Caspian Journal of Neurological Sciences
"Caspian J Neurol Sci"

Journal Homepage: http://cjns.gums.ac.ir

Research Paper: The Impact of Word Regularity on the Reading of Normal and Aphasic Gilak-Persian Adults

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Citation: Zebardast M, Danaye Tous M. The Impact of Word Regularity on the Reading of Normal and Aphasic Gilak-Persian Adults. Caspian J Neurol Sci. 2018; 4(1):6-12. https://doi.org/10.29252/NIRP.CJNS.4.12.6

Running Title: The Impact of Word Regularity on the Reading of Normal and Aphasic Gilak-Persian Adults

doi: https://doi.org/10.29252/NIRP.CJNS.4.12.6

Bullet Points:

- The world regularity does not influence reading words neither in normal nor in aphasic persons.

ABSTRACT

Background: Various factors influence the natural processing of words. The present study sought to investigate the effect of the regularity variable on the reading of words.

Objectives: The participants in the study were 50 normal and 5 aphasic people (of Broca, transcortical motor and conduction aphasia types) who were selected through convenience sampling method.

Materials & Methods: It was a quantitative study with quasi-experimental design. In this research, reading aloud subtest of the test 53 of the Psycholinguistic Assessment of Language Processing in Aphasia (PALPA) battery of tests was nativized and used. First, the mean and standard deviation was computed for the test scores of the two groups of participants (i.e. normal and aphasics). Regarding the aphasics' data, after verifying their normality of distribution by Kolmogorov-Smirnov Test, paired samples t-test was used to compare the mean scores on the results of the test on regular and exception words.

Results: Since normal subjects scored a perfect grade (SD=0), it was found that the regularity variable had no effect on the reading process in these individuals. Based on the results of paired samples t-test in the aphasic subjects (P=0.25), it was found that the regularity variable in these individuals has no effect on their reading process, too.

Conclusion: The evidence from the present study shows that the word regularity has no impact on the reading of words in both normal and aphasic adults. The theoretical and clinical implications of the findings would be discussed.

Keywords: Aphasia, Reading, Language

Article History:
Received: 11 Aug 2017
Accepted: 04 Nov 2017
Available Online: 01 Jan 2018

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Introduction

Language production requires the programming of semantic content and the encoding of this content [1]. Subjective representations are converted into orderly words of a group, sentence, or clause through grammatical encryption [2]. Upon recognition of written vocabulary, the first reading step, to understand that a chain of letters can be considered a word or not, the search is done among the words that the person knows. Here spelling knowledge is involved [3].

In reading, the information is sent by the eye to the visual cortex [4, 5]. For reading aloud, two routes are assumed: the vocabulary route is for the words which happen through the semantic system and the non-vocabulary route to read the non-words. There is also a third route, which is a subset of the lexical route which leads to the spelling output from orthographic input [3].

Several factors affect language processing. One of these factors is the frequency of words [6]. Generally, people react more quickly to words that are most often seen or heard. Objective words are more easily processed than abstract words [7]. The number of syllables in each word also affects its processing [8]. There is also a direct relation between the length of a word and the delay in its processing [9]. The regularity of words in reading can affect the processing of words [10]. If a letter of the alphabet always represents a sound in all words, it will consider as regular [11].

The basic assumption in all the common theories of lexicon is that the lexicon consists of several distinct components. The implication of this assumption is that brain damage can lead to selective interruptions in any of the components of the lexical system [12, 13]. One of these theories is the idea of Kay, Lesser and Coltheart (1992) which will be described as the theoretical framework of this research in the following.

When we recognize a word, we find it in "orthographic input lexicon". Knowledge about the meaning of the words is also stored in the semantic system. When we speak, the semantic meaning will be selected from the meaning system, and transferred to "the phonological output lexicon" and spoken forms of the words will be chosen there. But for non-words, we need spelling to sound rules. The model proposed is called "dual route model", in a procedure, through "the orthographic input lexicon" goes to "the phonological output lexicon" (and through the meaning system) which is called lexical route. In the other procedure, the words are not used at all, so we call it non-lexical route. We cannot read non-words with the use of lexical route and irregular or exception words cannot also be read with the use of non-lexical route. But we cannot explain reading aloud only with these two routes [3].

Shwartz et al. described a patient who could not use his semantic system. However, he could read all the words correctly [14]. This finding and the other similar findings led researchers into the third processing route or split lexical route into at least two disjoint routes; One is the route in which through semantic system from "orthographic input lexicon" leads to "phonological output lexicon", and the other is the route through which from "orthographic input lexicon" leads to "phonological output lexicon" directly and without resorting to semantic direction (Figure 1).

Glushko in a research declared that reading regular and irregular words occurs with the same information and stated that the speed of reading regular non-words is more than regulars and less errors occurs in reading regular non-words. He also believes that orthographic knowledge has effect on reading [15]. Patterson and Hodge with studying on 3 aphasic people, found that aphasic people read regular words without any errors but in reading exception words their ability reduce [16].

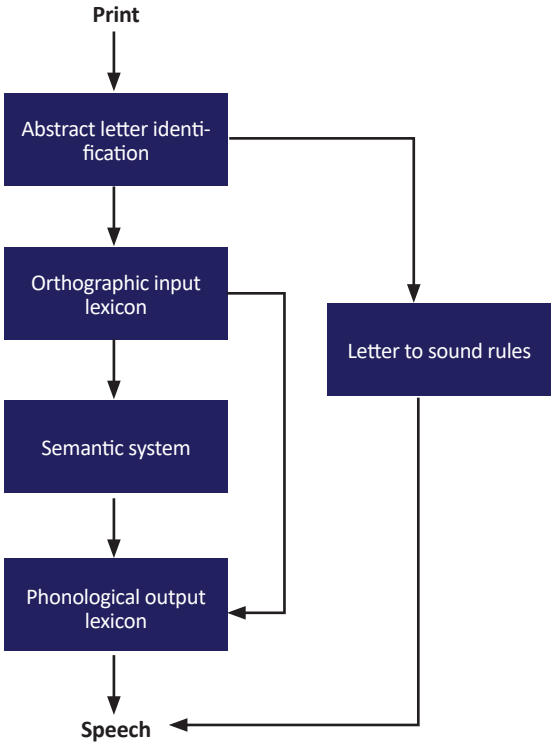

Figure 1. Three-route model [3]

Graham, Hodge and Patterson examined the relationship between language comprehension and oral reading in normal and aphasic people. It is found that defects in semantic memory affect comprehension and production in aphasic people and normal people act with no mistakes in reading both regular and exceptional words, reading loud phrases in aphasic people is also with no mistake, but reading exception words in aphasic people was with errors and most errors occur for the regularity generalization [17].

Richards, et al. compared reading and writing process in normal children and impaired children in their study. The results indicated that each of dyslexia and dysgraphia involved a certain part of the brain and each of these disorders requires different diagnosis and treatment [18].

Simashirazi et al. examined reading and writing skills in normal people with the use of a combination method called "phoneme-morpheme based". They found the speed of reading irregular words is slower, subjects read text, pseudo words and words naturally, but read irregular words slower and it means that phonetic route is more used [19]. Kangarlu et al. investigated speech disorders resulted by cerebrovascular events with the use of Persian language aphasia test proposed by Nilipour (1997) in four parts; finding words, recognizing and expressing verbs, oral expression, visual and mental speech comprehension and found that disorders occur in each of four parts but the amount of these disorders are different [20].

The present study sought to investigate the effect of word's regularity on their reading in normal and aphasic people. Among the researches on word processing, we can point to Baluch and Danaye Tous (2006), Por-Nour (2010), Gholamian and Geva (1999), Arabi-Moghadam and Senechal (2001), and Yeganeh (2014) [21-25]. But in these researches, there gularity effect on word processing has not been considered. Besides, there is no definite definition for the regularity/ irregularity of Persian words. So far, there has not been a Persian study about the effect of regularity/ irregularity on the processing of Persian words in normal and aphasic people. The present research seeks to fill this research vacancy, and on this basis, two hypotheses were put forward: 1. The reading of normal people is not affected by the regularity of words; 2. The reading of aphasic people is not affected by the regularity of words.

Materials and Methods

It was a quantitative study with quasi-experimental design. First, it was decided to test 50 normal and 15 aphasic people. When we started, we tested all 50 normal people, but we just found 5 aphasic people who were literate. Therefore, Participants of this study were 50 normal (20 students of Guilan university, 6 students of Kooshyar institute, University of nonprofit, in Rasht, 2 members of aphasics' family, 10 businessmen in some stores in Rasht and 10 people of the researchers' family members) and 5 aphasic people. The participants were selected through convenience sampling method. Aphasic participants were selected from Disabled and Elderly Hospice in Rasht and Shalizar disabled and elderly hos-

Table 1. Information on the participants of the study

Normal People		
Age mean		32.9
Gender	Female	26
	Male	24
Education level	Diploma	9
	BA/BSc.	25
	MA/MSc.	16
Aphasic People		
Age mean		57.2
Gender	Female	-
	Male	5
Education level	Diploma	3
	BA/BSc.	1
	MA/MSc.	1

pice in Rasht and they were diagnosed as Broca, transcortical motor and conduction aphasics).

The information on the participants is as presented in Table 1. Independent variables were regularity (including two levels; regulars and exceptions) and participants and the dependent variable was participants' test score. Words' frequency, concreteness, the number of letters and the number of syllables were also control variables.

In this study, reading aloud subtest of the test 53 of PALPA [3] was nativized and used. Data were collected by the researchers in the summer of 2016 in the same conditions for all participants. Materials of this subtest were 40 words including 20 regular and 20 exception words. Here, regularity in reading was intended. All words were matched in terms of frequency, concreteness, the number of letters and the number of syllables.

In this study, if a letter of the alphabet in most of its uses represents the same sound, the word containing this sound would be called regular and it is irregular in other cases. In Persian alphabet <الف-ل-و-ه-ی> are the letters which have more than one pronunciation and for determining the original sound of each letters, words in Moin Persian Dictionary including <الف-ل-و-ه-ی> were considered (Words from <الف> to <س>, in fact, half of the alphabet). After counting the frequency of the sounds, it became clear that <الف> with the sound /ɑ/, <ل> with the sound /l/, <و> with the sound /u/, <ه> with the sound /e/ and <ی> with the sound /i/ have the most frequency and words with these letters were considered as regular (for example, مرغ: hen and دوربین: camera) and in all other cases, the words were considered as irregular (for example اسب: horse and کوه: mountain). To select the required words, first between 11618 words, 262 concrete words were chosen. Then, for subjective frequency rating of these words, a questionnaire in Likert scale with 5 points (from very low frequent to very high frequent) was prepared. Questionnaires were distributed among 30 people and 143 concrete and high frequency words were chosen.

Finally, 20 regular words and 20 irregular words were selected from this pool of words with the following characteristics: Between irregular words, there were 7 one-syllable, 12 two-syllable, and 1 three-syllable words and according to the number of letters, there were 1 two-letter, 6 three-letter, 5 four-letter, 6 five-letter, 1 six-letter, and 1 seven-letter words.

Among regular words, there were 6 one-syllable, and 14 two-syllable words, and according to the number of letters, there were 7 three-letter, 6 four-letter, 6 five-letter, and 1 six-letter words. In reading a loud subtest, each word was shown separately and the person was asked to read it aloud. For the correct answer, the score of 2, incomplete answer, the score of 1, and wrong or no answers, the score of zero were considered. Content validity of the test was controlled by two experts. In order to control the reliability, the Cronbach's alpha value was calculated as 0.98. Data were analyzed by SPSS software version 16. It should be noted that oral informed consent was obtained from all participants.

Results

At first the mean and standard deviation were calculated for the scores of the two groups of normal and aphasic people (Table 2).

Normal people scored a perfect grade. Regarding the aphasic subjects, because their scores differed, after calculating mean and standard deviation, the Kolmogorov-Smirnov Test was used to check the normalization and then the paired samples t-test was used to compare mean scores of reading regular and exception words in aphasic people (Table 3 and 4). Due to the fact that the participants in the study were not equal in number, the data of 10 normal people which were more similar to the aphasic participants (in terms of literacy and age with a mean age of 57.2) were selected to compare the performance of the two normal and aphasic groups on reading aloud test.

As can be seen in Table 2, there was a relatively large difference between the average scores of normal and aphasic participants. To evaluate the difference between the two groups, the Mann-Whitney test was used and the results are presented in Table 5. The results showed that there is a significant difference in the mean scores of the normal and aphasic participants in the reading aloud test ($P<0.01$).

Discussion

Because of the equality in normal participants' scores in reading regular and exception words, it can be concluded that normal people's ability in reading regular and exception words were not different from each other, so, the first hypothesis of this study was verified. This finding is consistent with the findings of Glushko (1979) [15], Graham et al. (1994) [17], and Patterson and Hodge (1992) [16]. According to Graham et al. (1994), normal people have no errors in reading regular and exception words [17].

It can be concluded that normal people use the same processing route as regular words to read exception

Table 2. The mean and standard deviation of normal and aphasic people in reading the exception and regular words

Dependent Variable	Exception Words		Regular Words	
	Mean	SD	Mean	SD
Reading in normal people	40	0	40	0
Reading in aphasic people	14	19.04	21.8	16.3

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Table 3. The results of Kolmogorov-Smirnov Test

Task	Regular Words	Exception Words
Z Kolmogorov-Smirnov	0.55	0.79
Significance level	0.000	0.000

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Table 4. The results of paired samples t-test to compare mean scores of reading regular and exception words in aphasic people

Words	Mean	SD	T	P
Regular	21.8	16.34	1.33	0.25
Exception	14.4	19.42		

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words. Also, it should be noted that adults and normal people act automatically in reading words and read it with the use of lexical route as soon as they see the first letters of a word [26]. Besides, Shallice, Warrington and McCarthy (2007) believe that the semantic system has little or no role in reading aloud in normal people [27].

Figure 2 indicates regular and exception words' reading route in normal adult people. Mean score of aphasic people in reading regular and exception words was not statistically significant, therefore the second hypothesis of this study was verified. This finding is not consistent with the finding of Glushko (1979) [15], Graham et al. (1994) [17], and Patterson and Hodge (1992) [16]. Graham et al. (1994) [17] stated aphasic people performances in reading regular and exception words have significant differences. Patterson and Hodge in a study concluded that aphasic people have no mistake in reading regular words, but in reading exception words, due to the damage, the ability of their reading reduced [17].

However, in this study, although the mean scores of reading regular and exception words in aphasic people were different; this difference was not statistically significant. This result could be explained based on Kay, et al. (1992) who stated that the weakness of aphasic people in reading all words means impairment of the lexical processing route due to brain injury. It can be assumed that aphasic people resort to the non-lexical route to read a word in order to compensate for the defects in lexical processing. This leads in better performance in reading regular words in contrast to exception words (although, the difference in their performance on regular and exception words was not statistically significant). Based on Shallice, et al. (2007), we could assume that the brain damage of these people is progressive and because such damage leads in more prob-

Table 5. The results of the Mann-Whitney test for comparing the mean score of normal and aphasic participants

Words	Mann-Whitney Amount	Z Amount	Significance Level
Regular	5	-3.14	0.001
Exception	0	-3.65	0.001

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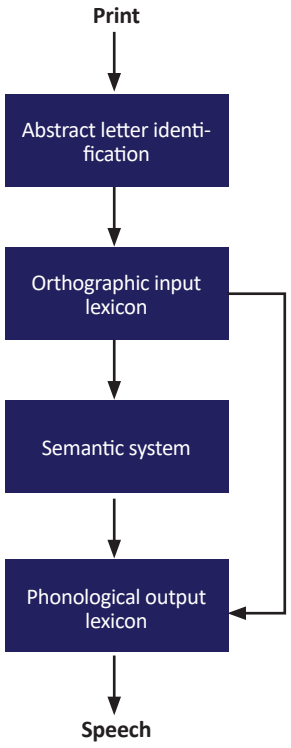

Figure 2. Reading aloud words through the lexical route (with or without using the semantic system, derived from lexical processing model of Kay, et al. (1992) [3]

lem in cognitive functioning, even the non-lexical route could be affected by the brain damage and as a result aphasics show weak performance even in reading regular words [27].

In sum, Normal people read both types of words through the lexical processing route. But aphasic people, regardless of the regularity/irregularity of the word and the speed of reading, performed weakly due to the severe deficiency in the lexical processing route, as well as the deficiency in the non- lexical processing route.

Conclusion

One finding of this research was that regularity has no influence on reading words in normal people. It can be said that normal people use the same route for reading both regular and exception words (i.e. lexical processing route). Another finding was that there gularity of words has no effect on reading in aphasic people. The aphasic people's weak performance in reading both regular and irregular words, suggest a deficit in lexical and non-lexical processing routes due to the progressive brain damage.

The results of comparing two groups of normal and aphasics showed that there was a significant difference between them according to the their reading scores ($P<0.01$). It can be said that the performance of aphasic participants in reading regular words, as well as exception words was much weaker than the normal people. Initially, it was decided to test 15 aphasic people, but in the research process we could only access to 5 patients. The number of literate aphasic people who visited a doctor regularly was very limited, and waiting to find them at the clinics and hospitals took a lot of time. In addition, many of the people who were identified as aphasic were elderly people who were not literate, and since some of the tests in this study required literacy, we could not use them.

This study only investigated the impact of regularity of words' on normal and aphasic people's reading behavior. It is suggested to consider the reading speed in the future studies. It is suggested to investigate the effect of the other variables, such as the image ability of words on the reading performance. Also, this research can be repeated with more aphasic people.

Acknowledgements

Special thanks go to the participants of this study for their participation. Thanks to Dr. Alia Saberi and also to Mr. Vatankhah, for his help in the statistical analysis and to our patient family for their encouragement. This article was based on MSc. thesis of the first author in the Department of Linguistics, Faculty of Literature and Humanities, University of Guilan, Rasht, and a part of a project under the control of Guilan Science and Technology Park No. 95/2078.

Conflict of Interest

The authors declared no conflicts of interest.

References

[1] Bock JK, Levelt WJ. Language production: Grammatical encoding. In: Traxler M, Ann M, editors. Handbook of Psycho-Linguistics. London: Academic Press; 1994.

[2] Caramazza A. Data, statistics, and theory: A comment on Bates, McDonald, MacWhinney, and Applebaum's "A maximum likelihood procedure for the analysis of group and individual data in aphasia research". Brain Lang. 1991; 41(1):43-51. doi: 10.1016/0093-934x(91)90109-e

[3] Kay J, Lesser R, Coltheart M. Psycholinguistic assessments of language processing in aphasia (PALPA): An introduction. Aphasiology. 1996; 10(2):159–80. doi: 10.1080/02687039608248403

[4] Rayner K, Pollatsek A. Basic processes in reading. In: Reisberg D, editor. The Oxford Handbook of Cognitive Psychology. New York: Oxford University Press; 2013.

[5] Rayner K, Pollatsek A, Ashby J, Clifton JRC. Psychology of reading. New York: Psychology Press; 2012.

[6] Madan CR, Glaholt MG, Caplan JB. The influence of item properties on association-memory. J Mem Lang. 2010; 63(1):46–63. doi: 10.1016/j.jml.2010.03.001

[7] Barber HA, Otten LJ, Kousta ST, Vigliocco G. Concreteness in word processing: ERP and behavioral effects in a lexical decision task. Brain Lang. 2013; 125(1):47–53. doi: 10.1016/j.bandl.2013.01.005

[8] Duncan LG, Seymour PHK. How do children read multisyllabic words? Some preliminary observations. J Res Read. 2003; 26(2):101–20. doi: 10.1111/1467-9817.00190

[9] Campoy G. The effect of word length in short-term memory: Is rehearsal necessary. Q J Exp Psychol A. 2008; 61(5):724–34. doi: 10.1080/17470210701402364

[10] Goswami U, Bryant P. Phonological skills and learning to read. London: Lawrence Erlbaum; 1990.

[11] Tallberg IM, Wenneborg K, Almkvist O. Reading words with irregular decoding rules: A test of premorbid cognitive function. Scand J Psychol. 2006; 47(6):531–9. doi: 10.1111/j.1467-9450.2006.00547.x

[12] Caramazza A. On drawing inferences about the structure of normal cognitive systems from the analysis of patterns of impaired performance: The case for single-patient studies. Brain Cogn. 1986; 5(1):41–66. doi: 10.1016/0278-2626(86)90061-8

[13] Shallice T. From neuropsychology to mental structure. Cambridge: Cambridge University Press; 1988.

[14] Schwartz MF, Saffran EM, Marin OS. The word order problem in agrammatism. Brain Lang. 1980; 10(2):249–62. doi: 10.1016/0093-934x(80)90055-3

[15] Glushko RJ. The organization and activation of orthographic knowledge in reading aloud. Journal of Experimental Psychology: Hum Percept Perform. 1979; 5(4):674–91. doi: 10.1037/0096-1523.5.4.674

[16] Patterson K, Hodges JR. Deterioration of word meaning: Implications for reading. Neuropsychologia. 1992; 30(12):1025–40. doi: 10.1016/0028-3932(92)90096-5

[17] Graham KS, Hodges JR, Patterson K. The relationship between comprehension and oral reading in progressive fluent aphasia. Neuropsychologia. 1994; 32(3):299–316. doi: 10.1016/0028-3932(94)90133-3

[18] Richards TL, Grabowski TJ, Boord P, Yagle K, Askren M, Mestre Z, et al. Contrasting brain patterns of writing-related DTI parameters, fMRI connectivity, and DTI–fMRI connectivity correlations in children with and without dysgraphia or dyslexia. NeuroImage: Clin. 2015; 8:408–21. doi: 10.1016/j.nicl.2015.03.018

[19] Shirazi TS, Nilli Pour R, Mehri A. [Study of reading and spelling skills in ordinary Persian language students taught in a combination method (Persian)]. Q J Educ. 2005; 21(1):130-13.

[20] Kangarlu M, Roshan B, Delavar Kasmai H. [The studying of speech and language disorders in C.V.A. (Persian)]. J Med Counc Iran. 2014; 32(3):232-8.

[21] Danaye Tous M, Baluch B. [The Effect of Transparency and Blurring of the Persian Script on the Function of Normal and Dyslexic Children in Phonological Knowledge Tests (Persian)]. J Lang Mind. 2006; 1(1):61-77.

[22] Pornour F. [Active visual and auditory memory action in lexical processing (Persian)] [MSc. Thesis]. Tehran: Allameh Tabatabaei University; 2010.

[23] Gholamain M, Geva E. Orthographic and cognitive factors in the concurrent development of basic reading skills in English and Persian. Lang Learn. 1999; 49(2):183–217. doi: 10.1111/0023-8333.00087

[24] Arab-Moghaddam N, Senechal M. Orthographic and phonological processing skills in reading and spelling in Persian/English bilinguals. Int J Behav Dev. 2001; 25(2):140–7. doi: 10.1080/01650250042000320

[25] Yeganeh Sh. [The effects of transparency and blurring of the Persian script on the writing skills of normal and dyslexic children through phonological awareness tests and spelling (Persian)]. Lang Sci. 2014; 2(2):71-96. doi: 10.22054/ls.2014.1081

[26] Pritchard SC, Coltheart M, Palethorpe S, Castles A. Nonword reading: Comparing dual-route cascaded and connectionist dual-process models with human data. J Exp Psychol. 2012; 38(5):1268–88. doi: 10.1037/a0026703

[27] Shallice T, Warrington EK, Mccarthy R. Reading without semantics. Q J Exp Psychol A: Section A. 1983; 35(1):111–38. doi: 10.1080/14640748308402120