, unlike Rassiga's, those idiomatic expressions whose meanings were thoroughly transparent were utilized. Also, unlike Rassiga's research, non-ambiguous idioms were utilized, for instance, " an prmard aftabe labe bume" denoting "a person who might die soon". To meet the above-mentioned goals and also to control the semantic ambiguity of idioms and proverbs, a questionnaire was designed based on which those participants whose age range was pretty similar to that of control group, were asked to express their opinions regarding the plausibility of the literal meaning of 50 idiomatic expressions via the selection of one of the three measures including unacceptable, somewhat acceptable and acceptable. To assess the reliability of each questionnaire in the test of conventional and figurative expression evaluation, Cronbach α method was employed. The result of the statistical analysis was indicative of the reliability of 96% for the questionnaire of semantic transparency, and 94% for the questionnaire of semantic ambiguity, which all corroborated the high reliability of the questionnaires and their plausibility. As a result, 30 non-ambiguous transparent idiomatic expressions, which had high frequency in each of the above-mentioned components were selected for our main test. Before conducting the main test, two trials were utilized to pave the way for our participants' better performance.

Statistics

All analyses were performed using SPSS software and R software version 3.2.5. The percentage of the correct answers in tests of conventional and figurative expressions was estimated, and the performance of the participants with each other was compared based on this criterion.

Furthermore, analysis of variance (ANOVA) statistics were conducted to compare the performance of our participants in diverse tests. Furthermore, to investigate whether a significant correlation was observed among the performance of the participants in the tests, Duncan statistics were recruited.

3. Results

Arizona battery for communication disorders of Dementia

The subtests of this test, which were related to language were performed in Alzheimer's and Parkinson's patients. The obtained mean raw grades by the Parkinson's patients were 13.4 out of 17, for the subtest of storytelling, 5.8 out of 6 for the subtest of comparative questions, 67.1 out of 75, for the subtest of repetition and the mean number of produced words in the subtest of generative naming semantic category was 10.5. As the above results demonstrate, Parkinson's patients should be regarded as non-dementia patients while the stage of the disease in dementia patients was envisaged as early-stage patients corroborating our initial categorization of these patients by MMSE.

Famous names and faces test

The results of this test showed a significant difference between Alzheimer's patients and healthy individuals regarding properties of cognition level ($F_{(25)}$=4.872, P<0.001), confidence level ($F_{(24)}$=3.075, P=0.005), and also between Alzheimer's and Parkinson's patients concerning cognition level ($F_{(24)}$=4.205, P<0.001) and confidence level ($F_{(23)}$=2.845, P=0.007). However, no significant relationship was observed between Parkinson's patients and healthy individuals in the measures of cognition and confidence level. As the evaluation of dementia in Alzheimer's patients demonstrated, these patients had a weak performance in the recognition of famous faces and names (44% correct responses) and the confidence level of their responses (2.5) was lower than other participants. In other words, healthy individuals answered in 94% of instances, and the confidence

level of their answers was 3.4, and Parkinson's patients with 67% correct answers and a confidence level of 3.3 performed better than Alzheimer's patients. The weak performance of Alzheimer's patients in this test can be assigned to their degenerated visuo-special capability, decrease in their cognitive ability, and decrease in the ability to comprehend known concepts. The deficit in the performance of memory can play an effective role here, but since Alzheimer's patients in the middle stage of their disease would suffer from long-term memory deficits, and their problems are related to the malfunction of immediate memory, this hypothesis should be dismissed.

Structured interview

In this test, the number of produced proverbs and idioms in the speech of the participants was analyzed. The dependent variable in this measure was the proportion of words in figurative expressions to the whole number of words produced by the participants. In this measure, Alzheimer's patients significantly produced more proportion of words in figurative expressions (32.5%) compared to Parkinson's patients (12.6%). Furthermore, the proportion of words in figurative expressions was 27.9 in healthy individuals.

Figurative expression completion, elicitation of response based on situational context

In the figurative expression completion test, the mean grade of healthy individuals was 92% while Parkinson's patients presented correct answers in 78% of the instances. In contrast, Alzheimer's patients manifested correct answers in 42% of the instances. Yet, in the test of elicitation of response based on situational context, healthy individuals performed correctly in 82% of the instances while Alzheimer's patients answered correctly in 67% of the instances. Also, Parkinson's patients performed accurately in 35% of the instances. The mixed design and comparative analysis of these two tests and, also Alzheimer's patients, Parkinson's patients, and healthy individuals indicated the significant effect of the test ($F=25.934$, $df=1$, $P=0.001$) and group ($F=7.964$, $df=2$). The results of ANOVA tests demonstrated the performance of our participants in the figurative expression completion test ($F=7.964$, $df=2$). Also, to investigate whether a significant correlation was observed between the performances of participants, the Duncan test was used.

In the figurative expression completion as a comprehension test, both healthy individuals and Parkinson's patients approximately performed at the same level yet the performance of the Alzheimer's group was significantly different from the performance of Parkinson and healthy individuals while in the production test of the elicitation of response based on situational context, the results were different. That is, the grades of Parkinson's patients were significantly different from those of healthy individuals ($F_{(23)}=4.866$, $P<0.001$, $F_{(26)}=3.758$, $P<0.0001$; $F_{(31)}=2.112$, $P=0.03$).

Northridge evaluation of idioms and proverbs in Situational Context

The performance of Parkinson's patients in sentence completion and multiple-choice tests was not significantly different from the performance of healthy individuals. In contrast, Alzheimer's patients exhibited a significantly different performance compared to the healthy group and Parkinson's patients ($F_{(26)}=3.353$, $P=0.002$; $F_{(24)}=3.641$, $P=0.002$; $F_{(24)}=3.528$, $P=0.002$; $F_{(21)}=3.440$, $P=0.005$).

Conventional and figurative expression evaluation

The results of this test demonstrated that the performance of Parkinson's patients was not significantly different from healthy individuals in each subtest of conventional and figurative expression evaluation while the performance of healthy individuals was dramatically different from Alzheimer's patients in both subtests of conventional and figurative expression evaluation. Furthermore, Alzheimer's and Parkinson's patients in both above-mentioned subtests had dramatically different performances. Alzheimer's patients committed more errors compared to other groups in the study. ($F_{(28)}=5.421$, $P<0.001$; $F_{(26)}=4.323$, $P<0.001$; $F_{(26)}=4.155$, $P<0.001$; $F_{(26)}=3.321$, $P=0.002$).

4. Discussion

This replicative study was conducted to analyze the impact of brain deficit on the linguistic performance of Parkinson and Alzheimer's patients. Regarding the effects of the variables of age and education on the performance of the participants, it should be asserted that in this research, Alzheimer's patients were significantly older than other groups, and also their education level was more than other groups. Notwithstanding, these parameters did not have a significant impact on the research results. The employed tests evaluating the cognitive performance of Alzheimer's patients were indicative of their debilitative and degenerative capability to recognize the renowned faces because as soon as the images of famous

characters were presented to them, they exhibited lots of challenges. The degenerative and poor performance of Alzheimer's patients could be assigned to the deficit in the ability to recognize faces, a reduction in cognitive resources, and a malfunction in the ability to recognize known faces [39]. This difficulty becomes more robust and vivid as Alzheimer's patients lose their capability to recognize their family members and relatives.

The fact that figurative expressions and particularly proverbs and idiomatic expressions are the major section of the natural speech of human beings, which reveals the necessity of clinical evaluation and also the appropriate cure for discursive abnormalities in the speech of human beings. Previous studies have demonstrated that a deficit in the left hemisphere of the brain caused patients to produce a large number of figurative expressions while damage in the right hemisphere and the subcortical area of the brain results in a significant reduction of figurative expressions [11]. This study evaluated the ability of the participants to comprehend and utilize figurative expressions based on the execution of spontaneous and planned speech test in Alzheimer's and Parkinson's patients as well as healthy individuals. Noteworthy to say, the results of the previous studies indicated a high frequency of figurative expressions in the discourse of Alzheimer's patients. In contrast, the outcomes of previous studies corroborated a reduction in the linguistic production of Parkinson's patients [40]. The outcomes of previous studies were indicative of a relative deficit in the structure of figurative language in patients which was in line with the general inappropriate cognitive performance of neurodegenerative patients with Alzheimer's due to the damage to the cortical areas of the brain and also Parkinson's disease due to the damage to the subcortical areas of the brain [12].

Moreover, in this research, by comparing Alzheimer's patients, Parkinson's patients, and healthy individuals, it was assumed that Alzheimer's and Parkinson's patients demonstrate different performance in the measures of figurative language evaluation. The next prediction was dissociation in the performance of the patients in the production and comprehension modes. The hypothesis was derived from a model of brain function based on which the production of figurative expressions, particularly proverbs, and idioms, was related to the intact and satisfactory performance of the basal ganglia. According to the above-mentioned model, the cortical area of the brain is involved in the reservation and retrieval of figurative expressions and in doing so, the cortical area of the right hemisphere plays a crucial role. In Alzheimer's patients till the final stage of dementia, the basal ganglia remain intact though these patients with an abnormality in the frontal and lateral cortex. In contrast, Parkinson's patients suffer from a deficit in the basal ganglia while the cortical areas of the brain which are responsible for the cognitive performance in these patients remain intact.

Yet, regarding the production of spontaneous speech, both hypotheses were corroborated. In other words, the group of Parkinson's patients significantly produced fewer figurative expressions compared to Alzheimer's patients. However, unlike the results of Van Lancker's research [28], the difference between healthy individuals and Alzheimer's patients did not reach statistical significance. The excessive production of figurative expressions could be assigned to the generation of empty speech as one of the most significant characteristics of linguistic production in Alzheimer's patients [24]. On the contrary, the property of speech brevity in Parkinson's patients could be related to the low frequency of figurative expressions in their speech. These findings highlighted a particular model in which the basal ganglia would play a predominant role in the production of figurative expressions. One outstanding sign demonstrating the intact performance of the basal ganglia can be related to individuals' idiosyncratic capacity to manipulate internalized behaviors [11].

The findings achieved from the comparison of the performance of Alzheimer's patients in the tests of "figurative expression completion" and "elicitation of the response based on the situational context" corroborated their poor performance in both tests. Likewise, the deficit in the comprehension ability of Alzheimer's patients in the subtests of sentence completion and multiple choice was observed while Parkinson's patients in the healthy group had an intact performance in both tests. Another important finding was the poor performance of Alzheimer's patients in the test of conventional and figurative expression evaluation, based on which the participant should have pointed out correctly the image related to the figurative or ordinary expressions. Alzheimer's patients performed significantly worse than other groups, which indicated the degenerative cognitive performance of these patients while Parkinson's patients in healthy individuals had an intact performance in the comprehension mode. All the above-mentioned findings are consistent with an attitude, which correlates deficits in the comprehension and storage processes to cortical dementia dismissing the destructive role of the subcortical area of the brain. Even in previous studies, Alzheimer's patients' challenges in the comprehension of proverbs and idioms even in the early stage of the disease were emphasized [24].

Compared to healthy individuals, Parkinson's patients performed more poorly in the test of "elicitation of response based on situational context" while the same pattern was not observed in the sentence completion test and other cognitive evaluation and figurative comprehension tests. The satisfactory execution of spontaneous speech would entail the initiation of comprehensive cognitive planning while the correct administration of the sentence completion test requires individuals to have intact cognitive capability to recognize the intended answer. In the previous studies, the importance of the type of test, spontaneous speech, and pre-planned tests were also emphasized [11, 15]. The observed dissociation in the performance of the participants may by due to the contexts in which the participants should have initiated the test, planned it, or reacted verbally or non-verbally, they performed more poorly than in the context in which a supportive model or instruction was provided for the participants to perform appropriately in the test. In this respect, the sentence completion test facilitated the process of the initiation of the test and can be regarded as a supportive and auxiliary vehicle while satisfactory performance in the tests of the elicitation of the responses based on the situational context or oral explanation would entail the comprehensive recruitment of cognitive skills, such as skill in test initiation, planning, and executive system. The asserted explanation is in pro with the proposed explanation in the previous studies that highlighted the pivotal and critical role of the executive system in the administration of the oral explanation test [24].

From the clinical perspective, improving figurative speech competence can play a crucial role in the enrichment of appropriate rehabilitative procedures. In other words, if the poverty of figurative expressions (proverbs and idioms) was observed in the speech of the patients, the accurate usage of these expressions can be taught to the patients to promote or augment their communicative competence. As a result, when the linguistic performance of these patients was tested accurately, it was ultimately resorted to such properties as the intactness of figurative expressions, the excessive use of these linguistic components, or their inappropriate usage to employ appropriate diagnostic procedures. On the other hand, the evaluation of linguistic abnormalities is more pleasant, provided that the distinction between figurative speech competence and conventional speech competence is considered because knowing this dichotomy can culminate in the diverse employment of rehabilitative procedures. As figurative expressions are normally regarded as familiar linguistic elements for the speakers of a particular language, they can be utilized as facilitative instruments of linguistic disruption. Many studies also have emphasized the critical role of these expressions in the rehabilitation of patients afflicted with severe aphasia [10]. Therefore, this issue can be envisaged as an invaluable one for clinical specialists as they should decide whether they should concentrate on ordinary expressions or pay particular attention to figurative expressions once they attempt to select appropriate and necessary cures for their patients to revive their linguistic deficit.

Last but not least, the achieved findings in this research can be well explained by dual and hybrid models of language processing [11]. On the other hand, the efficient implications and usage of this model in the diagnosis and cure of linguistic and speech deficits caused by brain damage as well as progressive brain abnormalities, such as Alzheimer and Parkinson's diseases cannot be neglected, because as asserted, the great majority of daily verbal interactions are composed of figurative expressions. As a result, the excessive use of figurative expressions on one hand, and their diminished use on the other hand, could have a destructive impact on the individual's communicative capabilities. Yet, it should be kept in mind that future research is necessary to analyze the impact of brain damage or brain atrophy upon other types of figurative expressions. In doing so, a more realistic picture regarding the significance of the dual model of brain processing can be drawn. For example, future research should aim to answer the question, what is the difference between the use and comprehension of metaphor, irony, and proverb in healthy subjects and neurodegenerative patients? In this respect, this research can investigate which specific area of the brain can modulate these expressions.

5. Conclusion

As observed, while Alzheimer's patients demonstrated better performance in the production tests of structured conversation and elicitation of response based on situational context , Parkinson's patients outperformed Alzheimer's patients in the comprehension tests of sentence and figurative expression as well as conventional and figurative expression evaluation. This dissociation between the performance of Alzheimer's and Parkinson's patients in the two modes of production as well as comprehension corroborated the fundamental role of the subcortical area of the brain in the production of idioms and proverbs.

Limitations

This research was conducted with small sample size and with distinctive demographic features. Undoubt-

edly, the purposeful and systematic control of the research participants based on demographic features can culminate in different results. On the other hand, online tests to evaluate the performance of the participants were utilized. Any methodological change in the research via online or offline tests to analyze the productive as well as comprehensive performance of the patients can culminate in different conclusions.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article were initiated after the required permission approval from the Ethics Committee of University of Gonabad, was taken (Code: 2021/52300/2820/100)

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Conflict of interest

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