

A Retrospective Meta-analysis of Semantic-Spatial Comparison of Persian and English Orthographic Systems

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Abstract. In this retrospective meta-analysis of the semantic-spatial comparison of the Persian and English orthographic systems, 32 Persian scholarly articles and their English equivalents were compared for number of words, number of pages, number of characters, and number of lines as variables. Non-scholarly papers were excluded from the study. Data were gleaned by word count capability of Microsoft word processor. It was concluded that the English orthographic system can express more semantic content using a smaller number of words; however, considering a given semantic content, the Persian orthographic system can express the same semantic content in less pages, smaller number of characters, and smaller number of lines. So, on the whole, the Persian orthographic system is more economic and cost-effective with respect to the number of pages, characters, and lines compared to the English writing system. Since the translations were performed by only one translator, care should be exercised in generalizing the findings to papers of other academic majors. Our findings also led to the development of the following formula for predicting the translation charges of scholarly papers:

Charge of Persian-to-English translation \approx *number of Persian lines* \times 1.35 \times *charge per line*

Keywords: Persian, English, orthographic system, alphabets, lexeme

1 Introduction

Human language first emerged in the spoken form and survived for thousands of years without any writing system. According to Venezky (1967), English orthography is the system of conventional rules of writing which are applied to represent spoken English in the written form. It was invented because human beings needed to record their spoken words for transmission to those who were not present there at the time of emission of the utterances. As Van Assche et al. (2013) put it, written symbols allow readers to connect spelling to sounds and sounds to meaning. Moreover, the orthographic systems of most languages round the globe have a broad degree of standardization and English orthographic system is not an exception. Unfortunately, there is no exact one-to-one correspondence between the written letters and spoken sounds in English, though some languages enjoy high degrees of such a correspondence. Additionally, there are multiple ways to spell nearly every phoneme, i.e., smallest meaningful unit, in English. On the other hand, most English letters have multiple pronunciations depending on where they occur in a word and also the context. According to Horton (2015), the situation is so chaotic that numerous orthographic mistakes are common even among indigenous speakers of English. This may be mainly attributed to the large number of cognates and words borrowed from many other languages during the evolutionary history of this language. Khansir and Tajeri (2015) assert that this long history has passed without successful attempts at fully-fledged spelling reforms. It is stated in Encyclopædia Britannica (2010) that the major portion of the spelling conventions in Modern English era were distilled from the phonetic spelling of a variety of Middle English. These conventions do not usually mirror the phonemic alterations which have emerged since the late 15th century, i.e., variations like those in the Great Vowel Shift. Fortunately, the orthographic system of English is consistent around the world as this is an international language and in spite of the various English dialects used in different countries and within different parts of the same country, only mild changes are observed in English writing symbols. Indeed, today the most well-known variations are the British and American Spelling systems with minor differences. This general uniformity of spellings

facilitates international communication; nevertheless, it adds to the discrepancy between the way English is written and spoken in any given location.

The Persian alphabet or Perso-Arabic alphabet is a modified version of the Arabic script which is used for writing the Persian language, the major language spoken in Iran. As Mirdehghan (2010) says, the writing systems of Persian, Urdu, and Pashto draw from a common script, i.e., Arabic, with adaptations to represent sounds specific to each language. Persian is also spoken in Afghanistan, and is the main language in Tajikistan, a former central Asian republic of the former Soviet Union. However, according to Baluch (2005), the Persian spoken in these countries and the writing system used to transcribe the spoken language, especially in Tajikistan, have been influenced by local factors and borrowed words. The Persian script has in common many characteristics with other systems which are founded on the Arabic script. The system is an abjad, i.e., vowels, specifically short vowels, are not shown in writing. The writing direction is exclusively right to left. Moreover, the script uses cursive writing, i.e., most letters in a word are connected to each other and when they are typed, the word processor automatically merges adjacent letter forms. Yet, some Persian compounds do not join and the Persian script adds four extra letters to the 28 letters for a total of 32 characters. According to Lapidus (2002, 2012), the substitution of the Pahlavi script with the Persian script to write the Persian language was accomplished by the Tahirid dynasty in 9th century. Jabbari et al. (2013) postulate that some examples of letter/sound mismatches exist in the orthographic system of both languages; however, those of English are more complex than Persian.

This paper was an attempt to do a semantic-spatial comparison of the orthographic systems of English and Persian using the semantic approach to determine the degree of efficacy and cost-effectiveness of the two systems in expressing meaning. In so doing, each lexeme was considered as a semantic unit. So, this study answers the following questions: 1. Which orthographic system, English or Persian, uses a smaller number of pages to express the same semantic content?, 2. Which orthographic system, English or Persian, uses a smaller number of lexemes to express the same semantic content?, 3. Which orthographic system, English or Persian, uses a smaller number of characters with no spaces to express the same semantic content?, and 4. Which orthographic system, English or Persian, uses a smaller number of text lines to express the same semantic content?

2 Methodology

2.1 Materials & Methods

This was a retrospective meta-analysis of the semantic-spatial comparison of the Persian and English orthographic systems. To do so, the following steps were taken: a) The researcher collected the Microsoft word files of all the Persian scholarly articles and abstracts translated by him into English for publication in ISI journals during the past five years, i.e., 2012-2017. The non-scholarly manuscripts were excluded from the study. b) He also collected all the corresponding Microsoft word files of the English articles and abstracts, i.e., retrospective data. c) They were classified according to the subjects of the articles that covered 16 areas as shown in Table 1. d) There were a total of 113 Persian articles, yet for more simplicity and accuracy, the researcher selected only 2 articles in each scientific field. So, there were 32 Persian and 32 corresponding English articles. The goal of selection of various fields was to increase data diversification leading to more generalizability of the findings. e) For convenience, the files of the Persian and English articles were named similarly and systematically, for example: "Diabetes English.doc" and "Diabetes Persian.doc" so that there was a nice alphabetical arrangement of the files. f) Since the researcher was concerned just with the texts of the articles, all the tables, graphs, pictures and figures were removed from both Persian and English articles. Moreover, textboxes, footnotes, and endnotes were excluded by ticking the related box in Microsoft Word file. References were also excluded to prevent data confounding. g) To remove any empty spaces in the word files, all the empty lines and empty spaces were removed by placing just one character space between any two successive sentences. h) The files of both English and Persian articles were saved using the following settings: Font type: Times New Roman, Font size: 14, Line spacing: 1.5, No space before and after lines, Paper size: A4, Margins: top: 2.5 cm, bottom: 2.5 cm, left: 2.5 cm, right: 2.5 cm. i) The word counts of all the files as variables of

the study were obtained using Microsoft word count including: pages, words, characters with no spaces, and lines. The data were imported to tables.

Table 1. Data of 16 subject areas covered by the Persian and their equivalent English articles

No.	Article field	Number of Persian articles	Number of English articles	Total
1	Biochemistry	2	2	32
2	Cardiovascular diseases	2	2	
3	Dentistry	2	2	
4	Education	2	2	
5	Health	2	2	
6	History	2	2	
7	Immunology	2	2	
8	Library sciences	2	2	
9	Literature	2	2	
10	Medical ethics	2	2	
11	Microbiology	2	2	
12	Nursing & midwifery	2	2	
13	Ophthalmology	2	2	
14	Pharmacology	2	2	
15	Physiology	2	2	
16	Psychology	2	2	

2.2 Data Collection

The required data of the Persian articles files including pages, words, characters with no spaces, and lines were obtained using Microsoft word count and imported to Table 2.

Table 2. Statistical data of 32 Persian articles files

Article No.	Persian title	Pages	Words	Characters with no spaces	Lines
1	آسیب کبدی ناشی از استرس اکسیداتیو	3	1157	4727	74
2	بررسی اثر کورکومین بر بیان Rac1-GTP, Rac1 و NOX1 در فیروز کبدی القاء شده توسط بستن مجرای صفراوی	2	775	3604	55
3	مقایسه تاثیر تزریق اپیدورال دگزامتازون و تریامسینولون در درمان کمردرد	7	2953	12297	188
4	بررسی تاثیر کاربرد پماد املا و کیسه یخ بر درد ناشی از ورود سوزن های عروقی در بیماران همودیالیزی	9	3815	15445	236
5	بررسی ارزش تشخیصی سنگ های پالپی دندان در تشخیص بیماری های ایسکمیک قلب و عروق	10	3978	17037	272
6	بررسی فراوانی فقدان دندان در مال اکلوژن های مختلف در بیماران مراجعه کننده به بخش ارتودنسی دانشکده دندانپزشکی دانشگاه علوم پزشکی شهید صدوقی یزد	1	321	1372	22
7	مقایسه کارآمدی روش تدریس مبتنی بر واژه پرداز میکروسافت ورد به کمک رایانه و سخنرانی در تدریس زبان عمومی پزشکی	7	4251	17334	293
8	مقایسه نمره پایان ترم و خود ارزیابی دانشجویان پرستاری در درس انگل شناسی پزشکی.	2	448	1873	32
9	بررسی ارتباط بین شاخص های فیزیکی کیفیت زندگی مرتبط با سلامت با اختلالات اسکلتی عضلانی در مونتاز کاران خودروسازی سایپا	8	2774	12832	196
10	استاندارد سازی پرسشنامه کیفیت زندگی بیماران دیابتی نوع دو QOLID : ترجمه و روا سازی گونه ایرانی	8	3348	13473	208
11	تشکیل سلسله صفویه	1	368	1589	23
12	جهانی شدن بیداری انسانی- اسلامی و جهانی سازی با هویت اسلام ناب محمدی(ص)	2	755	3243	50
13	آرتربت روماتوئید	9	3769	16443	246

Article No.	Persian title	Pages	Words	Characters with no spaces	Lines
14	سل	7	2879	11735	190
15	کاربرد TRIZ در مرجع نویسی الکترونیکی	9	3367	14864	278
16	حکیم سنایی غزنوی	1	210	862	15
17	عطار و تفکر تجلی	1	225	881	14
18	صور خیال با رویکرد مجاز در غزلیات سنایی	1	196	829	15
19	چالشهای اخلاقی طب اعتیاد در ایران	2	557	2422	43
20	بررسی نسبت رضایت اخلاقی و حقوقی بیماران در ایران	1	326	1574	25
21	بررسی تنوع گونه ها و الگوی مقاومت آنتی بیوتیکی انتروکوک های مقاوم به ونکوماپسین جدا شده از نمونه های بالینی	1	339	1479	24
22	اسیتوباکتر بومانی	3	1186	5884	79
23	برداشتن رحم	7	2231	10298	163
24	شایستگی اخلاقی رهبران پرستاری: با رویکرد کیفی مبتنی بر تحلیل محتوا	17	6653	28572	465
25	بررسی نقش تست سنتیگرافی مجاری اشکی در تشخیص انسداد مجاری اشکی با ریفلکس منفی	5	2053	8192	125
26	بررسی علل و نتایج تخلیه چشم در بیمارستان شهید صدوقی یزد	4	1570	6907	108
27	بررسی انگیزه و میزان رضایت مراجعه کنندگان جهت انجام حجامت در شهر یزد - 1393	5	1757	7657	119
28	بررسی میزان شیوع آترواسکلروز شریان کاروتید توسط رادیوگرافی پانورامیک در بیماران مبتلا به فشارخون بالا و عوامل مرتبط با آن در بیماران مراجعه کننده به یک کلینیک خصوصی	5	2007	8984	135
29	بررسی میزان بیان نسبی MicroRNA-133a در بیماران دریافت کننده ی وارفارین	5	2654	11715	181
30	SIRTUIN1 به عنوان یک پروتئین سیگنال دهنده در مرحله بعدی پیش شرطی سازی ایسکمی در موش ها	11	4357	19594	296
31	اثر تمرینات هوازی در مقایسه با درمانهای دارویی و روانشناختی بر افسردگی: بررسی نقش ساز و کارهای روانشناختی و فیزیولوژیک استرس و مقابله	13	5384	23158	354
32	کارآمدی رفتاردرمانی گفتاری در سلامت روانی بیماران دیابتی	9	3425	13979	244

Moreover, the required data of the English scholarly articles files as variables including pages, words, characters with no spaces, and lines were obtained using Microsoft word count and imported to Table 3.

Table 3. Statistical data of 32 English articles files

Article Code	English title	Pages	Words	Characters with no spaces	Lines
1	Hepatic injury induced by oxidative stress	4	1055	5803	92
2	Study of the effect of Curcumin on the expression of Rac1, Rac1-GTP, and NOX1 in hepatic fibrosis induced by ligation of bile duct	3	829	4517	72
3	Comparison of the Effect of Epidural Injection of Dexamethasone and Triamcinolone in treating Low Back Pain	9	2783	14769	250
4	Study of the Effect of EMLA Cream and Ice Pack on the Pain of Vascular Needles Insertion in Hemodialysis Patients	11	3385	18308	297
5	Study of the Diagnostic Value of Dental Pulp Stones in the Diagnosis of Ischemic Cardiovascular Diseases	13	3902	20872	338
6	Frequency of Hypodontia in Various Malocclusions in Patients Presenting to Orthodontics Ward of Yazd Shahid Sadoughi University of Medical Sciences	1	272	1556	27

Article Code	English title	Pages	Words	Characters with no spaces	Lines
7	A Study of the Effectiveness of Microsoft Word-Based Computer Assisted Instruction Method vs. the Traditional Lecturing Method in Teaching English for the Students of Medicine	12	3649	19382	320
8	Comparison of final exam scores and nursing students' self-assessment in medical parasitology course	2	384	2143	42
9	Survey of the Relationship Between Health-Related Physical Indices of Life Quality and Musculoskeletal Symptoms in Saipa Auto Assembly Workers	9	2729	15487	244
10	Standardization of the QOLID: Translation and Validation of the Iranian Version	10	3117	17199	279
11	Formation of Safavid dynasty	2	398	2136	33
12	Globalization, Humanistic-Islamic Awakening, and Globalization with the Pure Mohammadan Islam Nature	3	772	4387	73
13	Rheumatoid arthritis	11	3417	17952	292
14	Tuberculosis	9	2609	14301	234
15	The Use of TRIZ in Electronic Reference Services	14	3601	19965	410
16	Hakim Sanayee Qaznavi	1	253	1446	25
17	Attar and "manifestation" thought	1.1	302	1672	30
18	Imagery in Sanayee's Lyrics with a Metaphoric Approach	1	217	1215	26
19	The Ethical Challenges of Addiction Medicine in Iran	2	598	3309	54
20	Study of Proportion of Iranian Patients' Ethical and Legal Satisfaction Level	1.6	439	2612	43
21	Prevalence and antibiotic resistance of <i>Enterococci</i> species isolated from clinical sample	1	259	1501	25
22	Acinetobacter Baumannii	4	1213	6931	106
23	Hysterectomy	9	2402	13234	222
24	Ethical Competency of Nursing Leaders: A Qualitative Approach Based on Content Analysis	22	6458	36214	615
25	Study of the Role of Dacryocintigraphy of Lachrymal Ducts in Diagnosing Lachrymal Ducts with Negative Reflux	7	1852	10682	177
26	A Study of the Causes and Results of Enucleation at Yazd Shahid Sadoughi Hospital	6	1578	8623	137
27	Study of Motivation and Satisfaction Rate in Patients Presenting for Blood-letting in Yazd in 2014	6	1901	11023	174
28	Frequency Distribution of Carotid Artery Atherosclerosis and the Related Factors using Panoramic Radiography in Hypertensive Patients Presenting to a Private Clinic	8	2098	12245	201
29	Investigation of Micro RNA-133a Relative Expression in Patients Receiving Warfarin	8.2	2613	14612	241
30	SIRTUIN1 as a Signaling Protein in the Late Phase of Ischemia Preconditioning in Rats	14	4438	23574	386
31	The Effect of Aerobic Exercises Compared to Medical and Psychological Treatment on Depression: Investigation of Psycho Physiological Mechanisms	15	4564	26304	435
32	The effectiveness of dialectical behavioral therapy on psychological well-being in patients with diabetes	11	2981	17569	305

3 Results

On the basis of Microsoft word count data given in Table 3 and Table 4, the proportions of English (E.)

to Persian (P.) pages, the proportions of English to Persian words, the proportions of English to Persian characters with no spaces, and the proportions of English to Persian lines of both English and Persian articles and abstracts were estimated using professional calculator and tabulated in Table 4. The mean proportions are also calculated and presented in this table.

Table 4. Proportions of E. to P. pages, words, characters, and lines of the articles

Article code	Proportion of E. to P. pages	Proportion of E. to P. words	Proportion of E. to P. characters	Proportion of E. to P. lines
1	1.33	0.91	1.22	1.24
2	1.5	1.06	1.14	1.30
3	1.28	0.94	1.20	1.32
4	1.22	0.88	1.18	1.25
5	1.30	0.98	1.22	1.24
6	1	0.84	1.13	1.22
7	1.7	0.85	1.11	1.09
8	1	0.85	1.14	1.31
9	1.12	0.98	1.20	1.24
10	1.25	0.93	1.27	1.34
11	1.1	1.08	1.34	1.43
12	1.5	1.02	1.35	1.46
13	1.22	0.90	1.09	1.18
14	1.28	0.90	1.21	1.23
15	1.55	1.07	1.34	1.47
16	1	1.20	1.67	1.66
17	1.1	1.34	1.89	2.14
18	1	1.10	1.46	1.73
19	1	1.07	1.36	1.25
20	1.6	1.34	1.65	1.72
21	1	0.76	1.01	1.04
22	1.33	1.02	1.17	1.34
23	1.28	1.07	1.28	1.36
24	1.29	0.97	1.26	1.32
25	1.4	0.90	1.30	1.41
26	1.5	1	1.24	1.26
27	1.2	1.08	1.43	1.46
28	1.6	0.52	1.36	1.48
29	1.64	0.98	1.24	1.33
30	1.27	1.01	1.20	1.30
31	1.15	0.84	1.13	1.22
32	1.22	0.87	1.25	1.25
Mean Proportion	1.27	0.97	1.28	1.35

Other descriptive statistics such as maximum and minimum of proportions are displayed in Table 5.

Table 5. Descriptive statistics of the four variables under study

Variables	Maximum	Minimum
Proportion of E. to P. pages	1.64	1
Proportion of E. to P. words	1.34	0.52
Proportion of E. to P. characters	1.67	1.01
Proportion of E. to P. lines	2.14	1.04

4 Discussion

Our findings demonstrated interesting points about the variables of the Persian and English files of the articles and abstracts. We found that considering a given semantic content, English uses a smaller number of words to express the same content compared to Persian. As observed in Table 4, the mean proportion of English to Persian words is 0.97 suggesting that, on the average, the semantic content expressed by 1 Persian word can be expressed by 0.97 English words. This means that English can express more meaning with a smaller number of words compared to Persian. So, the English orthographic system is more economic and cost-effective with respect to word count compared to the Persian orthographic system. The fields of the articles were purposively selected diversely in a way as to include various fields to increase the accuracy of results.

However, the mean proportion of E. to P. pages was 1.27 indicating that the Persian orthographic system is more economic and cost-effective than the English one since the semantic content expressed by 1 Persian page of text requires 1.27 English pages to be expressed. Moreover, the mean proportion of E. to P. characters with no spaces was 1.28 indicating that the Persian orthographic system is more economic and cost-effective than the English one since the semantic content expressed by 1 Persian character requires 1.28 English characters to be expressed. Furthermore, the mean proportion of E. to P. lines was 1.35 indicating that the Persian orthographic system is more economic and cost-effective than the English one since the semantic content expressed by 1 Persian line of text requires 1.35 English lines to be expressed.

The cost-effectiveness of the Persian orthographic system over the English one can be attributed to at least two factors. One reason is that the Persian writing system does not represent the short vowels including /æ/, /e/, and /i/ while English does. This underrepresentation is, of course, a flaw of the Persian writing system because it causes some ambiguity in reading. For example, the Persian word 'کرم' may be read in four different ways with different meanings:

- /kerm/ meaning 'worm'
- /kæ`ræm/ meaning 'generosity'
- /ke`rem/ meaning 'cream'
- /kɔ`rɔm/ meaning 'chrome'

The second reason may be attributed to the cursive writing used by the Persian orthographic system. The Persian alphabets ligate and join to reduce space while there are no ligature letters in modern English writing system like /æ/ used in old English.

Furthermore, there are some differences among the proportions with respect to the subject of the articles. As can be observed in Table 4, in the field of microbiology, there are 1.64 pages needed for the English translation for 1 Persian page while there is the need to 1 English page for 1 Persian page in dentistry, for example. Also, the Persian writing system is most economic in the field of literature as article 17, when translated into English required 2.14 English lines for each Persian line. On the contrary, there is a one-to-one correspondence of lines required by both English and Persian articles in the field of bacteriology.

This work was the first endeavor in this type of comparison. So, there is no work with which to compare these findings. However, other studies have compared other aspects of the orthographic systems. Jabbari et al. (2013) speculated that by receiving education in L1 Persian, with its semi-opaque orthography system, the students would learn the English opaque graphemes better on the mismatches. Nonetheless, they found that both elementary and advanced learners faced difficulty learning English orthography system while they betrayed almost no positive effect from their first language. Taghipour et al. (2016) demonstrated that the Persian language contains much irregularity which is characterized by the complexity measures of L-systems which represent the words and that this irregularity has increased over the temporal evolution of the language. Furthermore, Baluch (2005) emphasized on how literacy acquisition by Persian beginner and skilled readers may be influenced by specific features of Persian orthography which affects cognitive processes involved in the reading of Persian. Finally, Mirdehghan (2011) presented a comparative analysis that can inform computational studies of Persian, Urdu, and Pashto orthography and ease the teaching of reading and writing in these languages, especially among second language learners.

5 Conclusion

Based on the findings of this study, it is concluded that the English orthographic system can express more semantic content using a smaller number of words; however, considering a given semantic content, the Persian orthographic system can express the same semantic content in less pages, smaller number of characters with no spaces, and smaller number of text lines. So, on the whole, the Persian orthographic system is more economic and cost-effective with respect to the number of pages, characters, and lines compared to the English writing system. Also, when a Persian article is translated into English, the number of English lines can be predicted by multiplying the number of Persian lines by 1.35. This would lead to the following formula used in estimating the approximate cost of Persian-to-English translation:

$$\text{Charge of Persian-to-English translation} \approx \text{number of Persian lines} \times 1.35 \times \text{charge per line}$$

5.1 Limitations of the Study

This study covered only scholarly articles and excluded papers pertaining to other academic majors. Thus, care should be taken in generalizing the findings to papers of other academic fields. Besides, the scholarly manuscripts were translated from Persian into English by only one translator that may lead to translator bias jeopardizing the external validity of the results. Again, generalization of results to new contexts should be carried out with sufficient caution.

5.2 Suggestion for Further Research

Future research can specifically focus on this topic with respect to comparison of writing systems of other languages or other features of writing systems.

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