Research Paper

# The Relationship Between Memory, Type, and Severity of Aphasia With Confrontation Naming in Post-stroke Patients With Chronic Aphasia

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## ABSTRACT

**Objectives:** The brain's widespread neural functions lead to aphasia in which the patients experience difficulties in cognitive and language functions. Memory, type, and severity of aphasia are associated with language and the naming process. In the current study, we investigated the relationship between memory, type, and severity of aphasia using the confrontation naming test in post-stroke patients with chronic aphasia.

**Methods:** This research was a descriptive-analytic cross-sectional study. We selected 45 chronic aphasia patients aged 35-70 years. The participants with a mild to moderate score in Mini-Mental State Examination (MMSE) were assessed with the Persian naming test, Wechsler Memory Scale, and Persian Western Aphasia Battery.

**Results:** There was a significant difference between memory with correct answers without a cue, correct answers with a semantic cue, and the total correct answers from confrontation naming ($P<0.001$, $r=0.62$; $P=0.01$, $r=0.37$; and $P<0.001$, $r=0.71$; respectively). Furthermore, the results indicated a significant difference between the type of aphasia with subtests of confrontation naming involving correct answers with semantic cues and total correct answers ($P=0.02$). Also, the results showed a significant difference between the severity of aphasia with correct answers without a cue, correct answers with a semantic cue, and the total correct answers from confrontation naming ($P<0.001$, $r=0.77$; $P=0.03$, $r=0.31$; and $P<0.001$, $r=0.67$; respectively). In comparing semantic and phonetic cues, memory, type, and severity of aphasia indicated significant association only with semantic cues.

**Discussion:** There is an association between memory, type, and severity of aphasia with confrontation naming in patients with aphasia. The data have highlighted the importance of factors that need to be considered to formulate a comprehensive treatment plan to achieve further improvement in naming skills.

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## Highlights

- There is an association between confrontation naming with memory, type, and severity of aphasia.
- Anomia had the highest association with confrontation naming, while Broca's aphasia had the lowest.
- Semantic cues had an association with memory, type, and severity of aphasia.

## Plain Language Summary

Naming is a common clinical sign in post-stroke patients with chronic aphasia. Memory, type, and severity of aphasia are associated with language and the naming process. Our goal in this study was to assess the role of these factors in confrontation naming. The results indicated that memory, type, and severity of aphasia may be involved in problems that aphasia patients experienced in naming skill. Based on the findings of this study, these factors should be considered to formulate a treatment plan in aphasia patients to achieve further improvement in naming skills.

## 1. Introduction

Aphasia is an acquired communication disorder [1], that happens to 21%-38% of stroke patients [2]. Due to the large-scale network activities of the brain and its widespread and overlapping network organization [3, 4], aphasia following a stroke is marked by cognitive and language dysfunctions [1, 5].

Cognitive dysfunction was reported to be in approximately half of the stroke individuals [6], while about 35% of them demonstrate some residual disability up to 4 years after stroke [7]. Following cognitive impairment in patients with aphasia, disturbance in word retrieval or anomia as a cognitive function is a common clinical sign in these patients [8]. Naming is a series of mental activities used to comprehend visual symbols such as a letter, colors, etc. and involves retrieving words associated with a visual stimulus. This process is conducted in four stages. In the first stage (perceptual), a pictorial image is examined for correct recognition of the stimulus. In the second stage, the semantic representation of the stimulus is activated, followed by label retrieval in the third stage; retrieving the phonological representation that corresponds to the semantic representation. The final stage is motor programming, where the articulatory systems are activated and consequently lead to naming [9-11]. According to the different neural bases in naming deficits, each of these stages is activated through a specific input and cue that can facilitate naming accuracy. The good phonemic cueing input of Broca's aphasics indicates that their naming deficits are often due to difficulty in the programming of phonological information for articulation, while the naming impairments of Wernicke's and anomia aphasics suggest that difficulty often occurs before or at the level of accessing phonological information [8]. Since multiple aspects such as perceptual, cognitive, language, and motor functions are involved in naming ability [12], various language and cognitive factors for instance memory, type, and severity of aphasia may have an important role in the naming process [13-15].

Previous studies have found that memory as a cognitive function is a key factor that may affect the recovery process; due to its association with language and naming, it can affect a patient's communication skills [5]. Kang et al. have reported an overlap between language and cognitive skills, therefore, patients with more severe aphasia, show greater impairments in cognitive functions [16].

In examining the relationship between the severity of aphasia and the recovery of skills such as naming, studies have reported that severity is an adverse criterion and severe deficits may lead the skills to improve slower [8, 17, 18]. Other studies have highlighted the importance of initial aphasia severity as a predictor of outcome with regard to residual language and cognitive deficits such as anomia [19, 20].

Furthermore, the type of aphasia is another factor that may have a role in naming deficits [8, 13]. In evaluating the different types of aphasia, subcortical aphasia compared to cortical aphasia seemed to have a better prognosis in recovery and naming task [14]; among cortical aphasia patients, Broca and conduction aphasia had the highest while global aphasia had the lowest improvement [21, 22].

Despite (1) a high prevalence of naming deficits following stroke, (2) the prominent role of linguistic and cognitive abilities on the recovery of naming in aphasic patients, and (3) the different effects of phonemic and semantic cues for activating the confronting naming process in various types and severity of aphasia, few studies have investigated the association of both linguistic (type and severity of aphasia) and cognitive (memory) ability with confronting naming [8, 23].

The present study aimed to explore the relationship between memory, type of aphasia, and severity of aphasia with confrontation naming in post-stroke patients with chronic aphasia. Specifically, we wanted to address the correlation of memory with phonemic and semantic cues, the type of aphasia with phonemic and semantic cues, and the severity of aphasia with phonemic and semantic cues.

## 2. Materials and Methods

### Study participants

This research was a descriptive-analytic cross-sectional study and the sampling method was available. We recruited 45 (28 men and 17 women) post-stroke patients [11, 24] with chronic aphasia aged 35 to 70 years. Patients were selected from the stroke center of Ghaem Hospital in Mashhad City, Iran from 2019 to 2021. The inclusion criteria were as follows: the first occurrence of left frontal and or temporal infraction or hemorrhage, aged 35 to 70 years [25], speech therapist diagnosed aphasia as deficits in a receptive and expressive language via Persian Western Aphasia Battery (P-WAB) [26], mild to moderate impairment in mini-mental state examination (MMSE), (score range is between 24 and 30), at least 6 months to 1 year passed after stroke onset, and the patient's consent to participate [27]. The exclusion criteria were as follows: the presence of psychiatric symptoms such as mood and emotional disturbances, drug abuse, sleep disorders, depression based on medical history and reports [24], chronic liver, kidney, and or heart diseases, the presence of progressive diseases, recurrent strokes, and non-cooperative patients [25, 28]. All patients signed a written consent form before participating in this study. This study was approved by the Ethics Committee of Mashhad University of Medical Sciences (Code: IR.MUMS.REC.981582).

### Study procedure

The eligible individuals according to the criteria were selected. All examinations were performed at Ghaem Hospital; the participants sat in a quiet dimly lit room, on a comfortable chair and a therapist collected data individually. The study comprised three tests, which were completed in a single session, and the participant had rest between each test. Initially, Persian Western Aphasia Battery (P-WAB) [29] was administered to evaluate the severity and type of aphasia. In the next stage, Wechsler Memory Scale (WMS) [30] was performed to evaluate memory. Finally, the Persian picture naming test [31] was administered by the speech therapist to assess confrontation naming. At the end of the evaluations, the therapist gave counseling to the patients to perform speech therapy if needed.

The following assessments were conducted.

### Persian Western Aphasia Battery (P-WAB)

This tool is utilized to evaluate the type and severity of aphasia; its validity and reliability have already been determined in Persian. It consists of five subtests: spontaneous speech, auditory comprehension, repetition, naming, and command comprehension [32]. The total score is the sum of these five, which range from 0 to 100 and are used to categorize the language dysfunction into mild (aphasia quotient [AQ] =76-93.8), moderate (AQ =51-75), severe (AQ =26-50), and very severe (AQ ≤ 25) [17, 29].

### Wechsler memory scale (WMS)

This scale is a clinical examination for measuring memory with three subtests: digit span, which evaluates the ability to immediately recall a list of numbers, logical memory, which evaluates immediate and delayed recall of information of a paragraph length, and associative learning, which assesses new learning for a set of matches words shown over three trials [30].

### Persian picture naming test

This test is designed to assess confrontation naming and the differential diagnoses of naming skill in verbal memory, naming aphasia, and Alzheimer patients. The internal consistency of the test was 0.96 and the test-retest correlation coefficient was 0.87 ($P<0.01$). This test has 50 pictures of 3 categories of animals, nature, and construction, and based on the test guide, if the participants did not state the name of the item after 10 seconds, the therapist will first use semantic cues, and if they still could not answer, phonetic cues are then given [31, 33].

**Table 1.** Demographic characteristics (n=45)

| Variables | | Mean±SD/No. (%) |
|---|---|---|
| Education level | <High school | 18(40.0) |
| | ≥High school | 16(35.6) |
| | Academic | 11(24.4) |
| Gender | Male | 28(62.2) |
| | Females | 17(37.8) |
| Age (y) | | 57.44±8.52 |
| MMSE score | | 18.5±11.59 |

Abbreviation: MMSE, Mini-Mental Scale Examination

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### Statistical analysis

Statistical analyses were performed using SPSS version 19.0. The data are presented as the Mean±SD and number (percentage). Variables with normal distribution were analyzed using the Kruskal-Wallis test. To test the correlation, the Spearman correlation coefficient was used. The significance level was set at 0.05.

## 3. Results

In this study, we investigated the association between confrontation naming with memory, type, and severity of aphasia. The demographic characteristics of participants are presented in Table 1.

Clinical data of the patients were recorded based on our assessments (Table 2). Our results between memory and the correct answers without a cue, correct answers with a semantic cue, and total correct answers in confrontation naming were significantly different (P<0.001, r=0.62; P=0.01, r=0.37; and P<0.001, r=0.71; respectively).

Furthermore, there was a significant difference between subtests of confrontation naming involving correct answers with semantic cues and total correct answers with the type of aphasia (P=0.02) (Table 3). Moreover, as shown in Table 3, when comparing the different types of aphasia incorrect answers with semantic cues and total correct answers, a significant increase in anomia and a significant decrease in correlation in Broca's aphasia was seen (P<0.012).

**Table 2.** Clinical characteristics (n=45)

| Variables | | Mean±SD/No. (%) |
|---|---|---|
| Type of aphasia | Broca's | 21(46.7) |
| | Wernicke's | 7(15.6) |
| | Anomia | 12(26.7) |
| | Subcortical | 5(11.1) |
| Severity of aphasia | AQ | 63.19±31.89 |
| | Memory | 69.17±73.63 |
| Naming | Correct answers without a cue | 17.15±7.52 |
| | Correct answers with semantic cue | 3.4±2.39 |
| | Correct answers with phonetic cue | 10.10±4.43 |
| | Total correct answers | 30.18±55.33 |

Abbreviation: AQ, aphasia quotient

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**Table 3.** Relationship of type of aphasia and subtest of confronting naming

| Variables | Mean±SD | | | |
|---|---|---|---|---|
| | Correct Answers | | | |
| | Without a Cue | With Semantic Cue | With Phonetic Cue | Total |
| Broca's | 14.16±1.26 | 1.2±48.52 [a] | 6.7±38.36 | 20.20±34.48 [a] |
| Wernicke's | 12.13±14.8 | 3.4±29.03 [ab] | 18.15±43.28 | 36.14±71.25 [ab] |
| Anomia | 22.15±17.22 | 6.5±5.99 [b] | 12.9±17.88 | 41.8±5.53 [b] |
| Subcortical | 24.13±2.16 | 2.2±4.88 [ab] | 11.9±8.93 | 38.7±4.09 [ab] |
| P | 0.28 | 0.02 | 0.08 | 0.02 |

[a] and [b] indicate significant differences between the two groups (P<0.05).

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Findings indicated a significant difference between severity and correct answers without a cue, correct answers with a semantic cue, and total correct answers in confrontation naming (P<0.001, r=0.77; P=0.03, r=0.31; and P<0.001, r=0.67; respectively).

## 4. Discussion

This study aimed to investigate the relationship between memory with confrontation naming, type of aphasia with confrontation naming, and severity of aphasia with confrontation naming in post-stroke patients with chronic aphasia.

Our results showed a significant correlation between confrontation naming with memory, confrontation naming with the type of aphasia, and confrontation naming with the severity of aphasia. The findings also demonstrated significant correlations between correct answers with semantic cues with memory, correct answers with semantic cues with the type of aphasia, and correct answers with semantic cues with severity in comparison to phonetic cues.

The results in the current study were similar to the relationships reported in previous studies [20, 34].

Our findings demonstrated that memory as a cognitive function had a significant correlation with the correct answers without a cue, correct answers with a semantic cue, and total correct answers in confrontation naming. These results are consistent with Yu et al. who examined post-stroke patients with language dysfunction and found verbal communication to be susceptible to cognitive factors and had a close relationship between cognitive and linguistic abilities such as naming [35].

In this research, our results show a significant association between type of aphasia and semantic cues in confrontation naming. Furthermore, anomia as the most moderate type of aphasia had the highest association with naming ability, while Broca's as a non-fluent aphasia had the least. In line with our findings, Basso et al. reported that expressive aphasia showed a greater improvement than perceptual aphasia; Wernicke's aphasia (perceptual aphasia) had a lower recovery rate than Broca's aphasia (expressive aphasia). Furthermore, they demonstrated that anomic aphasia had the best prognosis [19, 21]. In contrast with these findings, Hachioui et al. noted that various linguistic modalities do not seem to recover simultaneously. They reported that in aphasia patients, semantics and syntax improved 6 weeks after the onset of stroke, while phonology took longer, up to 3 months, due to the prolonged recovery of verbal communication, and language expression recovered later than receptive language [36].

Moreover, the severity of aphasia results showed a significant correlation between the severity of aphasia and correct answers without a cue, correct answers with a semantic cue, and total correct answers in confrontation naming. The present findings are consistent with Lazar et al. who investigated the factors that have a crucial role in well-predicted aphasia patients after stroke; the authors have not only stated that severity predicts the outcome of aphasia but also designated it as the strongest predictor of outcome [37].

Regarding our type of aphasia and its severity findings, Kang reported that patients with more severe aphasia showed more deficits in cognitive functions; the hypothesis is that recovery of cognition such as memory may be related to the recovery of language and naming. They categorized patients into 3 aphasia groups: severely im-

paired including global aphasia, moderately impaired, including Broca's aphasia, and mildly impaired, including anomia. They reported that improvements in cognitive domains are followed by improvements in naming skills in patients with anomia, Broca's patients showed improvements in fluency, comprehension, and severity of impairment, and global aphasia patients showed improvement in all test subtests. These results are supported by the fact that cognitive ability such as memory is an indicator of functions in speech and naming [16, 18].

Our findings in comparing semantic and phonetic cues showed that memory, severity, and type of aphasia had a significant association with semantic cues in comparison to phonetic cues. These results are consistent with the findings of Stimley (1991), who highlighted the effects of semantic and phonemic cues on naming aphasia patients. Based on their findings, they hypothesized that semantic cues were effective in accessing information in the semantic system and in its activation, which then makes the activation of the visual recognition/categorization system facilitate and increase the access to the relevant information to choose the phonological correct word forms [38].

## 5. Conclusion

This study suggests an association between memory, type, and severity of aphasia with confrontation naming in post-stroke aphasia patients. The results indicated that memory, type, and severity of aphasia may be involved in problems that aphasia patients experienced in verbal communication such as naming. Our data highlighted the importance of factors that need to be considered to formulate a comprehensive treatment plan to achieve further improvement in naming skills.

### Study limitations

A few limitations should be acknowledged. Firstly, due to different linguistic and cognitive recovery pathways, it is better to investigate the neural mechanisms and conduct a more comprehensive examination with functional magnitude resonance imaging. Secondly, this study lacked a control group. These limitations are suggested to be given more attention in future studies.

## Ethical Considerations

### Compliance with ethical guidelines

The study was approved by the Ethics Committee of Mashhad University of Medical Sciences (Code: IR.MUMS.REC.981582).

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### Authors' contributions

All authors equally contributed to preparing this article.

### Conflict of interest

The authors declared no conflict of interest.

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## References

[1] Chapey R. Language intervention strategies in aphasia and related neurogenic communication disorders. Philadelphia: Lippincott Williams & Wilkins; 2001. [Link]

[2] Khedr EM, Abbass MA, Soliman RK, Zaki AF, Gamea A, El-Fetoh NA, et al. A hospital-based study of post-stroke aphasia: Frequency, risk factors, and topographic representation. The Egyptian Journal of Neurology, Psychiatry and Neurosurgery. 2020; 56:2. [DOI:10.1186/s41983-019-0128-1]

[3] Lee JK, Ko MH, Park ZH, Kim GW. Prediction of aphasia severity in patients with stroke using diffusion tensor imaging. Brain Sciences. 2021; 11(3):304. [DOI:10.3390/brainsci11030304] [PMID] [PMCID]

[4] Behroozmand R, Johari K. Sensorimotor Impairment of Speech and Hand Movement Timing Processing in Parkinson's Disease. Journal of Motor Behavior. 2019; 51(5):561-71. [PMID]

[5] Mesulam MM. Large-scale neurocognitive networks and distributed processing for attention, language, and memory. Annals of Neurology. 1990; 28(5):597-613. [DOI:10.1002/ana.410280502] [PMID]

[6] Hadanny A, Rittblat M, Bitterman M, May-Raz I, Suzin G, Boussi-Gross R, et al. Hyperbaric oxygen therapy improves neurocognitive functions of post-stroke patients-a retrospective analysis. Restorative Neurology and Neuroscience. 2020; 38(1):93-107. [DOI:10.3233/RNN-190959] [PMID] [PMCID]

[7] Donnellan C, Werring D. Cognitive impairment before and after intracerebral haemorrhage: A systematic review. Neurological Sciences. 2020; 41(3):509-27. [DOI:10.1007/s10072-019-04150-5] [PMID]

[8] LaPointe LL. Aphasia and related neurogenic language disorders. New York: Thieme Medical Pub; 2005. [Link]

[9] Barrow IM, Hough M, Rastatter MP, Walker M, Holbert D, Rotondo MF. The effects of mild traumatic brain injury on confrontation naming in adults. Brain Injury. 2006; 20(8):845-55. [DOI:10.1080/02699050600832445] [PMID]

[10] Malt BC, Sloman SA. Conversation and convention: Enduring influences on name choice for common objects. Memory & Cognition. 2004; 32(8):1346-54. [DOI:10.3758/BF03206325] [PMID]

[11] Hemmati E, Sobhani-Rad D, Seifpanahi S, Ghaemi H. The relationship between working memory and confrontation naming following traumatic brain injury. Journal of Rehabilitation Sciences & Research. 2018; 5(4):115-9. [DOI:10.30476/jrsr.2018.44676]

[12] Norton ES, Wolf M. Rapid automatized naming (RAN) and reading fluency: Implications for understanding and treatment of reading disabilities. Annual Review of Psychology. 2012; 63:427-52. [DOI:10.1146/annurev-psych-120710-100431] [PMID]

[13] Williams SE. Factors influencing naming performance in aphasia: A review of the literature. Journal of Communication Disorders. 1983; 16(5):357-72. [DOI:10.1016/0021-9924(83)90018-7] [PMID]

[14] Watila MM, Balarabe SA. Factors predicting post-stroke aphasia recovery. Journal of the Neurological Sciences. 2015; 352(1-2):12-8. [DOI:10.1016/j.jns.2015.03.020] [PMID]

[15] Lahiri D, Dubey S, Ardila A, Ray BK. Factors affecting vascular aphasia severity. Aphasiology. 2021; 35(5):633-41. [DOI:10.1080/02687038.2020.1712587]

[16] Kang EK, Jeong HS, Moon ER, Lee JY, Lee KJ. Cognitive and language function in aphasic patients assessed with the Korean version of mini-mental status examination. Annals of Rehabilitation Medicine. 2016; 40(1):152-61. [DOI:10.5535/arm.2016.40.1.152] [PMID] [PMCID]

[17] Lahiri D, Ardila A, Dubey S, Ray BK. A longitudinal study of aphasia due to pure sub-cortical strokes. Annals of Indian Academy of Neurology. 2020; 23(Suppl 2):S109-15. [DOI:10.4103/aian.AIAN_475_20] [PMID] [PMCID]

[18] Pedersen PM, Vinter K, Olsen TS. Aphasia after stroke: Type, severity and prognosis. Cerebrovascular Diseases. 2004; 17(1):35-43. [DOI:10.1159/000073896] [PMID]

[19] Papathanasiou I, Coppens P. Aphasia and related neurogenic communication disorders. Burlington: Jones & Bartlett Publishers; 2016. [Link]

[20] González-Fernández M, Davis C, Molitoris JJ, Newhart M, Leigh R, Hillis AE. Formal education, socioeconomic status, and the severity of aphasia after stroke. Archives of Physical Medicine and Rehabilitation. 2011; 92(11):1809-13. [DOI:10.1016/j.apmr.2011.05.026] [PMID] [PMCID]

[21] Basso A. Aphasia and its therapy. Oxford: Oxford University Press; 2003. [Link]

[22] Jung IY, Lim JY, Kang EK, Sohn HM, Paik NJ. The factors associated with good responses to speech therapy combined with transcranial direct current stimulation in post-stroke aphasic patients. Annals of Rehabilitation Medicine. 2011; 35(4):460-9. [DOI:10.5535/arm.2011.35.4.460] [PMID] [PMCID]

[23] Laine M, Martin N. Anomia: Theoretical and clinical aspects. London: Psychology Press; 2006. [DOI:10.4324/9780203759561]

[24] Ginex V, Veronelli L, Vanacore N, Lacorte E, Monti A, Corbo M. Motor recovery in post-stroke patients with aphasia: The role of specific linguistic abilities. Topics in Stroke Rehabilitation. 2017; 24(6):428-34. [DOI:10.1080/10749357.2017.1305654] [PMID]

[25] Chen W, Ye Q, Ji X, Zhang S, Yang X, Zhou Q, et al. Mirror neuron system based therapy for aphasia rehabilitation. Frontiers in Psychology. 2015; 6:1665. [DOI:10.3389/fpsyg.2015.01665] [PMID] [PMCID]

[26] Ghoreishi ZS, Azimian M, Alaghband Rad J, Khorrami Banaraki A, Rafiee SM, Salavati M, et al. Analysis of connected speech in Persian aphasic patients and its relationship with type and severity of aphasia. Function and Disability Journal. 2020; 3(1):141-50. [DOI:10.32598/fdj.4.14]

[27] Zhao Q, Wang J, Li Z, Song L, Li X. Effect of anodic transcranial direct current stimulation combined with speech language therapy on nonfluent poststroke aphasia. Neuromodulation. 2021; 24(5):923-9. [DOI:10.1111/ner.13337] [PMID]

[28] Chen WL, Ye Q, Zhang SC, Xia Y, Yang X, Yuan TF, et al. Aphasia rehabilitation based on mirror neuron theory: A randomized-block-design study of neuropsychology and functional magnetic resonance imaging. Neural Regeneration Research. 2019; 14(6):1004-12. [DOI:10.4103/1673-5374.250580] [PMID] [PMCID]

[29] Nilipour R, Pour Shahbaz A, Ghoreishi ZS, Yousefi A. [Reliability and validity of Persian aphasia battery test (Persian)]. Salmand: Iranian Journal of Ageing. 2016; 10(4):182-91. [Link]

[30] Wechsler D. Wechsler adult intelligence scale-fourth edition (WAIS-IV). Washington: American Psychological Association; 2008. [DOI:10.1037/t15169-000]

[31] Nilipour R. [Aphasia naming test (Persian)]. Tehran: University of Welfare & Rehabilitation Sciences Press; 2011.

[32] Nilipour R, Pourshahbaz A, Ghoreyshi ZS. Reliability and validity of bedside version of Persian WAB (P-WAB-1). Basic and Clinical Neuroscience. 2014; 5(4):253-8. [PMID] [PMCID]

[33] Pour RN, Shahbaz AP, Ghoreishi ZS, Yousefi AT. [Measures of reliability and validity of Persian picture naming battery (Persian)]. Speech and Language Pathology Journal. 2014; 1(4):[Link]

[34] Kalaria RN, Ballard C. Stroke and cognition. Current Atherosclerosis Reports. 2001; 3(4):334-9. [DOI:10.1007/s11883-001-0028-5] [PMID]

[35] Yu ZZ, Jiang SJ, Bi S, Li J, Lei D, Sun LL. Relationship between linguistic functions and cognitive functions in a clinical study of Chinese patients with post-stroke aphasia. Chinese Medical Journal. 2013; 126(7):1252-6. [PMID]

[36] El Hachioui H, Lingsma HF, van de Sandt-Koenderman ME, Dippel DW, Koudstaal PJ, Visch-Brink EG. Recovery of aphasia after stroke: A 1-year follow-up study. Journal of Neurology. 2013; 260(1):166-71. [DOI:10.1007/s00415-012-6607-2] [PMID]

[37] Lazar RM, Minzer B, Antoniello D, Festa JR, Krakauer JW, Marshall RS. Improvement in aphasia scores after stroke is well predicted by initial severity. Stroke. 2010; 41(7):1485-8. [DOI:10.1161/STROKEAHA.109.577338] [PMID] [PMCID]

[38] Stimley MA, Noll JD. The effects of semantic and phonemic prestimulation cues on picture naming in aphasia. Brain and Language. 1991; 41(4):496-509. [DOI:10.1016/0093-934X(91)90170-6] [PMID]