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POSITIVE LANGUAGE TRANSFER IN MEDICAL WRITING (ESP)

The paper addresses the positive language transfer (L2 – L1) in research articles, published in bilingual medical journals (the Bulgarian – English language pair). A corpus-based analysis of scientific writing conventions in terms of sentence density, variation in structure, lexical and grammatical choice, etc. was conducted to establish the linguistic interference and the pragmatic knowledge of medical discourse norms by Bulgarian scientists as non-native authors, publishing in English. The comparison of original and translated texts revealed the effect of L2 writing conventions (English) and the application of these acquired "scientific formulae" in L1 writing of the Bulgarian researchers as ready-made models with no sacrifice in meaning and content.

Keywords: *scientific writing, research articles, medical language, parallel texts*

Introduction

Nowadays scientific collaboration and communication is most effectively marketed in English and many researchers strategically plan to publish their results in internationally recognized journals rather than in professional monolingual national editions. Thus, language transfer (both positive and negative) becomes predetermined as a bilingual status of the medical society is assumed to be the norm in the world of academia. Negative transfer occurs when differences between the two languages' structures lead to systematic errors in the learning of the second language, while positive transfer refers to areas of similarity between the two languages.[1]

Researchers are concerned with maintaining objectivity and presenting results in a clear, concise and effective manner, combined with framing their message in compliance with scientific style conventions. Further on, for science communication to be socially acceptable, the holistic approach should be followed. While these goals are already established in the academic community, they are not easily attainable by scientists, whose first language is not English.

This paper establishes structural parallels and highlights the effect of positive language transfer in the language pair English – Bulgarian (L2 → L1) by analyzing professional texts in English for medical purposes, published in bilingual journals. We hypothesized that the format of the research article in English might serve as a scaffold for the achievement of clear, concise and readable papers, written by non-native researchers in uniformity with the established scientific conventions. The comparison of the lexical choice, the syntactic structures and the arrangement of the research article components in the two languages (i.e. structural matching)

[1] https://dictionary.apa.org/interlanguage

as discourse-specific features of medical communication may be attributed to the 'noticing hypothesis' as a strategy in gaining second language fluency (Schmidt 2010). The above-mentioned hypothesis is oriented towards improving accuracy in language learning (not fluency) and suggests that language development is dependent on noticing limitations and fossilized errors in foreign language acquisition and production.

In medical science linguistic interference and language transfer may range from lexical borrowings (loan words, neologisms, Latin and Greek affixes, etc.), subsequent integration of new word forms or morphemes (Haspelmath 2009: 35), pattern borrowings (Sakel 2007: 23) to loan-based hybrids that are morphologically integrated from the donor language (English) into the recipient language in the absence of control over language norms.

Methodology

The term "parallel" in Computational linguistics is used for an original text (the source text) and its translation. A translation equivalent is a corresponding word or expression in another language[2]. Thus, parallel texts in different languages are considered translational equivalents (Cysouw, Wälchli, 2007). The present lexical analysis is based on research articles, published bilingually in Bulgarian medical journals (Appendix 1).

A collection of 200 medical research articles of English researchers, extracted from the *BioMed Central* journal (original open access articles) was used as a reference corpus for the observation of scientific style conventions (Bell 1995, Huth 1999, Zeiger 2000, Swales 2004), and as a resource for exploring the structural and linguistic interference in English for professional purposes (McEnery, Xiao 2011). The language content of the different sections of written texts was compared in terms of syntactic organization and lexical choice in the same document. The main functions of the lexical software tool Sketch engine were used to extract key vocabulary and phraseology from medical research articles, and to compare these bilingual texts in terms of concordance lines, wordlists and specific use of keywords. Two self-compiled corpora were built from Bulgarian open source bilingual electronic journals (Appendix 1) and original research, published in English in *BioMed Central Journal*[3].

Target text conventions are described as features of textual genres (Nielsen 2010: 24). Specific types of texts are grouped together by applying various criteria and share similar characteristics. From a methodological perspective foreign language acquisition cannot be attributed to one single approach (Funk 2012: 6). Parallel texts are useful in the instruction process for the purposes of noticing and memorizing typical lexical structures and vocabulary (Vermes 2010: 89). Therefore, our aim is to

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[2] Https://glossary.Sil.Org/term/translational-equivalence
[3] BMC Medicine https://bmcmedicine.biomedcentral.com/ (accessed June 16, 2017)

highlight the potential of the corpus-based approach in identifying how to produce a particular text type (a research article) in compliance with the style patterns of the scientific register.

Results

Many linguistic services and translation tools are available that may help researchers with lexical information besides the passive mode of printed resources (Fig. 1). One recent exception is for example the Perseus project for reading Latin and Ancient Greek texts based on lexical data and options for the most likely translation option.

Контингент и методи	Material and method
Изследвани са двама болни (мъже на 53 и 56 г.) с исхемичен мозъчен инсулт в басейна на средна мозъчна артерия (СМА), възникнал при наличие на подвижен тромб във ВСА. Тромбът е диагностициран с ЦДС и потвърден с КТА.	We examined two patients (males 53 and 56-year-old) with ischemic stroke in the middle cerebral artery (MCA) territory detected by carotid duplex sonography and confirmed by CTA. duplex sonography and confirmed by CT.
Резултати	**Results**
Клиничен случай 1. Мъж на 56 години, постъпва в болницата по повод слабост в десните крайници и затруднен говор с давност 1 ден.	Clinical case 1. 56-year-old male presented at the hospital with right-sided weakness and at the hospital with right-sided weakness and inability to speak for 1 day.

Fig. 1. Extract from a research article, Neurosonology and Cerebral Hemodynamics

In such specialized contexts, the research article sections are pre-established and fixed as translation equivalents (Table 1) in compliance with the Introduction – Materials – Results – Discussion (IMRD) format, introduced by Gastel and Day (2006). The Bulgarian correspondences were extracted from the following electronic journals: *Varna Medical Forum, Neurosonology and Cerebral Hemodynamics, Obstetrics and Gynecology,* and *Science Pharmacology*.

Table 1. Meta terms in bilingual medical research articles as per the IMRD format

Summary/Abstract and key words	Резюме и ключови думи
Introduction (literature review, objective, hypothesis)	Въведение (състояние на проблема, цел, хипотеза)
Methods & Materials (detailed procedure)	Материал и методи/Контингент и методи (подробно описание на процедурата)
Results (data and specific findings)	Резултати (статистически данни и резултати)
Discussion and conclusions (significance and practical application)	Обсъждане/Дискусия и заключение (значение и приложение на резултати-те)
References	Книгопис/Литература/Библиография

The investigation of reference corpora provides the combinatory options and the collocations of the medical domain in specific contexts, the appropriate terminology, as well as the syntactic structures to produce a relevant translation text in English. By examining corresponding sentence pairs, we determine that some of the terminology is not included in Bulgarian paper-based[4] and online dictionaries[5] (*сигнификантен/significant*). The possible collocations become evident from the reference corpus search in terms of modifiers (*statistically/highly/particularly/clinically*), nouns, verbs, etc. (Fig. 2).

Figure 2. The Sketch engine search for the combinability of key word significant.

The search for the Bulgarian term reveals only direct translation options as linguistic equivalents instead of the dictionary entries: adj. *significant – значим, значителен, съществен, значещ* (Fig. 3).

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⁴ Тълковен речник на българския език: http://talkoven.onlinerechnik.com/
⁵ Речник на българския език: http://ibl.bas.bg/rbe/lang/

1A. The effect was *significant* from the first year.	В. Ефектът е *сигнификантен* още от първата година.
2A. There was no *significant* difference in effect between sildenafil doses.	В. Не се отчита *сигнификантна* разлика в ефекта между различните дози силденафил.
3A. *There is no significant difference* between the anthropometric parameters and the accompanying cardiovascular and metabolic diseases of the two groups of patients.	В. *Не се наблюдава съществена разлика* между антропометричните параметри и спектъра на съпътстващите сърдечносъдови и метаболитни заболявания между двете групи пациенти.

Figure 3. Concordances with key word significant,
English-Bulgarian medical corpus

The corpus samples illustrate that the translational equivalents correspond to the terms, terminological and phraseological units that are specific for the medical language in the reference corpus. In medical texts the recurrent word combinations (domain-specific phraseology) that were extracted from the parallel samples showed the Bulgarian equivalents, and their combinatorial patterns (Fig. 4).

1A. The system is based on an optical *encoder technology*, enabling the calibration of the *ultrasound probe* and the *three-dimensional reconstruction* of images.	В. Системата се основава на оптическа *енкодерна технология*, даваща възможност за фокусиране на *ултразвуковата емисия* и *тридеменсионалната реконструкция* на образите.
2A. This system is intended for use as an *ultrasound imaging*, a *conventional neuronavigation* as an integrated ultrasound-based system, utilizing the advantages of both techniques.	В. Този тип невронавигационни системи се използват за *ултразвуково невроизобразяване*, *конвенционална невронавигация*, която съчетава качествата и на двете технологии.

Figure 4. Translation of terminological units in bilingual concordance samples,
Neurosonology and Cerebral Hemodynamics

Further to the above-mentioned benefits of identifying appropriate terminological units and their collocational potential comes the acquisition of the writing style conventions and their usage in the translated text of the same genre. Not only could the appropriate words be identified by authors who are trying to find an equivalent or investigate specific usage, but also the entire manuscript should be written following the conventions of the research article genre (resembling the style) by sorting the concordance lines in the reference corpus to the right or left. For example, reference books on good writing style in English highlight the preference of active voice as an alternative to the omnipresent passive constructions in Bulgarian manuscripts (Fig. 5).

A. **Abstract**

In the patients with a normal coagulation status and preserved haemodynamics, a high epidural block with superficial general inhalation or venous anaesthesia and small dosages of relaxant with endotracheal intubation *were applied*. Several parameters … *were analyzed*. PT shortening, platelet count reduction … *were established*. These changes *were predominantly outlined among* **…**

B. **Резюме**

При болните с нормален коагулационен статус и съхранена хемодинамика *са използвани* висок епидурален блок с повърхностна обща инхалаторна или венозна анестезия и малки дози релаксант с ендотрахеална интубация. *Анали-зирани са* няколко показателя …. *Установяват се* скъсяване на РТ, намаляване на броя на тромбоцитите …. Тези изменения *са изразени предимно при* …

Figure 5. Passive voice constructions in bilingual abstracts, Varna Medical Forum

Hence, the consideration that the passive is preferential only when describing processes, reporting and announcing decisions in academic writing is not adhered to by Bulgarian researchers. The observation of such indicative English patterns may reduce the inconsistencies in grammatical control concerning accuracy using articles, quantifiers, prepositions, complementation patterns, tenses, conditional forms, passive structures, impersonal forms, participles, and other stylistic differences that are observed on lexical and syntactic level (e.g use of keywords, specific verbs, quantifiers, linking words, etc.) in bilingual publications.

The samples above (Figures 4 and 5) show that trials and results are not rendered in English with ease. Non-native researchers are faced with their own literal or direct translation and intuition to form complex sentences and choose from word order options. Possible equivalents could be verified in extended contexts when searching for the most concise yet appropriate translation (Fig. 6).

> ➢ лекарствени продукти, за лечение на симптоми или заболявания, които не са включени в одобрената информация на продукта
> ➢ лекарствени продукти за показания, които не са официално одобрени
> ➢ лекарства, прилагани извън одобрените показания
> ➢ неодобрени лекарствени продукти
> ➢ лекарства off-label

Figure 6. Translation options for emerging concepts (off-label medication),
Science Pharmacology

The strictly formal, concise and precise style of the text type predetermines word choice, which is not arbitrary but rather indicative for each section of the research paper (Tables 2, 3).

Table 2. Lexical indicators for Results, IMRD format

Results
➢ table, figure, test, analysis
➢ show, find, observe, have, present, summarize, demonstrate, reveal, yield, perform, compute, determine, examine, test, analyze
➢ compared to/with, relative to, higher/lower than, less/fewer, change, rise, increase/decrease, relate, reduction
➢ relationship, correlation, association, percentage, proportion, rate, ratio, prevalence, incidence
➢ in addition, additionally, moreover, furthermore, however, in/by contrast, except for
➢ as expected interestingly, on the contrary

Table 3. Lexical indicators for Discussion, IMRD format

Discussion
➢ indicate, reveal, demonstrate, hypothesize, suggest, imply, propose, recommend, support
➢ findings, results, reasons, data, follow-up, explanations, mechanisms, evidence
➢ interestingly, of interest, surprisingly, contrary to, in contrast to, unexpected
➢ in/consistent with, in agreement with, in line with, in accordance with, comparable to, in comparison to, similar to
➢ confirm, evidence, insights, highlight, add, extend, apply, contribute to, require, need
➢ therefore, however, further, future, more, additional, whether, also, another, finally, due to, because, be attributed to, possible, perhaps, potential, alternatively, on the other hand
➢ may, could, can, should
➢ strengths, advantage, useful, new, novel, the first, limitations, limit, bias, unable to, weakness

Table 4. Lexical indicators for Conclusions, IMRD format

Conclusions
➤ recommend, imply, show, demonstrate, suggest, indicate, speculate, affect, effect, explain, lead to, influence, cause
➤ it can be concluded that
➤ given the above, as described
➤ further, future, additional

Orthographic control in terms of accuracy in punctuation, capitalization, measurements, units, symbols, abbreviations and acronyms is verified with the help of parallel corpus texts (Fig.7).

A. Using a *WHO* criteria [1997] the patients are classified according their *BMI* in the following groups: normal weight (BMI 18.5–24.9); overweight (BMI> 25); obesity (BMI >30), extreme obesity (BMI> 40 – obesity IV grade by *Bray*).	B. Въз основа на *БМИ* по критерии, приети от *Световната здравна организация* [1997], пациентите са класифицирани като такива с нормално тегло при БМИ от 18.5–24.9; с наднормено тегло при БМИ от > 25; със затлъстяване при БМИ >30. Екстремно затлъстяване се приема при БМИ > 40 (затлъстяване IV по *Bray*).
A. In our study we used a Philips Gemini TF (Time Of Flight) PET/CT, 16 slice CT, LYSO crystal (PET) with a brain PET/CT – low dose CT/3D-mode PET, single frame 10 min/frame protocol. Attenuation correction: Low dose CT. Reconstruction: Iterrative, Brain CTAC. Injected activity: 185mBq (adults). Fixation time: ~60 min. Analysis: visual assessment, MIP, quantification with NeuroQ (v.3.0).	B. При изследване на нашите пациенти използвахме: апарат Philips Gemini TF (Time Of Flight) PET/CT, 16 slice CT, LYSO crystal (PET); протокол: Brain PET/CT – Low dose CT/3Dmode PET, single frame 10 min/frame; корекция на атенюацията: Low dose CT; реконструкция: Iterrative, Brain CTAC; инжектирана активност: 185mBq (възрастни); време на фиксация: ~60мин; обработка: визуална оценка, MIP, квантификация с програма NeuroQ (v.3.0).

Figure 7. Abbreviation, capitalization and punctuation equivalence, Neurosonology and Cerebral Hemodynamics

Phraseological information may be corpus attested for positioning and appropriateness. Some frequent phrases were extracted from the Conclusions section of the BMC reference corpus such as *we conclude that/we have identified/we found/ this study provides evidence/we confirmed/the present study represents/our findings suggest that/these findings confirm/in conclusion* (Fig. 8).

1. *In conclusion*, we observed significant inverse correlations between dietary magnesium intake and the risk of stroke, heart failure, diabetes, and all-cause mortality;

2. In contrast, *we found* no correlation between dietary magnesium intake and the risk of coronary heart disease or total cardiovascular disease.

3. *Our findings underscore* the notion that increasing the consumption of magnesium-rich foods may be beneficial to overall health.

4. *The study confirms* the role of scapular fractures as a marker of the severity of the chest trauma (based on the number of associated thoracic injuries) but doesn't present scapular fractures as an indicator of high mortality in blunt chest trauma patients.

Figure 8. Key phrases in Conclusions, reference corpus BMC Medicine

Discourse markers and the broad range of linking words used as cohesion devices in academic writing such as cause-effect and temporal link words and expressions as described by Halliday and Hasan (2014) are non-typical for the Bulgarian medical writers. Thus, the indicative markers for addition (*moreover, furthermore, correspondingly, due to,* etc.), contrast (*although, however, in contrast, except for, alternatively, conversely, on the other hand, instead, despite/in spite of, while,* etc.), purpose (*since, because, respectively*, etc.), and sequence (*thus, hence, therefore, first, second, next,* etc.) are of limited or zero occurrence in Bulgarian publications (Fig. 9).

| A. Endovascular therapy is extremely rare in patients with prior carotid endarterectomy, *due to* a very high risk of embolization during the procedure [1, 2]. | B. Ендоваскуларна терапия се прилага изключително рядко при болни с предхождаща каротидна ендартеректомия, *поради* много висок риск от емболизация перипроцедурно [1, 2]. |

Figure 9. Occasional use of cohesive devices,
Neurosonology and Cerebral Hemodynamics

Syntactic preferences such as predicative constructions, modality options, impersonal forms, and participles were also subject to the cross-linguistic reference check. Notable is the fact that stylistic deficiencies such as scientific jargon and verbosity were overcome, therefore the sample sentences were direct, consistent in text organization, reading level, and academic style (Fig. 10).

Introduction	
A. The pathophysiology of all kinds of syncope includes a rapid decrease in blood pressure (BP), which leads to global cerebral hypoperfusion.	В. В основата на всички видове синкоп стои рязкото понижение на артериалното налягане (АН), водещо до преходна общомозъчна хипоперфузия.
A. The sudden interruption of cerebral blood flow, even for a period as short as 6 to 8 sec, is enough to cause full loss of consciousness.	В. Внезапното преустановяване на мозъчния кръвоток за период от 6 до 8 s е достатъчно да предизвика пълна загуба на съзнание.
A. Experience has shown that a fall in BP during tilt-table testing to 60 mmHg or lower provokes a syncopal reaction [16].	В. Натрупаният опит при провеждане на тест с наклон на тялото показва, че спад на систолното АН до 60 mm Hg или по-ниско е свързано с провокация на синкоп [16].

Figure 10. Consistency in parallel texts,
Neurosonology and Cerebral Hemodynamics

Discussion

Scientific publications by Bulgarian authors, which are representative of the research article genre were systematically studied to compare lexical choices that served as indicators of the research article genre in the medical domain.

First, we demonstrated that there are clear structural parallels in terms of IMRD format between original papers, written and published by Bulgarian researchers in English (or bilingually) and research articles, written by native speakers of English. The discourse-specific features of medical texts such as syntactic organization and lexical choice were also verified for translational equivalence with the help of lexical software programmes. The degree of correspondence concerning the use of terminological and phraseological units as well as specific nouns, verbs, adjectives and adverbs as lexical indicators that are indicative of the medical research article genre is relatively high. One established difference was the use of passive constructions in both corpora. In BMC research articles such grammatical structures were dominant only when describing processes, reporting and announcing decisions, while in the Bulgarian corpus the passive constructions were omnipresent. and Another difference is the frequency of hedges in the corpora. Modal verbs and adverbs occur quite often in Bulgarian manuscripts and their variety is limited. There is no use of strong negative verbs and adjectives such as *limited, weak, fail, unable to*, etc. Discourse markers are the next non-typical lexical means in the academic writing of the Bulgarian medical writers.

Therefore, stylistic differences were observed on lexical and syntactic level (vocabulary choice, use of quantifiers, linking words, hedges) in bilingual publica-

tions. Concerning the use of abbreviation, capitalization and punctuation there were no significant differences.

Notable is the fact that verbosity was overcome in the Bulgarian corpus (in terms of impersonal structures, fillers, tautology, subjective judgements) and the resulting English sentences were direct, precise and consistent in structure. Hence, we suggest that positive language interference (English – Bulgarian) brings to a change of the established norms in the Bulgarian scientific register. Our observations demonstrated that pragmatic knowledge was extensively accumulated by Bulgarian researchers concerning international genre conventions in relation to vocabulary, grammar, text type structure, sentence length, conciseness, clarity of expression, and lexical density. Thus, due to L2 influence (English), 'scientific formulae' are being transferred to L1 scientific writing (Bulgarian) for clarity of expression.

The focus of the present study was on the structural model of the research article and the lexical and grammatical characteristics of bilingual parallel texts. This comparison of bilingual texts is of highly pragmatic value and could be replicated by means of any lexical analysis software tool for achieving readability, coherence and emphasis as technical requirements in the writing process. The consistent organization of the scientific information by means of established linguistic patterns is indicative of the text type (research article).

The corpus-based analysis demonstrates the influence of already established conventions in the community of the international researchers that change the stylistic norms of a national language (e.g. markers for focusing the attention on the merits of the research and characteristic lexical units). High frequency grammar forms (active voice forms, linking words, specific verbs and phrases) are gradually adopted. Verbs denoting research activities (*assess, demonstrate, estimate, consider, indicate, identify, obtain*) and statistical significance (*conclude, find, indicate, reveal, emphasize, support, occur, assess, measure, determine, confirm*) also play a major role as indicators of importance in scientific discourse.

In conclusion, the level of compliance with the scientific conventions of the international academic community and knowledge of the formal markers and mechanisms for modeling the scientific text as main stylistic and linguistic requirements on the technical level proved to be high. Bulgarian researchers aimed at readable, concise papers, and managed to achieve consistency by repetition of scientific patterns. Linguistic transfer from the target language into the source language resulted from the equivalence-seeking strategies of the bilingual medical community (Bulgarian publications). The parallel structuring of the research article and the use of indicative vocabulary and structures added to the quality of the text production for publication purposes.

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APPENDIX 1. ORIGINAL RESEARCH ARTICLES – BULGARIAN MEDICAL CORPUS

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