DOI: 10.47810/PIBL.XXXVI.23.01

БЪЛГАРСКА АКАДЕМИЯ НА НАУКИТЕ
ИЗВЕСТИЯ НА ИНСТИТУТА ЗА БЪЛГАРСКИ ЕЗИК „ПРОФ. ЛЮБОМИР АНДРЕЙЧИН“
Книга XXXVI

WEB-BASED EXPERIMENTS IN MEDIATED RECEPTIVE MULTILINGUALISM*

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Abstract: The article focuses on phenomena of cross-lingual comprehension mediated by a bridge language. In a web-based experiment, German speaking subjects – without any previous knowledge of Bulgarian – translate written Bulgarian stimuli relying on some knowledge of Russian. We investigate the importance of the selected individual and linguistic factors for success in mediated receptive multilingualism. Proficiency in reading in Russian and orthographic distance between Russian and Bulgarian cognates are the most important predictors.

Keywords: web-based experiments, mediated receptive multilingualism, Bulgarian, German, Russian

УЕББАЗИРАНИ ЕКСПЕРИМЕНТИ В ОБЛАСТТА НА ОПОСРЕДСТВАНОТО РЕЦЕПТИВНО МНОГОЕЗИЧИЕ

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Резюме: Статията представя резултати от уеббазиран експеримент в областта на междуезиковата разбираемост чрез опорен език мост. Пред немскоговорещи участници без никакви предварителни познания по български език е поставена задачата да преведат писмени български стимули в онлайн режим, като се опират на евентуални познания по руски език. На тази емпирична база е възможно изследването на избрани субективни (индивидуални) и обективни (лингвистични) предпоставки за успех в опосредстваното рецептивно многоезичие. Сред най-важните предиктори попадат умението за четене на руски език и ортографическата дистанция между руските и българските сродни думи.

Ключови думи: уеббазирани експерименти, рецептивно многоезичие, български, немски, руски

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1. Introduction

The pervasive practice of understanding an unknown linguistic variety based on already acquired languages is known as "intercomprehension" (Doyé 2005), "receptive multilingualism" (Braunmüller, Zeevaert 2001), "lingua receptive" (Rehbein et al. 2012) or "semi-communication" (Haugen 1966). If Lx and L1 are alike, our prior linguistic knowledge becomes useful in establishing various cross-linguistic correspondences (Ringbom 2007) and employing different compensatory guessing strategies. It is possible for L1 speakers to comprehend linguistic expressions in Lx, without any prior Lx exposure. Enhancing such receptive skills facilitates the access to other languages and cultures. While observable cross-lingual similarities and differences are empirically essential in acquiring the necessary metalinguistic awareness, the practical success depends on factors like attitude and language exposure. Some studies could correlate the attitudes towards a language and its intelligibility (Gooskens, van Bezooijen 2006; Schüppert et al. 2015), but others did not find such correlation (van Bezooijen, Gooskens 2007; Gooskens, Hilton 2013). Age and level of education appear as explanatory variables of mutual intelligibility, too. For Germanic intercomprehension van der Ploeg et al. (2017) show that a higher level of education leads to better performance in text intelligibility. Although, in the written modality, these authors do not find the same age effects as Vanhove (2014), who registers a slight increase across the adult life span, both studies clearly suggest that age affects the intelligibility scores.

In the context of receptive multilingualism, researchers typically focus on closely related languages (Gooskens, Swarte 2017), with the assumption that the more similarities two languages share, the higher their degree of mutual intelligibility is. This is quite apparent for modern Slavic languages (Mel'nichuk 1986), as descendants of a single (reconstructed) ancestor Proto- or Common Slavic (Carlton 1991; Comrie, Corbett 1993). Pioneering studies (de Bray 1980; Townsend 1981; Gribble 1987) are followed by intercomprehension oriented work (Tafel 2009; Heinz, Kuße 2015; Anstatt et al. 2020). As Townsend and Janda (1996, 25) point out, "*[m]ost Slavs speak of understanding each other without much difficulty, but this is usually exaggerated and applies mostly to a simple concrete level*". Besides, Ringbom (2007, 11) distinguishes *objective* (established as symmetrical) and *perceived* (not necessarily symmetrical) cross-linguistic similarities. Different constellations are possible, e.g., speakers of language A may understand language B better than language C, i.e., [A(B)>A(C)], while speakers of language B may understand language C better than language A, i.e., [B(C)>B(A)]. The transparency of linguistic signal is typically asymmetric across languages: if language A has more complicated rules and/or irregular developments than language B, this results in structural asymmetry (Berruto 2004).

Mutual intelligibility is a dynamic process, which includes all kinds of multilingual communication (Rehbein et al. 2012, 253). The concept of intercomprehension needs to be respectively widened (Gooskens, Swarte 2017, 124) to refer both to *inherent* intelligibility, when speakers of L1 can understand Lx on the basis of

structural linguistic similarities, and to *acquired* intelligibility, when speakers of L1 have actually learnt Lx. An acquired lingua receptiva can apply to less related or unrelated languages, too (Muikku-Werner 2014, 100). Using a third language for communication reveals *mediated* receptive multilingualism (Branets et al. 2019).

In pedagogical applications, the EUROCOM approach involves acquired intelligibility and relies on mediated receptive multilingualism, providing strategies for understanding Germanic, Slavic, or Romance languages when the reader is already familiar with another closely related language functioning as so-called pivot or bridge.

Acquired and mediated receptive multilingualism involves pairwise or multiple combinations of languages not only from a single language family. Experiments with monolingual and multilingual speakers, e.g., German respondents trying to understand Polish (Jágrová et al. 2017a), provide insights into the way humans practice intercomprehension via pivot language(s).

Explicit and implicit learnability between closely related languages or via a bridge language has drawn attention to the efficiency of focused teaching interventions, e.g., while Golubović (2016) and Branets et al. (2019) show positive results, Bergsma et al. (2014) indicate no significant improvement. In web-based experiments with Russian native speakers Stenger and Avgustinova (2021) show that (i) participants with better performance tend to complete the individual word translation task faster, and (ii) implicit multilingual learnability (based on the experiment rank) influences both intelligibility and reaction time in comprehension of five unknown Slavic languages.

Individual receptive multilingualism (IRM) is essential for the European cultural and economic area.[1] Relevant critical domains include, e.g., multilingual language acquisition, multilingual language development, language attrition under multilingualism, as well as maintenance and recovery of heritage languages. Multilingual identity is an integral part of one's personality.

Common practice shows that due to linguistic and extra-linguistic factors the degree of success in IRM varies between written and spoken modalities (Gooskens 2019), i.e., between the visual and the auditory perception of the linguistic signal. Languages differ in many respects, representing a multidimensional space (van Heuven 2008), which leads to divergent perceptions of linguistic relatedness. Linguistic properties may be unique to a language, shared between different language varieties, or common to languages from the same group. Social experience is a crucial component of IRM and influences the specific cognitive strategies needed for comprehending a foreign language. From the viewpoint of language users, intercomprehension is the prototypical manifestation of a receptive multilingualism, while productive multilingualism presupposes a high proficiency in each of the languages, and translanguaging (Vogel, García 2017) involves a simultaneous use of more than one language in order to communicate, e.g., code-switching.

Providing practical insights into pragmatic and creative language use, this article contributes to both theoretical and applied work on receptive multilingualism,

[1] https://ec.europa.eu/education/policies/multilingualism/about-multilingualism-policy_en.

in particular on mediated receptive multilingualism with a special relevance for the Slavic-Germanic intercomprehension. We want to analyze how individual characteristics of participants might influence their performance in visual perception of an unknown language L3 via a related language L2, and whether the degree of (dis) similarity between related languages L3 and L2 can predict the intelligibility of an unknown language L3 by L1 speakers via their knowledge of L2. More precisely, we investigate here to what extent native speakers of German activate their knowledge of Russian while translating written Bulgarian words, which are cognates in Russian. Therefore, we are interested in cognate recognition between Russian and Bulgarian, processed by combining information from the L2 lexicon with the L3 stimulus word while the L3 is an unknown language. When the process is successful, it leads to positive transfer, which means a correct translation of the L3 stimulus word into L1. When the process is not successful, it leads to negative transfer, i.e., an incorrect translation of the L3 stimulus word into L1 (cf. Swarte et al. 2013, 149).

Our research questions are: (RQ1) To what extent native speakers of L1 (German) can understand an unknown language L3 (Bulgarian) through a related bridge language L2 (Russian)? (RQ2) What is the relationship between the human performance and the selected individual factors in mediated receptive multilingualism? (RQ3) To what extent can the selected linguistic factors explain the comprehension of an unknown language L3 via a related bridge language L2 by German native speakers in a mediated reading scenario?

After presenting the web-based experiments (incl. the experimental material, participants, and procedure) with intelligibility score and individual reaction time, we introduce the selected individual and linguistic factors that seem to be important for success in cross-lingual comprehension mediated by a bridge language and analyze the relationship between selected factors and human performance in a web-based experiment. This is followed by discussion and some general conclusions.

2. Web-based experiments

In studies on mutual intelligibility of (closely) related languages, a division is drawn between opinion testing, i.e., how well subjects believe to understand another language, and functional testing, i.e., how well they do understand the other language (Gooskens 2013). For testing human performance, a variety of controlled experiments are envisaged to provide insight into the relative importance of individual and linguistic factors that affect the mutual intelligibility of different related languages. Inferences based on contextual assumptions represent a central technique in receptive multilingualism, which naturally leads to the assumption that cross-linguistic word recognition should be better in context than in isolation. This view is quite intuitive and may sound trivial. Yet, for a context to be useful, it needs to be understandable, too. In the present investigation we look at written word recognition in L3 via knowledge of L2 without context as a precondition for any further text understanding in mediated receptive multilingualism.

2.1. Material

The items of our web-based experiment were taken from parallel Slavic lists consisting of internationalisms[2], Pan-Slavic vocabulary[3], and cognates from Slavic Swadesh lists[4]. All three lists were slightly modified. Thus, formal non-cognates were removed and formal cognates, if existing, were added to the lists where the pairs in the original lists consisted of non-cognates. For example, Bulgarian – Russian *ние – мы* '*we*' were removed and the Bulgarian *звяр* '*beast*' instead of *животно* '*animal*' was added to its Russian formal cognate *зверь* '*animal*, *beast*'. The linguistic items in these lists belong to different parts of speech, mainly nouns, adjectives, and verbs. In the second step, we manually collected a cross-linguistic rule set of corresponding orthographical units (transforming both individual letters and letter strings) from comparative historical Slavic linguistics (e.g., Bidwell 1963, Vasmer 1973, Zhuravlëv et al. 1974 – 2012). This resulted in sets of diachronically-based orthographic correspondences, e.g., Bulgarian – Russian: *б*:*бл*, *ж*:*жд*, *я*:*е*, *ла*:*оло* etc. We then tested this set of diachronically-based orthographic correspondences on the parallel word lists mentioned above. By applying the transformation rules, we categorized the cognates in the pairs as (i) identical, (ii) successfully transformed, or (iii) non-transformable by the rules. In most cases, the automatic transformations were judged to be satisfactory, e.g., Bulgarian – Russian 128 correctly transformed items excluding doublets of a total of 935 items in all three lists (for more details see Fischer et al. 2015; Stenger 2019; Stenger et al. 2020a). 120 Bulgarian – Russian cognate pairs were used in intelligibility tests among Bulgarian and Russian native speakers (cf. Mosbach et al. 2019, 2021). In this experiment German native speakers were confronted with 64 single Bulgarian words (see Appendix) from the above mentioned lists (62 nouns and 2 numerals) presented in one challenge.

2.2. Participants

The subjects were recruited for participation in the experiment at the Saarland University, at the Central Institute for Language and Communication[5], at the Department of Slavic Studies[6] and at the Department of Language Science and Technology. The

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[2] Internationalism list was available at http://www.eurocomslav.de/kurs/iwslav.htm; 11.07.2015. Refer to Angelov (2004).

[3] Pan-Slavic list was available at http://www.eurocomslav.de/kurs/pwslav.htm; 11.07.2015. Refer to Likomanova (2004).

[4] Slavic Swadesh-list is available at https://en.wiktionary.org/wiki/Appendix:Slavic_Swadesh_lists; 25.01.2023.

[5] The following Slavic languages are offered to students and guest auditors at the Central Institute for Language and Communication of the Saarland University: Bulgarian, Polish, Russian, Ukrainian, Croatian and Serbian. As part of a program of the Saarland Ministry of Education, language courses are also offered for school students at Central Institute for Language and Communication, https://www.szsb.uni-saarland.de/start.html; 25.01.2023.

[6] Due to structural conditions, the winter semester 2018/19 was the last semester of Slavic Studies at the Saarland University.

participants started the experiment with registering and completing a background questionnaire in their own language (German). After completing the background questionnaire, participants were asked to translate randomized 64 Bulgarian written stimuli into their native language (German). A total of 45 participants took part in the experiment. As we are interested in mediated receptive multilingualism, only people who speak German natively and know Russian, but who do not know the stimulus language Bulgarian have been included in the analysis. In order to avoid any learning effects we consider here the results of the initial experiment. This experiment was not the initial one for 12 participants, that's why they were excluded from the analysis. The number of remaining participants is 33, aged between 12 and 78 years (the mean age of participants is 23) with 23 women and 10 men. In this investigation we do not distinguish between young and older subjects. We will analyze Bulgarian written word recognition for all participants. All participants are living in Germany. The proficiency in Russian of participants ranges from the German – Russian bilingual speakers towards expertise of Russian as a language learned from 1 to 30 years. Six subjects indicated Russian as a second native language. However, only four participants indicated years of residence in Russia (most likely in childhood): three years (two subjects), five years, and ten years.

2.3. Procedure

Bulgarian written words intelligibility for German native speakers was tested by means of a free translation task at the experimental website of the Saarland University: https://intercomprehension.coli.uni-saarland.de/de/. The experimental website with an interface in 12 Slavic languages, English and German has more than 220 challenges in 12 Slavic languages (for more details see Stenger et al. 2020b).

Randomized stimuli were presented for translation into subject's L1. The participants saw the stimuli on their screen; one by one (see Figure 1). The subjects had

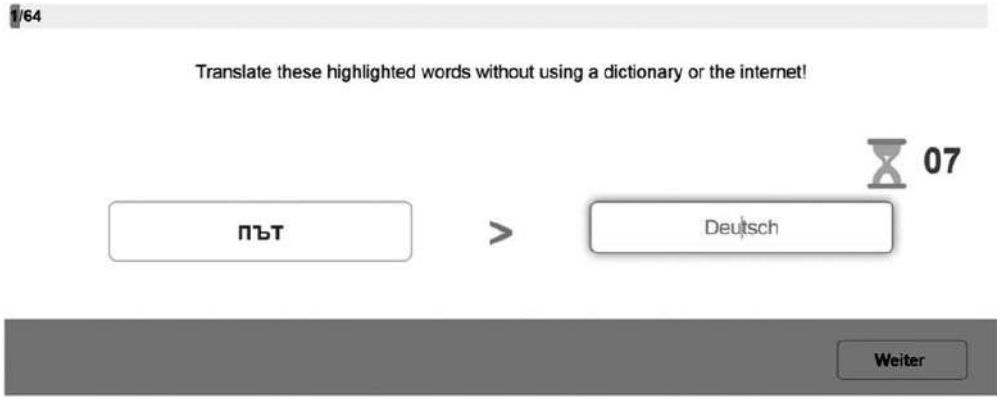

Figure 1. Screenshot of the translation task from Bulgarian into German of the word 'way'

10 seconds to type a translation and move forward. The chosen time limit was based on our experience from cognate guessing tasks and is in line with related studies, e.g., Golubović (2016). An immediate feedback was given in the shape of an emoticon on the left at the bottom of the page – a thumb up for a successful translation or a sad face for a wrong or missing translation. The output was automatically categorized as 'right' or 'wrong' via pattern matching with pre-defined expected answers. The responses were then manually checked for typographical errors in the final analysis.

2.4. Intelligibility score and individual reaction time

In our investigation with German subjects, we examine the chance of their good performance in intelligibility of an unknown language (Bulgarian) via a related language (Russian). The anonymized data collected in web-based experiments were analyzed along two dimensions: *intelligibility score* and *individual reaction time*. The percentages of successful solutions constitute the intelligibility score for a given language pair. After calculating the percentages of correct translations per participant, we found that the mean percentage of the correct responses for the 64 Bulgarian stimuli presented to German native speakers is 45.50%. Investigating mutual intelligibility between closely related languages in Europe, Gooskens et al. (2017) set a score of 40% as a tentative threshold for successful communication.

Thus, we can conclude that our participants quite successfully completed the experiment. On the basis of the correct answers, we classified the participants into five main sub-groups (see Table 1).

Table 1. Distribution of intelligibility scores in five sub-groups of participants

% intelligibility score	Number of participants
13 – 19	6
20 – 38	9
41 – 58	7
61 – 75	7
83 – 86	4

From Table 1, it becomes clear that 18 participants (55%) have score above 40%. This allows us to draw one important intermediate conclusion that knowledge of an L2 (Russian) can help native speakers of German (L1) to understand an unknown language L3 (Bulgarian).

In order to gain insight into the intelligibility process of L3 via L2 we made an analysis of what kind of Bulgarian stimuli were easier and more difficult to understand for German subjects. Figure 2 presents 13 Bulgarian stimuli with intelligibility score more than 70% and Figure 3 presents 16 Bulgarian stimuli with intelligibility score less than 25%.

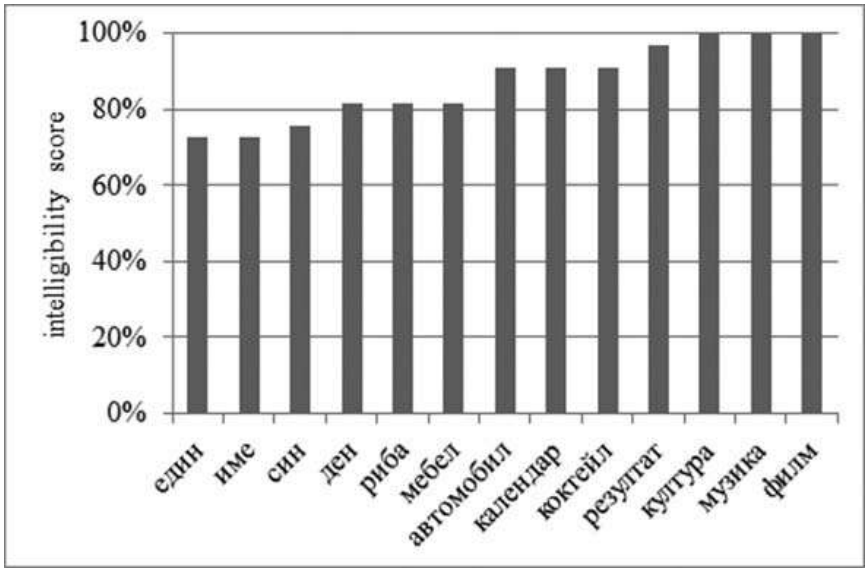

Figure 2. The easiest Bulgarian stimuli for German subjects

We will first discuss the data in Figure 2. It can be observed that German subjects made few mistakes translating Bulgarian stimuli selected from the list of internationalisms. In total there are ten internationalisms in the stimulus material and eight internationalisms belong to the easiest Bulgarian stimuli: *автомобил* 'automobile, car', *календар* 'calendar', *коктейл* 'cocktail', *култура* 'culture', *мебел* 'furniture', *музика* 'music' *резултат* 'result', *филм* 'film'. For example, *култура* 'culture', *музика* 'music', and *филм* 'film' were translated correctly by all German subjects. In addition, the transparency of Bulgarian – Russian cognates, for example, Bulgarian *един* and Russian *один* 'one' and Bulgarian *име* and Russian *имя* 'name', seems to be responsible for positive transfer from L2 (Russian) to L3 (Bulgarian) and for correct translation from L3 (Bulgarian) into L1 (German).

In contrast, the German subjects experienced many problems translating 16 Bulgarian stimuli presented in Figure 3. For example, there was only one correct response for the Bulgarian stimulus *път* 'way' (the Russian cognate *путь*). 11 German speakers translated the Bulgarian stimulus *път* 'way' into German as *trinken* 'to drink'. Eight subjects understood the Bulgarian word *път* as *fünf* 'five' and two participants interpreted it as *singen* 'to sing'.

On the one hand, the Bulgarian vowel ъ /ɤ/, which does not exist in Russian, may lead to confusions. Their Russian counterpart ъ has no phonetic, but an orthographic function (hard sign). On the other hand, the incorrect answers show that the German subjects used their knowledge of Russian, compare the Russian words *пить* 'to drink', *пять* 'five', *петь* 'to sing' and the Bulgarian stimulus word *път* 'way' with the Russian cognate *путь*. However, the knowledge of the L2 leads here to a negative transfer from the L3 into the L1.

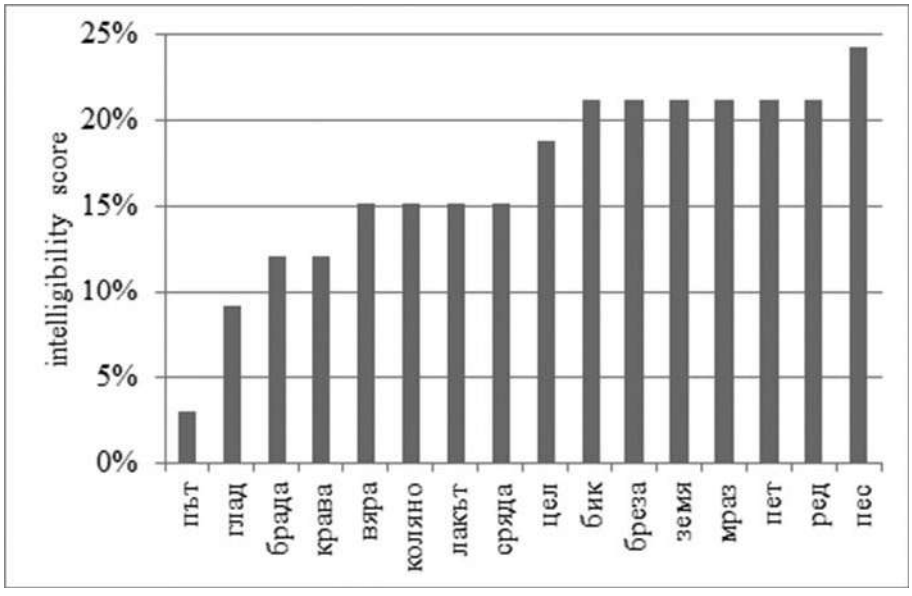

Figure 3. The most difficult Bulgarian stimuli for German subjects

The role of the so-called neighbors seems to be responsible for the wrong translation in the experimental task. Neighbors are linguistically defined as word forms that are similar and may therefore serve as competing responses, hindering communication (Gooskens et al. 2015, 257). The term is used to explain word recognition in a monolingual situation (cf. Eckstein 2004; Sliusar', Alekseeva 2017) and in a situation where two (closely) related languages are involved (cf. Kürschner et al. 2008; Gooskens et al. 2015; Stenger 2019).

In our investigation L3 and L2 are (closely) related languages and neighbors in the L2 may be responsible for a negative transfer (cf. Swarte et al. 2013), i.e., cases where information from L2 is falsely transferred and leads to mistakes in understanding of the L3. It is interesting to mention here that the L1 (German) and other known languages Lx (i.e., English) may also be responsible for wrong translation in the experiment. For example, the Bulgarian word *ред* 'row' was translated into German as *rot* 'red' (three times) or as *Rede*, *reden* 'speech, speak' (two times). The first wrong translation can be seen as a negative transfer or interference from English and the other wrong translation – from German.

In testing cross-lingual intelligibility, the *individual reaction time* can be a sensitive response measure (Schüppert, Gooskens 2011; Stenger, Avgustinova 2021). It is generally assumed that the time it takes a participant to make a decision reflects the processing time and thereby the degree of complexity of the task (Gass, Mackey 2007).

In the context of receptive multilingualism, the assumption is that the faster the subjects react, the better the intelligibility, if the test language is very similar to the language of the subjects and the most answers are correct (Gooskens 2013). More specifically, the intelligibility of a stimulus interacts with the individual reaction time

needed for processing it. In our investigation we assume that participants with higher intelligibility score would perform faster than participants with smaller intelligibility score. With other words, the better the human performance, the less the individual reaction time.

We measured individual reaction time in ms. (incl. the initial hesitation time, typing time and final hesitation time before clicking on 'Next') per stimulus using the functionality of the experimental website. The mean reaction time per participant was calculated on the basis of correct translations only.

To test our hypothesis, we conducted a Pearson correlation analysis between the mean individual reaction time for a correctly translated item and intelligibility score, which resulted in a significant negative correlation with a coefficient $r = -0.46$ ($p < 0.01$). That means that there is a link between word recognition in an unknown language via a related language and individual reaction time. More specifically, the better the participants perform the translation task, the less time they spend on it in average. Conversely, the worse the participants do the translation experiment, the more time it takes them to complete it.

3. Explaining variables in mediated receptive multilingualism

Modeling a mediated form of IRM we introduce relevant interlocutors' characteristics and (dis)similarities between the L2 and L3 languages that may play an important role in mediated receptive multilingualism. Additionally, we correlate the selected individual and linguistic factors with intelligibility score of experiments in order to validate their predictive potential in an intercomprehension reading scenario via a bridge language.

3.1. Individual factors

When registering for a challenge at the experimental website, participants need to complete an online background questionnaire in their native language, providing information about age, gender, level of education, places of growing-up, areas of residence, among other. During the process, it is made explicit that the collected data will be anonymized and used for scientific purposes only, for which the participants need to give their informed consent. These anonymized background data enable a multifaceted interpretation of experimental results.

The question is what personal characteristics lead to the empirically observed human performance in mediated receptive multilingualism. The following individual factor appears to be crucial for revealing the dynamics of IRM in reading Bulgarian through Russian: *self-assessed language knowledge* in intelligibility tests. Participants' familiarity with languages is established, for example, by capturing *which languages they know* (or have learnt) and the extent to which they think they know the indicated languages. The participants indicate their knowledge of languages on a continuous sliding axis with six reference levels according to the Common European Framework

of Reference for Languages (CEFR). In compliance with CEFR, we distinguish four kinds of activities: two related to reception (listening and reading) and two related to production (speaking and writing). Each activity is assessed per language on a separate scale. One can hover over the info-symbols for a short description of each level.

In addition to German as their native language and Russian as a known language, the participants indicated language skills in a total of 16 foreign languages. The mean number of known languages incl. native language is five. Thus, we can speak here about multilingual identity among the participants of our experiment. The most common foreign language is English (31 participants), followed by French (21 participants) and Spanish (13 participants). Latin was mentioned six times and Italian four times. Danish was mentioned two times. As for the knowledge of Slavic languages, Croatian, Polish, and Serbian were listed twice each, Bosnian and Ukrainian – one time each. The following foreign languages were mentioned only one time: Chinese, Dutch, Greek, Kazakh, and Swedish.

In this investigation we focus on *reading* as a receptive skill in L2 (Russian) among German native speakers. Our choice of reading skill in Russian is motivated by two factors. On the one hand, we analyze the understanding of Bulgarian stimuli in written rather than oral form. On the other hand, Bulgarian and Russian use the Cyrillic script, unlike some other Slavic languages and Germanic languages. The participants' level of reading in Russian was determined by participants themselves. The participants' proficiency in reading ranges on the scale (0 – 100) from A1 to C2 level (see Table 2).

Table 2. Distribution of proficiency in reading in Russian per CEFR levels

The participants' proficiency in reading	Number of participants
A0 – A1	8
A2	6
B1	5
B2	4
C1	4
C2	6

Underlying assumptions are that multilingual participants (with knowledge of many languages) have greater language awareness and are on average better at intercomprehension (Berthele 2011; Vanhove, Berthele 2015), and participants with a higher level in reading of L2 perform better on translation task experiments in L3 (cf. Swarte et al. 2013).

Firstly, we correlated the number of known languages with intelligibility score of participants and found a positive but low and not significant correlation: $r = 0.32$ ($p = 0.068$). That means that the number of known languages does not play an important role in our experiment.

It can be explained by the fact that the participants' linguistic repertoire includes, as already mentioned above, first of all German and Russian, English, often also French or Spanish, Latin or Italian, depending on which 2nd or even 3rd foreign language was taught in school or what language background the family has. However, in this experiment we tested the intelligibility of an unknown Slavic language (Bulgarian) through a related Slavic language (Russian). In the context of Slavic-German intercomprehension the knowledge of additional Germanic or Romance languages seems not to play an important role which makes sense in principle.

Secondly, we correlated participant's proficiency in reading in L2 (Russian) with intelligibility score and found a positive and significant correlation: $r = 0.67$ ($p < 0.00005$). Thus, we can conclude that German participants who have higher proficiency in reading in Russian are more successful at translating Bulgarian words than the participants who have lower proficiency in reading in Russian.

3.2. Linguistic factors

The availability of a considerable number of cognates (corresponding words with a common root and similar meaning) is expected to facilitate cross-lingual intelligibility processes. The more cognate pairs between L1 and Lx exist, the better their mutual intelligibility should be. Nonetheless, certain formal properties of Lx cognates may have changed in the course of time to the extent of being no longer transparent to a person with no historical-linguistic background. For example, Jágrová et al. (2017b) found that despite similar lexical distances in terms of the share of non-cognates, Czech and Polish (both West Slavic, Latin script) were orthographically more distant from each other than Bulgarian and Russian (South and East Slavic, Cyrillic script). The nature, position, frequency of orthographic correspondences can indeed influence intelligibility (Stenger 2019; Stenger, Avgustinova 2020). Investigating Cyrillic script intelligibility for Russian readers, Stenger (2019) confirms that *identical orthographic correspondences* increase intelligibility, while *non-identical* (*mismatched*) ones yield a barrier, and in addition shows that cognates are generally easier to understand if the beginning of the word is identical.

In our investigation, we also distinguish between identical and mismatched correspondences, for example, the Bulgarian – Russian cognate pair *автомобил – автомобиль* 'car' has 9 identical orthographic correspondences and 1 mismatched orthographic correspondence[7]. We assume that identical orthographic correspondences between Bulgarian and Russian will positively affect intelligibility of Bulgarian stimuli among German native speakers while that mismatched correspondences will affect it negatively.

Word length has been shown to influence the intelligibility of individual words. In the recognition of South Slavic written stimuli by Russian readers, Stenger (2019) highlights the word length of stimuli as an explanatory variable, since South Slavic words tend to be

[7] The data of identical and mismatched orthographic correspondences between Bulgarian and Russian are available in Stenger (2019, 354f.).

generally shorter than their East Slavic cognates. We calculated Bulgarian word lengths in terms of the number of characters. The longest Bulgarian word is *автомобил* 'car' and consists of 9 characters. The shortest Bulgarian word is *еж* 'hedgehog', consisting of 2 characters[8]. Our assumption is that longer words are more easily recognized than shorter words in an intercomprehension reading scenario via a bridge language.

Word frequency may also influence the correct understanding of cognates, since speakers are exposed more often to frequent words (cf. Kürschner et al. 2008). Word frequencies of Russian cognates we use are based on frequency lists from the Russian national corpus (Liashevskaia, Sharov 2009). With regard to the stimuli, the most frequent Russian cognate is *один* 'one' (2245.7 ipm[9]) and the least frequent one is *никель* 'nickel' (7.4 ipm)[10]. So, the initial hypothesis is that the more frequent the Russian cognate is, the easier it would be to understand the equivalent Bulgarian stimulus from the German perspective.

Our goal is to validate the introduced linguistic factors – the identical orthographic and mismatched orthographic correspondences (ioc vs. moc), the word length (wl) and the word frequency (wf) – with the obtained intelligibility score to see whether these factors can perform well as explanatory variables in mediated receptive multilingualism.

The intercomprehension scores correlate significantly with the identical and mismatched orthographic correspondences, as well as with the Bulgarian word length (Table 3). Similar results were shown by Stenger (2019) in Bulgarian word intelligibility among Russian native speakers and could be replicated in our experiment. We also found a positive but low and not significant correlation between the intercomprehension score and the Russian word frequency. It is interesting that word frequency of Russian cognates seems to play a little more important role in our experiment in comparison to Bulgarian word intelligibility among Russian native speakers (cf. Stenger 2019; Stenger, Avgustinova 2020).

Table 3. The correlations between intercomprehension scores and linguistic factors

Translation task	**Linguistic factors**			
	ioc	**moc**	**wl**	**wf**
BG via RU for GE	$r = 0.45$ $p < 0.0005$	$r = -0.39$ $p < 0.005$	$r = 0.37$ $p < 0.005$	$r = 0.22$ $p = 0.086$

As we see, three single linguistic factors (identical orthographic correspondences, mismatched orthographic correspondences, and word length) do affect the understanding of an unfamiliar language through a related bridge language on the word level. Taking into account all these three factors with the help of Leveshnstein

[8] The data of Bulgarian word length is available in Stenger (2019, 360f.).
[9] instances per million words
[10] The data of Russian word frequency is available in Stenger (2019, 360f.).

algorithm (Levenshtein 1966), we obtain the so-called *orthographic distance* between Bulgarian and Russian cognates.

A string similarity measure based on Levenstein algorithm approximates synchronically observable orthographic characteristics of cross-linguistic correspondences (cf. Stenger 2019; Stenger, Avgustinova 2020). The *orthographic distance* between two corresponding items takes into account the minimum number of symbols that need to be inserted, deleted or substituted in order to transform a word in one language into the corresponding word in another language.

In the simplest form of the algorithm, all operations have the same cost. We use 0 for the cost of mapping a character to itself, e.g., *a*:*a*, 1 to map it to a different character, e.g., *a*:*o*. Insertions and deletions of different characters cost 1. In more sensitive versions, base and diacritic may be distinguished. For example, the base of *ë* is *e*, and the diacritic is the diaeresis. Though it is not exactly clear what weight should be attributed to each of the components (Gooskens, Heeringa 2004), it is generally assumed that differences in the base will usually confuse the reader to a much greater extent than diacritical differences (Heeringa et al. 2013). If two characters have the same base but differ in diacritics, we assign them a substitution cost of 0.5.

In order to obtain distances which are based on linguistically motivated alignments, the algorithm is adapted so that in the alignment a character representing a vowel may only correspond to a vowel character and a consonant character only to a consonant character. We consider the normalized orthographic distance with regard to the assumption that a segmental difference in a word of two segments has a stronger impact on intelligibility than a segmental difference in a word of ten segments (Beijering et al. 2008).

Table 4 illustrates a calculation of the orthographic distance between the Bulgarian word *хлад* and the corresponding Russian word *холод* 'cold'.

Table 4. Alignment of the Bulgarian – Russian cognate pair for 'cold'

Alignments	1	2	3	4	5
Bulgarian	х		л	а	д
Russian	х	о	л	о	д
Costs	0	1	0	1	0

The sum of costs (2) divided by the number of the positions in the alignment (5) gives us a normalized orthographic distance of 0.4[11]. The basic assumption is that small orthographic distances would correlate with high intelligibility scores, while large orthographic distances are expected to correlate with low intelligibility scores. With other words, the larger the orthographic distance between L3 and L2, the more difficult it is to understand L3 trough L2 and to translate into L1.

[11] The calculated distances between Bulgarian and Russian are available in Stenger (2019, 335ff.).

We correlated the results of written word translation experiment with the normalized orthographic distance. There is a negative and significant correlation of – 0.46 ($p < 0.0005$), which means that on the word level the written intelligibility in mediated receptive multilingualism can be predicted well from the normalized orthographic distance between L3 and L2.

4. Discussion and conclusions

In this study we investigated whether knowledge of Russian can help German native speakers to decode written words from an unknown Bulgarian language in a web-based experiment. As mentioned above, previous research on the mutual intelligibility between (closely) related languages in Europe (Gooskens et al. 2017) has indicated an intelligibility score of 40% as a tentative threshold successful communication. In our investigation, the mean percentage of correct responses for the 64 Bulgarian stimuli presented to 33 German native speakers is 45.50%. The experimental results suggest that Russian as L2 can indeed help subjects of L1 German to quite successfully process written words of an unknown L3 Bulgarian (RQ1). Additionally, we could determine that there is a link between successful human performance and individual reaction time in an intercomprehension reading scenario via a bridge language. The results revealed that the German participants with higher intelligibility score were significantly faster at correctly translating the written Bulgarian stimuli than the German participants with smaller intelligibility score.

The main purpose of the present study was to explore the possibility of selected individual and linguistic factors playing a role in intelligibility of an unknown language L3 Bulgarian via a related bridge language L2 Russian among participants with German as a native language L1.

An individual factor that plays the most important role in our experiment is the participants' proficiency in reading in L2. In our experiment, German participants who have a higher proficiency in reading in Russian are more successful at translating written Bulgarian words than the participants who have a low proficiency in reading in Russian. Note that these results directly relate to the overall level of knowledge of Russian as a foreign language. Therefore, recruiting additional subjects in future would allow us to focus on (German L1) participants with a higher level of (Russian L2) language proficiency.

However, the selected individual factor multilingual awareness seems not to play a role in written Bulgarian word recognition among German subjects. It has been suggested that knowledge of one or more Germanic or Romance languages could not be a source of individual information that might provide an explanation in successful Bulgarian – German intercomprehension via a bridge language Russian established in our study. It also can be explained by the fact that there is a small number of internationalisms (only 16% of the stimulus material), in the understanding of which the knowledge of Germanic and Romance languages may play a positive role in the cognate recognition (RQ2).

To gain insight into relative importance of (dis)similarities between the L2 and L3 languages in mediated receptive multilingualism, we analyzed single linguistic factors that playing a role in intelligibility between (closely) related languages at the word level for speakers of the respective languages in a first confrontation (cf. Kürschner et al. 2008; Stenger 2019; Stenger, Avgustinova 2020; Mosbach et al. 2021). We wanted to validate the prediction potential of selected linguistic factors in mediated receptive multilingualism, too. By correlating the intelligibility score with the identical and mismatched orthographic correspondences, the Bulgarian word length and the Russian word frequency we could determine the relative importance of these linguistic factors in a spontaneous comprehension of an unknown language via a related bridge language. A mediated intelligibility among German native speakers appears to be due to the identical and mismatched orthographic correspondences between Bulgarian and Russian cognates and the Bulgarian stimulus length, while the factor identical orthographic correspondences is the most important one among four single factors.

Interestingly, the Russian word frequency does not make a significant contribution to the prediction of mediated intelligibility. Also, in previous research the link between intelligibility of (closely) related languages and word frequency has mostly been rather weak (cf. Stenger 2019; Stenger, Avgustinova 2020). It is possible that this is caused by the experimental design where participants may be less strongly influenced by the word frequency of their native or bridge language.

In addition, we correlated the intelligibility score with orthographic distance between Bulgarian and Russian cognates. Our results show that we are able to predict mediated intelligibility to a middle extent. The orthographic distance between Bulgarian and Russian cognates correlates significantly with the written mediated intelligibility among German subjects. Thus, it can be detected as the most important linguistic predictor in mediated intelligibility by German subjects (RQ3).

It should be noted here that even more individual, linguistic and extra-linguistic factors may play a role in receptive multilingualism (cf. Gooskens, van Heuven 2020), in particular in mediated receptive multilingualism (cf. Branets et al. 2019). It depends on experimental settings, language combinations and participants' groups. As already mentioned in Section 2.2, we do not distinguish here between young and older subjects. However, it will be interesting to compare the nature of intelligibility and individual receptive multilingualism awareness across generations, for example between young (18 to 35 years) and older (> 35 years) subjects.

In this study we were interested in mediated intelligibility and wanted to know whether the methods used to analyze mutual intelligibility between (closely) related languages, i.e., inherent intelligibility, are also well suited to be applied in mediated receptive multilingualism. Looking at our results it seems safe to say that proficiency in reading in L2 (Russian) as an individual factor and orthographic distance between L3 (Bulgarian) and L2 (Russian) cognates as a linguistic factor are the most important predictors in our experiment. It would be interesting to test the same material with native speakers of German (L1) in a free translation task to recognize the meaning of stimuli in Russian (as L3) via a bridge language Bulgarian (as L2).

Our investigation can be improved by adding additional experimental tasks, i.e., on the phrasal, sentence and text levels (in visual and oral modality) including larger number of speakers as well as other language combinations in order to provide a stronger basis in research on mediated receptive multilingualism.

In general, the results of this study show that it is possible to understand an unknown language through a related bridge language to a certain degree. As several studies of the last years show, there are many advantages of being able to communicate in one's own language and to comprehend another language by means of receptive multilingualism. In this context it is very important to improve individual receptive multilingualism creating opportunities for people to be exposed to foreign languages, for example, through multimedia cross-linguistic experimental settings, school and university exchange programs, intercomprehension courses etc.

As already mentioned in Section 1, individual receptive multilingualism has received attention in educational settings (FREPA, EUROCOM). Our website (https://intercomprehension.coli.uni-saarland.de) as an e-learning tool motivates the use of individual linguistic repertoires as an integrated communication system, for example, in a global classroom. Students develop individual multilingualism awareness in international communication. They have the opportunity to work with innovative concepts and virtual formats of individual multilingualism, test themselves online at different proficiency levels, expand efficiently their language repertoires in specific directions, and gain practical multilingual experience. Multimedia intercomprehension experiments may particularly encourage individual receptive multilingualism in situational contexts with specific topics and domains of interest, e.g., sports, tourism, education, health infrastructure, media and digital communication.

Acknowledgments

This work was funded by Saarland University (UdS-Internationalisierungsfonds, Transform4Europe). We thank two anonymous reviewers for useful comments on an earlier version of this article.

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Appendix

64 Bulgarian stimuli in alphabetical order

автомобил	култура
бик	лакът
брада	лято
бреза	мебел
вишна	месец
вълк	месо
вяра	мраз
вятър	музика
глава	мъж
глад	небе
гърло	никел
ден	огън

дъжд	пес
един	пет
еж	плаж
езеро	пустиня
език	път
жал	радост
звяр	ред
здраве	резултат
земя	риба
злато	ръка
зъб	син
име	смърт
календар	сняг
коктейл	сол
коляно	сряда
корен	филм
кост	хлад
крава	цвят
кръв	цел
кръст	яйце

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