The master dashboard screen on a highly-technical computer: The metaphorical portrayal of the immune system in English and Serbian popular medical discourse

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Abstract

Due to the increased interest in immunity and the immune system, mostly triggered by the recent Covid-19 pandemic, there has been a proliferation of online texts dealing with these concepts in an easily accessible manner. In this paper we compare the metaphorical portrayals of the immune system in 84 English and Serbian online magazine articles and blog posts, mostly published in the period 2020-2023, and investigate how such metaphorical representations facilitate the explanation of this abstract concept to non-experts and respond to new communicative contexts through the processes of recontextualization and reformulation. Specifically, our research aims are: 1) to identify the source domains employed in English and Serbian online popular medicine texts to conceptualize the various aspects of the immune system; 2) to investigate the similarities and differences between the two languages in this regard; and 3) to establish the functions that metaphor performs in popular medical discourse on the immune system in English and Serbian. The findings reveal a considerable overlap between English and Serbian both on conceptual and linguistic planes and in the use of metaphor in linking different audiences and discourses while popular medicine texts in English exhibit a greater richness in metaphor and a more vivid metaphoric imagery belonging to distinct source domains. Our paper also contributes to the explorations of the various functions of metaphor in popular medical discourse.

Keywords: Popular medical discourse, metaphor, immune system, reformulation, recontextualization, English, Serbian.

Resumen

La pantalla del panel de control principal en un ordenador altamente técnico: La representación metafórica del sistema inmunológico en el discurso médico popular en inglés y serbio

Debido al creciente interés por la inmunidad y el sistema inmunitario, desencadenado sobre todo por la reciente pandemia de Covid-19, se ha producido una proliferación de textos en línea que tratan estos conceptos de forma fácilmente accesible. En este trabajo comparamos las representaciones metafóricas del sistema inmunitario en 84 artículos de revistas y blogs online en inglés y serbio, publicados en su mayoría en el periodo 2020-2023, e investigamos cómo dichas representaciones metafóricas facilitan la explicación de este concepto abstracto a los no expertos y responden a nuevos contextos comunicativos a través de los procesos de recontextualización y reformulación. En concreto, nuestros objetivos de investigación son: 1) identificar los dominios fuente empleados en textos de medicina popular en línea en inglés y serbio para conceptualizar los distintos aspectos del sistema inmunitario; 2) investigar las similitudes y diferencias entre ambas lenguas a este respecto; y 3) establecer las funciones que desempeña la metáfora en el discurso médico popular sobre el sistema inmunitario en inglés y serbio. Los resultados revelan un considerable solapamiento entre el inglés y el serbio, tanto en el plano conceptual y lingüístico como en el uso de la metáfora para vincular diferentes audiencias y discursos, mientras que los textos de medicina popular en inglés muestran una mayor riqueza en metáforas y una imaginería metafórica más vívida perteneciente a distintos dominios distintos dominios de origen. Nuestro artículo también contribuye a la exploración de las diversas funciones de la metáfora en el discurso médico popular.

Palabras clave: Discurso médico popular, metáfora, sistema inmunitario, reformulación, recontextualización, inglés, serbio.

1. Introduction

Popular medical discourse refers to both oral and written communication of health and medical issues aimed at a non-specialist audience and in its written form encompasses texts which "deal with specialized topics in a language close to general discourse and to the layman's everyday experience" (Gotti, 2014, p. 17), which is in line with the wider notion of popular scientific discourse. The main role of this popularization process is "usually identified with the conveyance of specialist knowledge for information purposes" (Gotti, 2014, p. 16), while popularization itself is defined as a social process

which consists of "a large class of discursive–semiotic practices, involving many types of mass media" such as the Internet "and other genres of communicative events, aiming to communicate lay versions of scientific knowledge, as well as opinions and ideologies of scholars, among the public at large" (Calsamiglia & Van Dijk, 2004, p. 371). Any popularization process typically implies "the presence of a recognized expert, a recognized non-expert, and a type of information which is specialized but presented in a way that is assumed to be understood by a lay public" (Anesa & Fage-Butler, 2015, p. 110). Since digital genres play an important role in enabling the public communication of science and allow for a range of interaction possibilities (one-to-one and one-to-many, see Anesa & Fage-Butler, 2015) and other affordances such as wide reach, it is very important to understand the process of scientific knowledge dissemination, mediation, and construction in these media (Luzón, 2013) (see also Bernad-Mechó & Valeiras-Jurado, 2023; Dontcheva-Navratilova, 2023; Maier & Engberg, 2023; Florek & Hendges, 2023; Silaški & Đurović, 2024). This need has become compelling as new media "collapse multiple audiences into single contexts" (Marwick & Boyd, 2011, p. 114), bringing commonly distinct audiences together.

Since the onset of the Covid-19 pandemic, immunity has emerged as one of the widely debated but essentially highly specialized topics in electronic mainstream and social media. The pressing need for conveying scientific knowledge about how to keep one's immune system healthy to the vast audiences has led to the proliferation of articles in popular science journals, online newspapers as well as of blogs, YouTube videos, and other existing and still emerging digital genres in which complex medical concepts have been transformed into more comprehensible and attractive ones. This study investigates popular medical discourse, which focuses on communicating research findings, medical information and health-related concepts to the lay audience by way of online magazine articles and blog posts "through which people access health information and then form their impressions and understandings of health issues" (Brookes, 2023, p. 215). Popular medical information transmitted through digital genres is associated with both explaining medical issues and promoting dietary supplements, medications, healthy lifestyles, in a manner similar to advertising genres, whose aim is not only to inform about and popularize scientific medical concepts and discoveries, but also to remind the audience of the benefits of the recommended products as well as to persuade its members to buy them.

Therefore, popularization of scientific knowledge is aimed at both explaining complex issues *and* persuading the audience either to accept that a particular scientific viewpoint is based on evidence and facts or, by subtly appealing to their needs and even fear, change their health attitudes and eventually make them buy the recommended product. These purposes of popularization are at times intertwined and mirror each other, which is why it is difficult to clearly delineate them.

In this practice of adapting and relaying messages to the lay public, scientific experts and popular science text writers gladly rely on metaphor as one of the fundamental tools for bridging the gap between the conceptualization of medical concepts among experts and the lay public's perception of these concepts, thanks to the metaphor's power to make less familiar domains understandable by structuring them in terms of more familiar domains.

Therefore, in this paper we aim:

1) to identify the source domains employed in English and Serbian online popular medicine texts to conceptualize the various aspects of the immune system;
2) to investigate the similarities and differences between the two languages in source domains and metaphors used to popularize the knowledge about the immune system;
3) to establish the functions metaphor performs in popular medical discourse on the immune system in English and Serbian.

2. Popular scientific discourse and metaphor

Science popularization, in which rigorous scientific knowledge is simplified for the benefit of the lay readership, inevitably entails a tripartite link between scientists, journalists writing popular science texts, and the general public. They take part in two main processes involved in transferring knowledge across different communication settings – *recontextualization* and *reformulation* (Boginskaya, 2020; Calsamiglia & Van Dijk, 2004; Ciapuscio, 2003; Gotti, 2014). According to Ciapuscio (2003), the production of a text which popularizes science involves "recontextualizing and reformulating one's source in such a way that it is comprehensible and relevant for a different kind of addressee, in a discursive context that, though predictable, differs from that of the original source" (p. 210). Recontextualization thus

refers to the "scientific knowledge and discourse that is originally produced in specialized contexts to which the lay public has limited access" and putting it in a different context which is "now in the realm of the public discourses of the mass media or other institutions" (Calsamiglia & Van Dijk, 2004, pp. 370-371) – i.e., it entails a shift from the expert context to the lay context. In reformulation, there is no change in the context of the message, but there is remodeling of language to suit a new target audience (Gotti, 2014).

Metaphor plays a prominent role in both recontextualization and reformulation processes – it serves to establish the links between the two domains of knowledge and, according to Calsamiglia and Van Dijk (2004), it is one of the types of a discursive activity of explanation. This role of metaphor is due to its ability to associate highly specialized concepts with "relatively concrete, well-structured, familiar and accessible areas of experience" (Semino, 2008, p. 153). This comparison with everyday knowledge and "the recourse to concretization is meant to facilitate comprehension of abstract information and distant situations" (Gotti, 2014, p. 23). The explanatory uses of metaphor in the media frequently overlap with its ""promotional" or even "sensationalising" functions" (Breeze, 2017, p. 71) whose aim is to attract the attention of the audience or engage the reader.

Explanatory, informative and persuasive functions of metaphor particularly come to the fore in popular medical and health discourse. In a number of studies so far (Anesa & Fage-Butler, 2015; Balteiro, 2017; Boginskaya, 2022; Đurović & Silaški, 2024; Hidalgo Downing & Kraljevic Mujic, 2009; Navarro i Ferrando, 2021; Silaški, 2023; Williams Camus, 2009), scholars have pinpointed different roles that metaphor serves in popular medical discourse depending on the target audience as well as on the intended communicative purposes. Thus, Anesa and Fage-Butler (2015) analyze metaphor as one of the explanatory tools in what they call "oblique" or indirect popularization of biomedical information on an online health forum; Balteiro (2017) shows how metaphor used in communicating Ebola to the lay readers reveals not only its function in the reformulation and explanation of expert knowledge, but also in influencing the readers' perception of the virus; Đurović & Silaški (2024) investigate the explanatory and persuasive functions of metaphor in the Serbian pro-vaccination discourse; by focusing on the difference between those conventional and what the authors consider "culturally adapted metaphors", which display different degrees of creativity, Hidalgo Downing and Kraljevic Mujic (2009) analyze how the choices of particular metaphors

are linked to specific communicative functions in the genre of abstracts on immunology in articles from a popular science magazine; finally, by exploring metaphors as a strategic communication instrument in the Serbian pandemic discourse, Silaški (2023) underlines the dimension of metaphor creativity when it comes to pro-vaccine efforts by health professionals, pointing out that they tend to deploy their own sets of metaphorical imagery they believe are the most apt for simplifying and popularizing scientific medical knowledge.

All the above studies point to metaphor as one of the main linguistic and conceptual tools for popularizing scientific texts.

3. Data and method

Our small-scale analysis is based on two purpose-built datasets containing online texts on the immune system in English and Serbian, respectively. The texts represent online resources open to the general audience and were mostly published in the period 2020-2023,[1] when the Covid-19 pandemic accelerated publishing science news about immunity as well as recommendations about how to maintain and strengthen it. The selected texts belong to popular medical discourse and comprise two major genres: blog posts and online magazine articles (see Table 1).

English dataset			Serbian dataset		
Genre	**No. of texts**	**No. of words**	**Genre**	**No. of texts**	**No. of words**
Blog post	30	28,394	Blog post	25	28,052
Magazine article	14	12,400	Magazine article	15	13,375
TOTAL	**44**	**40,794**	**TOTAL**	**40**	**41,427**

Table 1. Description of the English and Serbian datasets of popular medicine texts.

The blog posts, "open dynamic spaces" for science communication "where both experts and interested public can participate" (Luzón, 2013, p. 430), are in our data authored by individual specialists in the field of medicine and health, science journalists, groups of researchers or medical experts affiliated with medical institutions – hospitals and clinics – running collective blogs and writing about various health related topics aimed at general public. Some blog posts are written to share the latest discoveries and research findings about the immune system and represent what Luzón calls "science blogs"

(2013, p. 428). Other blog posts exhibit rather promotional aspects as they focus more on offering health and nutrition advice on how to strengthen one's immunity, or advertising products intended for such purposes. Magazine articles in the two datasets take a variety of forms: popular science articles, educational materials for students, interviews with medical experts as well as promotional materials (including health and nutrition tips, food recipes, product advertisements).

The data were collected by means of an Internet search performed in the following way: the key expressions *imuni sistem*/'immune system' were combined with metaphor markers *zamislite*/'imagine', 'think of', *zamislimo*/'let's imagine', and *kao*, *kao da*/'like', 'as if', "signals of potential cross-domain mappings" (Steen et al., 2010, pp. 40-41). As metaphors found in authentic discourse are frequently accompanied by words and phrases such as 'imagine', 'like', 'sort of', 'metaphorically speaking', and other signalling (Goatly, 1997) or tuning (Cameron & Deignan, 2003) devices (see Tay, 2013, p. 150), this data collection procedure narrowed down our search and targeted only those texts in which it was expected and "announced" that the immune system would be metaphorically described. Therefore, the texts include not only examples of metaphors but also other figurative comparisons such as similes and analogies as "forms of directly expressed metaphorical comparison" or "direct metaphors" (Steen et al., 2010, pp. 57-58). The words such as *zamislite*/'imagine', 'think of', *zamislimo*/'let's imagine' and other direct metaphor markers mentioned above serve both as a vehicle of announcing the popular definition and reformulation of the immune system concept and of directing the addresses' attention to a specific depiction of that concept.

Therefore, the immediate combining of the key expressions with the given metaphor markers enabled us to extract topically relevant texts for the analysis (totaling 82,221 words in both datasets). The obtained texts were first carefully read and then manually analyzed to determine those lexical units which would enable the identification of the source domains and metaphors used to depict the most important aspects of the immune system. Although our identification of source domains was informed by MSDIP (the Metaphorical Source Domain Identification Procedure) (Reijnierse & Burgers, 2023), an addition to MIPVU (Steen et al., 2010), it did not presuppose consulting the dictionaries for each lexical unit, but rather entailed focusing on words or phrases and even longer stretches of text used metaphorically for the purposes of structuring particular aspects of the immune system. If it was possible to determine that the context of the

metaphor contained indications for a particular source domain, in the last step we identified a source domain (see Reijnierse & Burgers, 2023, pp. 297-298). This process was also informed by the procedure for identifying linguistic metaphors in Serbian (Bogetić et al., 2019).

4. Findings

Our analysis offered evidence of a number of source domains which were used for the metaphorical portrayal of the main aspects of the immune system in English and Serbian popular medicine texts (see Table 2). The conceptualization of the immune system is organized around its *structure* and its *functioning*; the *structure* refers to two related aspects: a) the *components* of the immune system and b) their *interconnectedness* and *interplay*, whereas the *functioning* encompasses the following two aspects: c) the *protection* of the organism and d) the *maintenance* of the immune system. Although for the sake of the analysis the reported findings are systematized around these four aspects of the target domain, their clear delineation was not entirely possible. Thus, the *components,* the *interplay* and the *protection* aspects, in terms of the source domains they are accounted for, often relate to one another or even overlap.[2]

Aspect of the IMMUNE SYSTEM		Source domain – ENGLISH	Source domain – SERBIAN
STRUCTURE	*components*	COMBAT	COMBAT
		BUILDING	BUILDING
		SPORT	
			MAP
		SUPERNATURAL BEINGS	
	interconnectedness	ORCHESTRA	ORCHESTRA
		TEAM	TEAM
		NETWORK	NETWORK
		MECHANISM	MECHANISM
		SUPERNATURAL BEINGS	
FUNCTIONING	*protection*	COMBAT	COMBAT
		BUILDING	BUILDING
		PERSON	PERSON
		COMPUTER	COMPUTER
		ORCHESTRA	ORCHESTRA
		ENGINE	ENGINE
		SUPERNATURAL BEINGS	
	maintenance	ENGINE	ENGINE
		CULTIVATION	
		BUILDING	

Table 2. The main source domains characterizing the IMMUNE SYSTEM aspects in popular medicine texts in English and Serbian.

4.1. The metaphorization of the immune system *structure*

The immune system is not monolithic but consists of different cells, tissues and organs engaged in the protection against harmful threats. The *components* aspect thus characterizes the main parts of the immune system such as B-cells which create antibodies, T-cells which remove infected cells, tissues like bone marrow and lymphoid tissues as well as organs such as spleen and thymus. The findings reveal that the *components* aspect of the immune system is associated with the conventional COMBAT and BUILDING source domains in both English and Serbian, which allows the lay readership to establish a link between this concept and the more concrete and better delineated areas of experience.

Different specialized cells, tissues and organs that the immune system is composed of are explained by comparing them to various specialized military units, each designed for specific tasks, like 'infantry'[3], 'command centers', 'reconnaissance', 'surveillance' in English, i.e., *infantry group* ('pešadijska grupa'), *command centers* ('komandni centri'), *a navy* ('mornarica'), *an air force* ('avijacija') in Serbian. In both English and Serbian datasets, there are additional instances of clearly anthropomorphized parts of the immune system similar to those of a military – there is 'the main soldier in the first-line defense' (a macrophage cell), there are 'specialized fighters' (B-cells and T-cells), 'generals' (T-cells), 'liaison officers' (dendritic cells), 'the defensive troops' (various immune cells), 'sentinels' (macrophages and dendritic cells), 'antiterrorism units' (T-cells), etc. Such representation of the *components* aspect in both languages serves to convey an image of a strict hierarchical structure, akin to that of the military, in which everyone's defensive tasks and responsibilities are explicitly designated and where there is a clear chain of command.

Different segments of the immune system and immunity, which help strengthen it, are understood in both languages by means of the BUILDING source domain as well, as examples 1 and 2 show:

(1) A strong immune system is like *a brick house* with *oak doors* and *shielded windows*. (E)[4]

(2) Zamislite da je vaš imunitet *kuća!* Ishrana je *temelj*, redovan san stvara *jake zidove* a umjerena fizička aktivnost *pouzdan krov*. (S)

[Imagine your immunity as *a house*! Your diet is *the foundations*, regular sleep creates *strong walls* and a moderate physical activity *a reliable roof*.]

It follows that the parts of the immune system may not necessarily be related to cells, tissues, or organs (example 1), but to other elements as well (example 2), represented by means of the HOUSE metaphor in which the structure of an abstract concept, the immune system, is explained by associating it with the elements of the physical structure of a building. Such a comparison helps to foreground the importance of the given structural elements in preventing the entry of pathogens. This is particularly achieved by the modifiers 'brick', 'oak', and 'shielded' (example 1), as well as *strong* ('jak') and *reliable* ('pouzdan') (example 2), which, together with the nouns they modify, also contribute to the engaging descriptions of the *components* aspect.

In addition, the *components* aspect is clarified only in English by means of the conventionalized SPORT source domain by drawing on our knowledge about the structure of a football team and the specific roles assigned to its players. The various parts of the immune system are again supported by the personified characterizations; the thymus is viewed as 'the leader of the coaching staff' that, together with the other organs and tissues (assistant coaches), is responsible for the training and managing of cells and proteins – 'the players on the field'. The *components* aspect is also represented in English by way of the creative SUPERNATURAL BEINGS source domain, in which the different immune cells are compared to Marvel comic book characters endowed with formidable supernatural skills and powers (example 3).

(3) ... the immune system is made up of different cells that have different abilities to protect your biological function. Think of these special cells as *Marvel superheroes* where each cell has its unique *superpower* to create the *"Avengers"*: your immune system. (E)

On the other hand, in order to additionally capture the *components* aspect, metaphor producers in Serbian popular medical discourse recourse to the MAP source domain and explain the different components of organ systems, including the immune system, by reference to the various features of the actual world represented and simplified on Google maps (example 4).

(4) Ako bismo *napravili paralelu između ljudskog organizma i google mapa*, ljudski organizam se sastoji prevashodno od ćelija, koje zajedno prave tkiva, koje zajedno prave organe i sve to zajedno pravi organski sistem. *Ovo je veoma slično google mapama*, gde se svet sastoji od kuća, gradova, država i kontinenata. *Tako da ono što je ćelija u ljudskom organizmu, to je npr. kuća u google mapama.* (S)

> [If we were to *draw parallels between the human organism and a Google map*, then the human organism consists primarily of cells, which together form tissues which together form organs, which together form an organ system. *This is very similar to Google maps*, where the world is made up of houses, cities, countries and continents. So that *a cell in the human organism is actually a house on a Google map*.]

The GOOGLE MAP metaphor serves to successfully recontextualize the abstract *components* aspect by comparing it to the concept more appealing to contemporary lay readers, and to create a mental image that helps them not only better understand but also visualize this abstract concept in a simplified manner.

The *interplay* between various components of the immune system and their *interconnectedness* is related to the previous aspect, i.e., to the notion that the immune system is not a singular entity, but a collection of components each performing its particular role, yet all cooperating closely with each other. In both English and Serbian, the aspect of the elements of the immune system's two main subsystems – innate and adaptive – teaming up to prevent or limit infection is characterized by means of several source domains: ORCHESTRA, TEAM, NETWORK and MECHANISM.

The *interplay* between the components of the immune system, which functions well only if its parts work together in harmony, is thus conveyed through the images of the immune system as 'an orchestra' or 'a band' consisting of various cell types rendered as 'many different instruments' playing together 'to make the music' (in English) and *the immune system is like an orchestra with many instruments* ('imuni sistem je kao orkestar sa više instrumenata') in Serbian, with the thymus being *the conductor* ('dirigent'). Comparing the immune system to an orchestra emphasizes the importance of harmonization and coordination among its different components necessary to produce a melody, i.e., an appropriate immune response. The interrelation between the parts of the immune system is also structured in terms of TEAM, which helps to highlight that the performance of each component (a player) is conditioned and guided by the performance of any other component if the entire system is to maintain the state of harmony. The structuring of the complex and mutual relations of the segments within the immune system also relies on the NETWORK source domain and the following expressions: 'a network of warriors', 'a network of bodyguards', *a network of recruit centers* ('mreža regrutnih centara'). Finally, strong interaction

among all the different parts of the intricate immune system structure that are inextricably bound together is viewed in mechanistic terms via the MECHANISM source domain (linguistically realized as 'a well-oiled' and 'complex machine' or 'machinery' in both languages), conveying the notion of an arrangement of tightly-knit mechanical parts working together in a synchronized manner.

However, it is only in the English dataset that the *interplay* aspect, as illustrated in example 3 above, relies on the SUPERNATURAL BEINGS source domain. Namely, the interrelationship of the immune system's parts necessary for defending the body against pathogens is likened to a fictional team of superheroes with their own unique powers ('the Avengers'), enhancing the team's overall strength achieved by working together closely and cohesively.

4.2. The metaphorization of the immune system *functioning*

The *protection* aspect as part of the more general *functioning* aspect of the immune system communicates its main task – to keep the human organism safe from harmful threats coming from the outside (viruses, bacteria) or the inside of our own body. The scientific literature on the immune system describes this aspect as a distinction between the self and the nonself/other, with the sharp boundaries set between the two, and the nonself being perceived as foreign and enmity-like. Hence, it is quite to the expectations that the most common source domain used both in English and Serbian datasets to explain the protection aspect is the conventional COMBAT source domain, in addition to those of PERSON, BUILDING, COMPUTER, ORCHESTRA and ENGINE.

The *protection* aspect, intertwined with that of the *components*, and in both languages likened to COMBAT, is organized around the characterization of the human body, i.e., the site of infection, as a conceptual space where the clash between the two opposing sides takes place (cast as 'battlefield' ['ratište'] or 'the site of battles' ['poprište bitaka']). Such a portrayal activates other metaphorical re-presentations which describe the protective nature of the immune system's responses against various personified pathogens (linguistically rendered in both languages as 'invaders', 'conquerors', 'besiegers', 'intruders', 'aggressors', 'attackers', 'marauders'). Preparing a strong immune response on the part of the body is structured as 'planning an attack', 'gathering the weapons' or 'sending the troops' in English, i.e.,

preparing *tactics* ('taktike') in Serbian; the immune cells and proteins are generally represented as an 'arsenal' and the 'weapons' in both languages, or more specifically as 'seeker missiles' in English and the *landmines* ('nagazne mine') in Serbian. In addition to the already provided instances of personification in which human attributes and behavior are assigned to the agents referring to the *components* aspect, the *protective* roles of the immune cells are also personified in both languages and linguistically rendered as 'killer T-cells', 'natural killer cells' ('ćelije ubice', 'ćelije prirodne ubice'), additionally viewed as *executioners* in Serbian ('dželati'); there are also 'helper T-cells' ('pomagači'), 'Big Eaters' ('žderači'), 'hunter T-cells' ('ćelije [koje] love'). Serbian data reveal a more diversified and extended semantic network characterizing the COMBAT source domain compared to the English dataset. However, it is interesting to note that despite Serbia's relatively recent experience with war, the metaphorical imagery used is mainly associated with the popular features of medieval rather than contemporary warfare, particularly evident in the instances of co-occurrence of COMBAT and BUILDING source domains, as accounted for below.

The *protection* aspect is also clarified through the roles, functions and responsibilities of those professionals whose main task is to protect the public: 'the police' ('policija'), 'intelligence service' ('bezbednosna služba'), 'firefighters', 'security guards' ('čuvari'), even the 'bouncers', all subsumed under the PERSON source domain. Therefore, the various aspects of the immune system's *functioning* – protection, monitoring, neutralizing threats – are structured by means of the roles of people who efficiently perform various duties under emergency conditions.

The image of the immune system as a structure surrounded by layers of protective boundaries is conveyed by way of the BUILDING source domain, further specified as the HOUSE, CASTLE, FORTRESS and TOWN metaphors identified in both English and Serbian datasets. In this characterization of the immune system the emphasis is placed on the defensive nature of these types of buildings and the strong protection they provide. Thus the role of all metaphors grouped around the BUILDING source domain is to communicate the notion of "a bounded area protecting what is within from external danger" (Charteris-Black, 2006, p. 563). The explanatory power of these metaphors lies in the structuring of the immune system as 'a medieval castle' ('srednjevekovni zamak'), invoking the vivid images of high, fortified walls and other defensive barriers for protection. In such a portrayal, the BUILDING source domain frequently combines and

overlaps with that of COMBAT, as shown in the characterization of pathogens as 'an enemy army' ('neprijateljska vojska') that surrounds the castle and besieges it. Likewise, the immune defence is compared to the protection of 'a fortress' ('tvrđava') in which the crucial defensive role is assigned to the lymphnodes linguistically rendered as 'towers' ('tornjevi'), which should highlight the strategic locations of these organs throughout the body to fight harmful substances; or 'a town' ('grad'), surrounded by 'a brick wall' ('zid od cigle'), which is the way the skin, being the body's first physical barrier for preventing the entry of pathogens, is described.

In some examples, conventional metaphors belonging to the BUILDING source domain are used in a creative way "to convey specific messages and perspectives" (Pérez-Sobrino et al., 2022, p. 132) on the *protection* aspect. In both datasets, likening a host to 'a home' seems to provoke and "attract" other metaphorical expressions connected to it such as a 'home security/alarm system' pointing to the immune system or its components, and the 'burglars' – the personified pathogens; binding an antibody to a corresponding antigen is viewed as matching 'a key to a lock'; a 'security guard' in English and *a doorman* ('vratar') in Serbian are both creative instances of the PERSON source domain stemming from the structuring of the human body as HOME.

In both languages, the *protection* aspect is conceptualized by means of the COMPUTER source domain to explain the various defence functions of the immune system's components by analogy to a highly sophisticated and technologically advanced mechanism able to supervise and control other processes and systems. In addition, in the same way as the computer processes various data stored in it and provides the corresponding output so the immune system gathers the information about the state of the body and reacts accordingly (examples 5 and 6).

(5) Imagine your immune system as *the master dashboard screen on a highly-technical computer*. It governs everything. (E)

(6) Imuni sistem liči na *računar* koji stalno računa ko se nalazi u našem organizmu, u kakvom su odnosu, da li je taj odnos zdrav ili nije. (S)

[The immune system is like *a computer* constantly *calculating* who lives in our organism, in what relationships they are, whether that relationship is healthy or not.]

However, it is only in the English dataset that the *protection* aspect is additionally explicated by the 'spaceship', 'coffee filter', 'application' and other miscellaneous figurative instances which serve as effective tools for communicating the role of the immune system's defence mechanisms in vivid, unexpected and creative manners. For example, the *protection* aspect, mixed with that of surveillance, is described by means of the 'spaceship' and 'Marvin martians' expressions (example 7) and the image of monitoring the surroundings (the body) for potential threats.

> (7) Imagine your immune system kind of like *spaceship* that is monitoring your entire body, watching for perpetrators. In my minds eye I see Marvin the martian from Bugs Bunny cartoons . . . watching over with his blaster, blasting away at suspicious molecules. We do have to keep him in check so he does not get too trigger happy, as he does in the cartoons — and as with auto immune diseases, imagine he is a good shot and has a good eye not mistaking foreign bodies for self. *In this spaceship we have a "command center"* where we can monitor our entire body watching for perpetrators and monitoring *our Marvin martians* to make sure they are not overworking. (E)

Controlling the immune cells as not to mistakenly perceive healthy cells as harmful is understood through a metaphor-activated image of a cartoon character that needs to be held in check. A humorous and informal tone of this example extracted from a blog post, as well as the references to popular culture, contribute to the attention-grabbing function of metaphorical expressions in example 7.

The situation in which one's immune system mistakenly attacks its own body tissues is more specifically explained in both datasets by means of the ORCHESTRA source domain, which this time implies a *lack* of harmony and interconnectedness between the components, unlike its use for the characterization of the *interplay* between the immune system's parts. A poorly working and out-of-balance immune system is thus compared to an unsynchronized, out-of-tune orchestra that lacks coordination among its members and their instruments, producing a discordant noise as a result. This same feature of the *protection* aspect, its malfunctioning, is also described via the ENGINE source domain. In both languages, the imbalance of the immune system is structured as driving a car at high speed, suggestive of the absence of control as well as of potential risks and serious consequences that such reckless behavior may produce. Different disorders of the immune

system are additionally explained in English by way of an 'autopilot mode' expression to convey the meaning of insufficient monitoring and control, and consequently a lack of proper reaction in the case of unpredictable circumstances. In Serbian, the immune system failure is associated with the image of a car whose gas tank is filled beyond capacity, causing a decrease in performance.

English, however, uses a different set of correspondences for characterizing a variety of the immune system disorders. A malfunctioning immune system, similar to the structuring of the *protection* aspect, draws again on 'the police force', 'a security guard' and 'intelligence service' metaphorical renderings of the PERSON source domain, highlighting now the poor performance of these professionals. For example, autoimmune diseases are compared to the police force that mistakenly start arresting innocent people; the immune cells that fight against the body's healthy tissues are viewed as 'double agents' – those that change sides and paradoxically, instead of protecting the host from harm, turn against that same host.

The *malfunctioning* aspect, intertwined with that of the *maintenance* of the immune system, is additionally explained in a vivid manner by means of the BUILDING source domain. The latter is described as a regular home cleaning ('getting rid of dirt brought in from outdoors'), whereas in the former the immunity-associated problems are characterized as 'a poor quality home' that has a roof but the windows are missing, also instantiated by usually rarely used elements of the conventional HOME metaphor in the form of simile ('like a home [which] after many years may no longer insulate').

In Serbian, however, a malfunctioning immune system is characterized as 'a radio' which does not work properly and produces 'a hissing noise' – this is equated with allergies and autoimmune diseases (example 8), that is, the inability of the immune system to mount an adequate immune response:

(8) "Zamislite imuni sistem kao *radio:* ako se uključite na određeni talas, čućete besprekorno čist zvuk; *ali ako stignete između stanica, nasumični signali stvaraju glasan i rezak šum*". (S)

[Imagine the immune system as *a radio*: if you tune a radio to a specific wavelength, you'll hear a perfectly clear sound; *but if you stop between the stations, random signals will produce a loud hissing noise*.]

Finally, one of the most important aspects of the efficient functioning of the immune system is its *maintenance*. This aspect includes various habits,

practices and strategies which are aimed at supporting a proper functioning of the immune system. In both English and Serbian datasets the understanding of the *maintenance* aspect is facilitated by means of the ENGINE source domain (which previously in the *protection* aspect served to structure a faulty immune system). Namely, the supporting of the immune system's optimal performance is viewed as a 'regular car check-up' (linguistically rendered as 'refueling', 'repairing', 'changing the oil').'

It is only in English that the *maintenance* aspect is explicated by means of the CULTIVATION source domain and the 'weeding of the garden' expression to foreground the idea of identifying and eliminating the harmful substances to prevent diseases.

On the other hand, taking care of one's immune system is referred to in the Serbian dataset as a proper maintenance of one's smartphone's battery (example 9).

(9) Zamislite da je imunitet *baterija vašeg telefona, što više koristite mobilni uređaj više baterije se troši, kada se ona potroši vaš telefon se gasi te je potrebno da ga punite, ali ako ga napunite prije nego se ugasi vaš telefon i dalje će biti u funkciji*, tako je i sa imunitetom i vašim organizmom. (S)

[Imagine immunity as *a battery of your mobile phone, the more you use your phone, the faster the battery runs out; when the battery runs out, your phone turns off so you need to charge it, but if you charge it before it turns off it will still work*. The same applies to immunity and your organism.]

Such a portrayal helps to illustrate the importance of regularly practicing healthy lifestyles, which should result in maintaining a proper balance of the immune system, explained in example 9 by drawing on an accessible and familiar area of experience to technologically literate lay readers – a regular charging of the smartphone.

5. Discussion

The above analysis has shown that both in English and Serbian the immune system aspects – its *components*, the *interplay* among them, the *protection* the immune system provides, and its *maintenance* – are associated with highly conventional source domains such as COMBAT, BUILDING, ORCHESTRA, NETWORK, MECHANISM, PERSON, ENGINE which,

because of their physical groundedness in familiar and clearly recognized objects and activities, are easier to access for the lay readership and are more readily exploited to render scientific knowledge about the immune system in a simplified manner. By comparing what is to be understood to something more tangible, metaphors belonging to such conventional source domains serve "a bridging function", which increases the possibilities for the readers "to apply previous knowledge as a resource for understanding" (Pramling & Säljö, 2007, p. 289). In that vein, a prominent feature of the metaphorical portrayal of the immune system in both languages is personification – an effective explanatory strategy used for the popularization of the various aspects of this medical concept. A considerable overlap exists between English and Serbian not only on the conceptual but the linguistic plane as well, exhibited by the similar metaphorical expressions through which the identified source domains and metaphors are made manifest (COMBAT and PERSON source domains in particular).

In addition to the above role of metaphor in contributing to the simplification, clarification, and the vast audiences' understanding of the immune system, metaphor in both datasets also serves to impart effective descriptions that may draw attention and arouse interest of the non-specialist readership. Popular medicine texts in English, however, display a greater richness in metaphor and a more compelling metaphoric imagery belonging to distinct source domains. This is evidenced by the wealth and diversity of expressions used to characterize the *components* and the *protection* aspects, which in the latter particularly refers to a malfunctioning immune system. This finding is also reflected in the practice common with the English popular medicine text writers to adopt a more creative approach to adapting scientific information and research discoveries about the immune system to the knowledge of non-specialist audiences, and to engaging such audiences. As attested by the analysis, this is achieved by deploying creative extensions of conventional metaphors or by utilizing some usually unused elements of the source domain (as in the case of the BUILDING domain). Furthermore, in a number of English examples a novel way of explaining the aspects of the immune system was realized by means of integrating metaphors and features characteristic of informal discourse. Such metaphors rest on the unexpected and most probably one-off mappings from source (e.g., SUPERNATURAL BEINGS) to target, which allows for describing a complex concept in a vivid and impactful manner. A humorous and informal tone of such portrayals, together with various intertextual

references to pop culture as common popularization devices, especially in blogs, are used to "construct proximity and intimacy with the audience" (Luzón, 2013, p. 447).

Though to a lesser extent, the use of idiosyncratic metaphors is also manifested in Serbian popular discourse, such as 'the Google map' parallel. Although maps miss out many features of the real world, such a simplified image offers an innovative and fairly uncommon way of conceptualizing and conveying a specific perspective on the *components* aspect of the immune system, binding together the explanatory and the rhetorical functions of metaphor. Generally speaking, popular medicine text writers in both English and Serbian "do not simply reproduce metaphors, but generate new ones" (Breeze, 2017, p. 82) and in most cases these metaphors are associated with the same source domains. By creating novel associations and comparisons between disparate concepts and phenomena, such metaphors are capable of providing better insights into the various complex aspects of the immune system.

These instances of creativity may be accounted for by the practice of using "signals" such as metaphor and simile markers which "trigger" a rich variety of source domains and metaphors in the two languages, often resulting in an engagement strategy of telling "mini stories" about certain aspects of the target domain. In that way, popular science writers appear to be very productive in drawing the readers' attention to the metaphoricity of what follows after this kind of "introduction" (Semino, 2008, p. 27). Specifically for English, it may also be noted that in the majority of popular medicine texts in our dataset the complex, abstract aspects of the immune system's *structure* and *functioning* are initially structured metaphorically, usually at the very beginning of the text, and then elaborated on in a rather factual, neutral and non-metaphorical manner.

Additionally, depending on a particular aspect of the immune system they are to explain and simplify, some source domains and metaphors identified in the analysis may be deployed to reinforce negative views of that aspect in both languages, notably the *protection*, in the context of the malfunctioning of the immune system (cf. Balteiro, 2017; Brookes, 2023). Such metaphors (e.g., those belonging to the ORCHESTRA and PERSON source domains in the English dataset), used now to characterize the immune system's self-harm, serve to clarify and make the vast audiences aware of the various disorders of the immune system and its risk-inducing character.

5. Conclusion

In this study we provided an account of the metaphorical portrayal of the immune system target domain and its main aspects in English and Serbian popular medical discourse featuring this concept. The similarities and differences between the two languages have been determined on the basis of not only the identified source domains and their metaphors used to facilitate the comprehension of the immune system among the lay readers, but also the functions that these metaphors perform in such a discourse for the purposes of popularization. The findings of our analysis indicate that in general terms, the lay accounts of the immune system in both the English and Serbian popular medicine texts exhibit a significant degree of overlap, as reflected by the use of the same source domains employed to characterize the target domain. The identified differences refer to the variety of source domains and metaphors, but also to the novel ways used to communicate lay versions of scientific knowledge about the target domain, with English prevailing in versatility in that respect. These differences may be due, firstly, to differential cultural experience and the different culture-associated salience of concepts and customs, which may result in some source domains being more typical of one culture/language than of the other (e.g., the CULTIVATION source domain only in the English dataset). Secondly, certain differences may be attributed to the width of the immediate cultural context and culturally-shared experiences, as reflected in resorting to popular culture analogies and references (e.g., in the use of the SUPERNATURAL BEINGS source domain only in the English data). Culturally-induced choices of certain source domains, resulting in fairly novel and unusual mappings (e.g., the 'spaceship' analogy), together with the original and creative realizations of mappings from conventional source domains onto the target domain, particularly by way of metaphor extension (e.g., the BUILDING domain, especially the HOME metaphor), may also be viewed as a distinctive feature of the English data. Though to a lesser extent, the Serbian data also exhibit creativity in order to offer novel perspectives on the crucial aspects of the target concept. The Serbian metaphor producers thus tend to rely on those concepts (e.g., the 'smartphone battery') and images (e.g., the 'Google map' comparison) whose mappings with the target domain should resonate better with the technologically fluent lay readers and may be taken as a reflection of personal cognitive style of framing a concept. Finally, diverse social contexts, i.e., differential memory (see Kövecses, 2005), may account for yet another distinction between the two languages, reflected now

in a more diversified metaphorical lexis referring to the COMBAT domain in the Serbian data compared to the English ones – it seems reasonable to assume that this may be due to a relative chronological proximity of war in Serbia and the surrounding countries.

Concerning the functions that metaphor plays in the processes of recontextualization and reformulation, the two main dimensions of popularization, i.e., the transfer of knowledge from specialized to lay contexts, our analysis of metaphors for the immune system points to some general conclusions. Firstly, metaphor plays an important *explanatory* role in the process of constructing and re-creating non-specialist medical discourse (recontextualization), which is mainly due to its ability to enhance comprehensibility of lay readers by comparing one realm of experience to another. In addition, being able to provide exceptionally vivid conceptual and linguistic imagery metaphor serves as a useful *descriptive* device that bridges the space between the expert and the lay medical discourses. This particularly comes to the fore in cases where medical phenomena pertaining to the immune system are metaphorically linked to "contemporary technical phenomena that are better known to educated readers" (Calsamiglia & Van Dijk, 2004), those that have been exposed to the ubiquitous influence of digital content. Finally, metaphor has pronounced *rhetorical* and *persuasive* functions in that it serves as an attention-grabbing device (usually in headlines or at the very beginning of popular medical texts), boosting the article's appeal by using emotionally engaging language, thus sparking the interest of the audience and persuading them to continue reading. In the process of reformulating the language of scientific discourse and adapting it to a lay audience, metaphors (including those directly expressed in the form of similes and analogies) serve as an apt *paraphrasing* and *illustrative* tool – they help draw the necessary parallels between the known and the unknown, thus filling the knowledge gap always present and necessary to be filled in the processes of popularization, but embellishing it with colourful language more suitable for the non-expert audience. These functions of metaphor in popular medical discourse may combine, intertwine and overlap, making it difficult to clearly and neatly delineate them.

While our study sheds light on the metaphorical portrayal of the immune system in English and Serbian popular medical discourse, we acknowledge that the size, diversity and representativeness of our datasets may be limited, which may affect the generalizability of the findings. Therefore, larger sets of data coming from a broader range of sources are necessary to provide a

more comprehensive understanding of how the immune system is metaphorically structured in popular medical discourse in the two languages. Conducting a quantitative analysis of the data would also provide a more rigorous basis for comparison in this respect.

We believe that the avenues for further research lie in investigating metaphor and its role as an important recontextualizing and reformulation strategy from a contrastive perspective in other disciplinary contexts and in identifying the ways in which metaphor fulfills its manifold functions in popular discourse in languages other than English to establish possible similarities and differences.

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NOTES

[1] A small number of texts published before the stated period or those for which there was no publication date provided were also included in the datasets. The links to all the texts making up the English and Serbian datasets are provided in the Appendices 1 and 2, respectively.

[2] The source domains exclusively found in the respective datasets are shaded.

[3] The examples of metaphorical expressions in English and Serbian are marked in the text under single inverted commas. The English translation equivalents of the Serbian metaphorical expressions are italicized.

[4] Examples from the datasets are marked with either E (English) or S (Serbian). A translation into English is provided for the Serbian examples.

Appendix 1

Links to texts making up the English dataset

https://vaccinemakers.org/sites/default/files/resources/HS.reading%20passage.unit1_.lesson3.FINAL_.pdf

https://www.iveeapp.com/blog/5-effective-ways-to-boost-your-immune-system

https://www.independenceaustralia.com.au/tips-and-advice/5-ways-to-support-immune-system/

https://nuunlife.com/blogs/news/what-is-the-immune-system

https://kjmnutrition.com/2020/04/08/what-you-need-to-know-about-nutrition-and-the-immune-system-staying-strong-with-tbi/

https://embracingnutrition.co.uk/supercharge-your-immune-arsenal-this-winter/

https://letstalkscience.ca/educational-resources/stem-in-context/immune-response

https://www.bartonhealth.org/tahoe/health-library/disorders-of-the-immune-system-4679.aspx?iid=134_123

https://www.webmd.com/lung-cancer/non-small-cell-lung-cancer-immunotherapy

https://directorsblog.nih.gov/2021/06/17/meet-an-inspiring-researcher-who-helped-create-covid-19-mrna-vaccines/

https://stramcenter.com/blog/blog-detail/strengthening-your-immunity/

https://askthescientists.com/immune-system/

https://thebarefootnaturopath.com.au/services/autoimmune/

https://awtsuprints.com/blogs/fitness/improving-your-immune-system-by-strength-training

https://vadogwood.com/2021/07/13/if-you-have-a-weakened-immune-system-will-the-covid-19-vaccine-help/

https://www.pulleychiropractic.com/germ-theory-terrain-theory-immune-system/

https://www.andersonsuperiorwellness.com/post/fight-the-flu-with-food

https://www.chop.edu/centers-programs/vaccine-education-center/human-immune-system/parts-immune-system

https://interactivehealthclinic.com/how-to-bust-allergies-this-season/

https://www.befitbodymind.org/learn-thrive/support-your-immune-system/

https://www.amymyersmd.com/article/cold-plunge-benefits

https://nutritionw.com/pandemic-how-to-naturally-help-your-immune-system-fight-hard/

http://healthkenya.co.ke/surveillance-after-vaccine-introduction/

https://primehealthdenver.com/the-proven-allergy-treatments/

https://www.bactivax.eu/blog/a-tale-about-our-immune-system-superheroes-a-continuous-epic-fight-against-evil-bacteria-and-viruses-and-other-nasty-creatures-nature-is-throwing-at-us

https://www.lifehack.org/880930/self-care-plan

https://www.pfizer.com/news/articles/can_you_strengthen_your_immune_system#:~:text=Think%20of%20your%20immune%20system,unwanted%20intruders%20off%20your%20property

https://www.munsonhealthcare.org/blog/boosting-your-immune-system-7-proven-steps-to-improved-disease-immunity

https://www.knutenelson.org/news-stories/natural-ways-to-boost-your-immune-system

https://health.clevelandclinic.org/immunocompromised-meaning/

https://integrisok.com/resources/on-your-health/2023/february/immune-health

https://medium.com/wadepthealth/your-bodys-defense-system-d4f135ebce02

https://www.infectioncontroltoday.com/view/how-iron-man-immune-cells-helps-t-cells-fight-infection

https://www.pennmedicine.org/updates/blogs/health-and-wellness/2020/may/what-it-means-to-be-immunocompromised

https://mdpremier.com/top-5-foods-that-boost-your-immune-system-quickly/

https://upnorthlive.com/features/your-health-matters/7-expert-ways-to-boost-your-immune-system

https://rheumatoidarthritis.net/what-is-ra/how-your-immune-system-works

https://maconmagazine.com/fitness-corner-how-to-balance-your-immune-system-by-shawn-mcclendon/

https://www.healthline.com/health/how-do-i-know-if-im-immunocompromised#what-it-means

https://driedfruitsa.co.za/news/use-your-diet-to-support-your-immune-system-this-winter/

https://www.healthcentral.com/slideshow/understanding-b-cells-with-primary-immunodeficiency

https://cherishedagency.com/6-ways-to-give-your-senior-loved-one-an-immunity-boost-this-winter/

https://rene.co.ug/the-immune-system-your-bodys-very-own-avengers/

https://www.vitacost.com/blog/weak-immune-system-symptoms/

Appendix 2

Links to texts making up the Serbian dataset

https://eklinika.telegraf.rs/korona/64375-imunitet-na-covid-19-otkrio-nove-faktore-od-kojih-zavisi-brzina-i-jacina-imunog-odgovora

https://novimagazin.rs/vesti/220965-intervju-nemanja-despot-marjanovic-virus-ne-napada-samo-pluca

https://www.bbc.com/serbian/lat/svet-53945260

https://visionstore.co.rs/probiotici-i-jacanje-imuniteta/

https://epoteka.rs/blog/imunoloski-sistem-vezbanje-kvalitetan-san-zivot-bez-cigareta-i-alkohola/

https://eklinika.telegraf.rs/korona/46121-t-celije-imunog-sistema-otkrile-zasto-neko-ne-reaguje-na-covid-19

https://www.mediastart.info/dr-ivkovic-u-principu-nema-potrebe-proveravati-nivo-antitela/

https://minutzamene.com/najbolja-hrana-za-imunitet/

https://bs.healthy-food-near-me.com/microbiome-7-facts-about-the-inhabitants-of-our-body/

https://www.moj-imunitet.com/kako-funkcionise-nas-imunoloski-sistem.html

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