

Overcoming COVID-19 vaccine hesitancy: An investigation of the Foreign Language Effect

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Vaccine hesitancy remains one of the greatest challenges for global health. Previous research has shown that the recruitment of rational processes is increased in hypothetical decision-making scenarios when the underpinning information is presented in a foreign language. We investigate whether vaccine campaigns could benefit from this Foreign Language Effect (FLE) in order to overcome vaccine hesitancy. We conceptually replicated a recent study on COVID-19 vaccine campaigns (Freeman et al. 2021) to assess whether information can more successfully reduce vaccine hesitancy when presented in a foreign language as well as how other factors, such as language proficiency, impact the FLE. Based on a survey of 436 participants, we conclude that there may be the potential to lower vaccine hesitancy among individuals with English as a foreign language by presenting information in English, rather than in their native language. Conversely, participants who are native speakers of English and negatively predisposed against the COVID-19 vaccine react more negatively to information they read in a foreign language compared to their native language.

Introduction

In 2019, shortly before the outbreak of the COVID-19 pandemic, the World Health Organization (WHO) published a list of the ten greatest threats to global health. One of these threats was ‘the reluctance or refusal to vaccinate despite the availability of vaccines’ (<https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019>, accessed 20 August 2024). Since then, the impact of this threat has become more tangible, since broad levels of uptake of vaccines and their boosters are a key factor not only in the global recovery from the COVID-19 pandemic but also in planning for future threats to global health. To encourage the high levels of immunization necessary to contain the spread of viruses, communication relating to the risks and benefits of approved vaccines needs to overcome significant challenges. Potentially, the most difficult of these challenges is the question of how to overcome irrational and/or counterfactual beliefs (‘antivaxx beliefs’) amongst individuals who are reluctant to be vaccinated, particularly since

such beliefs are often amplified by disinformation campaigns exploiting the inherent mechanisms of modern social media. For example, a study of over 200,000 tweets tagged with the name of the first available vaccine (Jemielniak and Kremповych 2021) found that information originating from sources known for distributing misinformation was retweeted more frequently than more reliable information. The authors conclude that Twitter discourse 'is filled with misinformation and bad press, and may be distributed not only organically by anti-vaxxer activists but also systematically by professional sources' (Jemielniak and Kremповych 2021: 4).

The high efficacy and low side effects of the various vaccines against the COVID-19 virus and its variants have been amply demonstrated, and as of March 2023 (when many countries had stopped reporting vaccination data) approximately 72.3% of the global population (5.55 billion individuals) have received at least one dose of a Covid vaccine and a total of over 13 billion doses have been administered (<https://www.nytimes.com/interactive/2021/world/covid-vaccinations-tracker.html>). That notwithstanding, rates of vaccine hesitancy remain at concerningly high levels across many countries and contexts, despite the positive messaging emerging from an unprecedented global vaccination program. For example, Steinert et al. (2022) report a very wide spread of individuals self-identifying as vaccine-hesitant across European countries, ranging from as low as 6.4% of adults (in Spain) to as high as 61.8% (in Bulgaria). The authors highlight the need for more effective public health campaigns, and point to how 'subtle information nudges can shape individuals' health-related beliefs and decisions' (2). However, as they show, the success of such campaigns in both debunking myths ('vaccines cause autism') and increasing uptake varies greatly across contexts and studies.

Vaccine hesitancy is affected by a broad range of factors. As Steinert et al. (2022) have shown, country and region are important factors. For example, the proportion of participants describing themselves as hesitant to be vaccinated in a study conducted between April and June 2021 (Lazarus et al. 2022) was 18.8% in the UK, 26.3% in Germany, and 36.5% in France. Factors such as gender, age, educational level, and socioeconomic status also play a role, with females, younger people, and people with lower educational levels typically more hesitant (Steinert et al. 2022). An important factor is national and ethnic origin since some segments of the population are typically more difficult to reach by vaccination campaigns, such as migrant communities or ethnic minorities (e.g. Crawshaw et al. 2022; Hussain et al. 2022). For example, in the UK, vaccine hesitancy is almost four times higher among Black ethnic groups (71.8%), and more than twice as high in the Pakistani and Bangladeshi communities (42.3%) than in the White British population (Robertson et al. 2021).

The way in which health campaigns frame their messages is at least as important as ensuring that the content is clear, accessible, accurate, and effective. This framing includes the language in which the campaign is conducted, with many studies highlighting the importance of providing materials in the native language of the target audience (e.g. Kreuter and McClure 2004). Providing information not only in the majority but also in minority and migrant languages may not only reduce the language barriers which could limit the effectiveness of some campaigns, but also help build trust and reach a wider range of individuals (e.g. Crawshaw et al. 2022). However, differences in vaccine uptake across subsections of the population cannot always be ascribed to language barriers—for example, the groups in which the Robertson et al. (2021) study mentioned above found higher levels of hesitancy typically have good or very good proficiency in English.

Interestingly, however, there are findings that indicate that the use of non-native languages, in particular English, can induce individuals to make more rational choices than when the information is presented in their native language (L1) (the Foreign Language Effect (FLE), e.g. Keysar et al. 2012; Costa et al. 2014a; for more details see below). As such, the use of a foreign language can be a potentially valuable instrument in overcoming counterfactual beliefs.

This paper presents an investigation into the impact of presenting information on the COVID-19 vaccine in a foreign language. In an attempt to separate the FLE from effects of prestige and power associated with majority versus minority or migrant languages, we have chosen to focus

on school-learned foreign languages in three European countries with varying levels of vaccine hesitancy.

Multilingualism, decision-making, and the FLE

The question of the language in which health-related information should be provided to migrant and minority populations is a relatively recent one that has arisen in the broader context of recognizing culture as a factor impacting behaviour and decision-making in health-related contexts (Kreuter and McClure 2004). It is important that governments and health authorities recognize and address the problems and obstacles that language barriers pose to information campaigns. Such barriers tend to be exacerbated in emergency situations such as the COVID-19 pandemic and can lead to inequalities in that people with insufficient knowledge of the dominant language may be excluded from information relating not only to the containment of the spread of the virus but also to available support (Civico 2021), leading to the exclusion of linguistic minorities from the discourse. A special issue of the journal *Multilingua* (Vol. 39(5), Zang 2020) is dedicated specifically to multilingual crisis communication against the background of COVID-19 and documents the need for broader awareness of such challenges. This was demonstrated, for example, by Piller, Zhang and Li (2022), who point out that while the exclusion of linguistic minorities from fair and equitable access is common around the world, access to timely, high-quality information becomes more vital in times of crises, and this exacerbates these pre-existing inequalities.

During the COVID-19 pandemic, ethnic minority groups not only suffered disproportionately high levels of morbidity and mortality (Price-Haywood et al. 2020) but they were also particularly vulnerable to information inequality through a combination of language barriers, a lack of trust in official communications, poor access to high-quality information and massive exposure to misinformation (Piller, Zhang and Li 2022). A systematic review of 24 studies on vaccine hesitancy/acceptance in ethnic minority groups (Hussain et al. 2022) finds that vaccine hesitancy among these populations is a complex phenomenon, influenced by many factors such as a lack of trust (often exacerbated by historical medical mistrust), and emphasizes the need for health campaigns to be grounded in equality, respect for diversity, and cultural competence.

While it is clearly important that health-related information is provided in ways that are linguistically and culturally appropriate and sensitive, there may be a different angle to the question of whether it is preferable to communicate in the target audience's first (L1) or second language (L2). This consideration is linked to the cognitive processes that individuals rely on when making decisions. It has long been established that the human tendency to recruit implicit and intuitive processes rather than formal or logical reasoning is what allows fast decision-making (e.g. Kahnemann 2011). As a species, we tend to ignore evidence that contradicts our implicitly held intuitive beliefs and fail to revise them even when their evidential basis is (a) extremely weak to begin with and (b) entirely refuted later on (Anderson, Lepper and Ross 1980). In particular, if there is a potentially negative outcome associated with a decision, this outcome is typically more strongly weighted than warranted by the probability of it occurring (e.g. Hayakawa and Marian 2022), and individuals are willing to take risks in order to avoid the outcome in what has been referred to as loss aversion bias (e.g. Keysar, Hayakawa and An 2012). These tendencies are amplified in situations with a high degree of emotional resonance (Costa et al. 2014b), such as vaccinations. This has become a topic in which the problem of a loss aversion bias—the disproportionate fear of an extremely unlikely negative outcome—is particularly widespread, based on strong beliefs that are highly resistant to factual evidence.

In this context, it is important to look to a finding that has often been reported with respect to hypothetical decision-making scenarios and suggests the possibility that the use of a second language in public health campaigns may actually be helpful for overcoming loss aversion bias. Previous research investigating risk assessment processes in decision-making has demonstrated that the recruitment of measured, rational processes and utilitarian choices are increased when people process information in a foreign language rather than in their native language—a phenomenon that is referred to as the FLE (e.g. Keysar, Hayakawa, and An 2012; Costa et al. 2014b).

An example of this effect is presented by [Keysar, Hayakawa, and An \(2012\)](#), who report that, when a problem is formulated in participants' L1, the choice between two factually identical options is influenced by loss aversion bias and thus depends on how the problem is framed. This is demonstrated using various scenarios, among them the 'Asian disease' problem¹ which requires participants to hypothetically decide between developing one of two potential treatment options to combat an ongoing epidemic. According to the scenario, if no treatment is developed, 600,000 people will die. Treatment A will lead to 400,000 people dying and 200,000 surviving, whereas Treatment B presents a 33.3% chance of saving all 600,000 and a 66.6% chance of saving no one. Keysar et al. tested three groups of students in different contexts (native English speakers in the USA with proficiency in Japanese as a foreign language, native Korean students in the USA with L2 knowledge of English, and native English students in France with L2 knowledge of French). When tested in their native language, more participants preferred Treatment A when the formulation of the treatment outcomes focused on the survival rate rather than on the mortality rate ('Gain frame': 200,000 people will be saved vs. 'Loss frame': 400,000 people will die). Interestingly, this loss aversion bias disappeared entirely when the experiment is carried out in the participants' L2 ([Keysar, Hayakawa and An 2012](#)). A similar effect has been found in relation to the familiar 'trolley dilemma', where participants are asked whether they would sacrifice the life of one person, whom they have to push off a footbridge to stop a trolley, which would otherwise smash into a group of five people, killing them all: more participants choose the utilitarian option of killing one to save five when the dilemma is presented in their L2 than in their L1 ([Costa et al. 2014b](#)).

Similar results have been found in a number of other experimental paradigms for a range of languages and related rationality effects (for a recent overview, see [Purpuri et al. 2024](#)). For example, causal and correlational illusions—the (incorrect) assumption that two events are related, or that a series of unrelated positive outcomes makes another positive outcome more likely—are reduced in foreign languages ([Costa et al. 2017](#); [Díaz-Lago and Matute 2019](#)). All of these findings suggest that decision-making in L2 is less influenced by cognitive biases, especially where the bias is grounded in emotional reactions ([Costa and VivesCorey 2014b](#)), that it is less subject to intuitive judgments and more impacted by deliberation ([Costa et al. 2017](#)). Beyond hypothetical decision-making scenarios, similar facilitation of rational processes has been found for the perception of the risks and benefits of real-life hazards: [Hadjichristidis, Geipel and Savadori \(2015\)](#) asked native Italian students with an English major to rate the perceived risk and benefit of 26 items, from nuclear power plants through cellular phones to climate change, and consistently found the risk to be perceived as lower and the benefit as higher in the L2 as opposed to the L1.

The FLE has been explained with reference to the psychological processes that are recruited during decision-making. The dual-process model of decision-making (e.g. [Phillips et al. 2016](#)) posits that judgements and decisions take place at the intersection of rapid, automatic, and intuitive processes that rely on emotional reflexes on the one hand, and conscious, rational, and effortful processes of outcome evaluation on the other hand. The former type of process usually wins out, particularly in highly emotive contexts. However, the FLE appears to promote the latter type of process. This is attributed to a combination of factors, including the more limited emotional resonance and semantic entrenchment of foreign languages ([Pavlenko 2007, 2017](#); [Dewaele and Salomidou 2017](#)), a higher cognitive load during L2 processing ([Costa et al. 2014a](#)) and the resulting recruitment of more effortful and controlled processing routines ([Costa et al. 2017](#)). Speakers who learn an L2 later in life, particularly in instructed or professional settings, not only use the language less frequently than a monolingual would but also tend to have less experience with using it in situations where emotions are most strongly engaged. [Pavlenko \(2017\)](#) thus argues that foreign languages are characterized by diminished affective processing alongside a positivity bias.

A further potential explanation for the FLE is linked to cognitive load, that is, the fact that L2s are typically processed more slowly and effortfully, which may favour the recruitment of conscious and rational considerations (reflective processes) and thus reduce the involvement of rapid and automatic emotional reflexes (intuitive processes) in decision-making. Both assumptions—lower emotional entrenchment and higher cognitive load—receive support from the fact

that the FLE is strongest at lower levels of L2 proficiency and all but disappears amongst advanced L2 learners (Costa et al. 2014a). Recently, a link has been made to neurological processes: brain areas related to controlled processes are recruited by L2 processing to a greater extent than in the L1 (Costa et al. 2017). In summary, then, processing information in an L2 can result in slower, more deliberate, and more rational thought, thus allowing reason to overcome any spontaneous emotional responses.

Using an L2 to promote rational decision-making in healthcare contexts

The findings presented above suggest the intriguing possibility that the FLE might be useful in order to overcome cognitive biases and irrational decision-making in real-life situations, such as healthcare and medical interventions—and, in particular, vaccinations. An anonymous reviewer has pointed to the problematic nature of subverting patient understanding and eliciting informed consent in this context. While we fully agree with the importance of ethical considerations, we feel that the simple manipulation of presenting the same information in different languages does not violate such constraints: as is the case in any other investigation of the effectiveness of public health communications, we merely seek to find a way of framing the message most effectively, but patients remain entirely free to make their own choices.

To the best of our knowledge, there are only two studies, both very recent, which have attempted to establish whether the FLE can be beneficially applied in the context of healthcare. The first is an investigation of health communication among a population of Chinese-English bilinguals ($n = 160$) residing in the USA, which reports that perception of the severity of a range of diseases differs depending on whether their description is provided in the L1 or the L2, with levels of pain and distress lower and estimates of curability higher for the L2 English condition than the L1 Chinese one (Hayakawa, Pan, and Marian 2022). Interestingly, the FLE in this study was stronger for balanced and simultaneous bilinguals than for participants with relatively lower levels of L2 proficiency and a later age of acquisition. This finding is at odds with investigations of the FLE in hypothetical scenarios, where the strongest effect is typically found in the groups with lower proficiency (see above).

The second study, which is particularly relevant to the current paper, involved a language intervention for information related to the COVID-19 vaccine (Geipel, Grant, and Keysar 2022). Six hundred and eleven Hong Kong Chinese residents were presented with this information in either their L1 (Chinese) or their L2 (English). This study found higher levels of trust in the safety and effectiveness of the vaccine when the information was received in English. The study did not investigate further language-related predictors, such as proficiency or age of acquisition.

These two initial findings indicate that the choice of the language of presentation of health-related information may impact the uptake of that information. It is, however, difficult to draw more general conclusions about the use of foreign languages on the basis of these two investigations, in particular since the FLE is likely to be highly context-dependent. Specifically, the two existing studies concern populations for whom L2 English likely plays an important role in everyday life. The symbolic value of this language for each participant will be influenced by their perceptions of English speakers within their respective sociocultural context as well as their personal experience with the language. In contexts where there is so much individual variation with respect to the contexts of experience, it becomes difficult to establish to what extent a language effect is the outcome of a (positive or negative) symbolic function specific to the population under investigation, as opposed to more considered, rational thought processes as promoted by foreign language processing. The design introduced here seeks to minimize this variability by focusing on classroom learners, who have a more homogenous experience with respect to their foreign language.

Interim conclusion

A range of previous studies indicate that information processing and decision-making are more rational and less affected by cognitive bias in foreign languages than in native ones. The language

of presentation of information relating to health decisions, such as the safety and efficacy of the COVID-19 vaccine, may therefore impact attitudes and feed into the choices that individuals make. As such, it is important to get a better understanding of whether and to what extent the language of presentation can either enhance or attenuate the desired effect of public health campaigns for particular groups. The present study, therefore, investigates whether presenting information relating to the COVID-19 vaccine in a foreign language can recruit more rational thought processes, as previously suggested, and therefore result in lower levels of vaccine hesitancy among participants who are negatively predisposed against the vaccine than the same information presented in participants' native language.

The broad range of language learning and proficiency contexts represented in the studies summarized above points to an important methodological and terminological problem related to the concept of 'native' versus 'second' or 'foreign' language. Populations investigated have typically comprised university students studying their second language either in a study-abroad setting or at home, and where levels of proficiency are reported in the study, they typically rely on self-reports, which limits the reliability of conclusions about the impact of proficiency levels (Pupuri et al. 2024). There is also usually very little information about learning background, age of acquisition, and so on, although all of these may strongly impact semantic and affective valence processing (Pavlenko 2017).

In order to control these factors as far as possible, the present study opts to investigate native versus school-learned foreign languages. In order to minimize the context-dependent symbolic function of the L2, we recruited speakers with limited foreign language experience. We also aimed to include participants at lower proficiency levels, which is where the FLE is most likely to manifest itself.

Our investigation therefore focused on three widely taught foreign languages in three European countries, English, French, and German, in order to be able to recruit the necessary number of L2 learners within the timeframe and under the inevitable COVID-19 restrictions operating at the time of the data collection.² Furthermore, anti-vaccine beliefs vary among the three countries (see above): they are almost twice as high in France as in the UK, with Germany occupying an intermediate position. Participants were (current or former) classroom learners of one of the three target languages, and native speakers of another.

Research questions

This study addresses the following research questions:

- RQ1: Can presenting information relating to the COVID-19 vaccine in a foreign language lead to reduced vaccine hesitancy as compared to presenting the same information in a native language?
- RQ2: What is the impact of the language of presentation (English, French, German)?
- RQ3: What is the impact of participants' proficiency in and experience with the foreign language?

Methodology

Ethical approval

The study was reviewed and was granted ethical approval on 28 September 2021 by the Ethics Sub-Committee 3 at the University of Essex, UK (application no. ETH2122-0113).

Precursor study

The present study conceptually replicated a recent study conducted in the UK (Freeman et al. 2021) in which 18,855 adult participants were recruited. A pre-assessment classified them into vaccine-willing ($n = 12,463$, 66.1%), doubtful ($n = 2,932$, 15.6%) or strongly hesitant (3,460, 18.4%). Participants were randomly presented with one of ten short informative texts (all in English) about COVID-19 vaccines. The texts emphasized the different advantages of vaccination, including the collective

benefits to society, the personal benefits of being vaccinated, and the safety of approved vaccines. After presenting the information, Freeman et al. (2021) measured participants' vaccine hesitancy and attitudes to Covid and compared these to attitudes pre-intervention. None of the text types had a significant effect on participants who held positive attitudes towards the vaccine, nor on those who expressed moderate doubts, while three of the texts—one about personal benefits, one about collective benefits, and one about the safety of the vaccine—led to a slight reduction in vaccine hesitancy among the most strongly opposed participants. Given the very negative baseline attitudes in this group, the authors of the study deemed it unlikely that the small improvement achieved by the intervention would lead to a change in their decision not to take up the vaccine. They further note that none of the information they had provided to their participants successfully lowered vaccine hesitancy in the intermediate, vaccine-doubtful group. They point to the need to develop interventions specifically targeted at reaching this population, that is, the people who may be persuaded to change their stance and allow themselves to be vaccinated.

Participants and exclusion criteria

The participants for the present study were recruited by Qualtrics (www.qualtrics.com) in December 2021 and January 2022 through their panel base; all participants who completed the survey were remunerated for their participation by Qualtrics. Initial screening questions ensured that only individuals whose native language was English, French, or German; who considered themselves able to read simple texts in at least two of the three target languages (i.e. their native language and one other language); and who had not yet been vaccinated against COVID-19 would take part in the study.

Participants were asked to select the strongest L2 from among the L2s targeted, that is, French or German for L1 speakers of English, English or German for L1 speakers of French, and English or French for L1 speakers of German.

In total, 436 individuals participated in this study. Of those participants, 156 were L1 speakers of English, 134 were L1 speakers of French, and 146 were L1 speakers of German. Two hundred and four participants identified as male, 229 as female, 2 preferred another gender identity, and 1 preferred not to state their gender. Participants were between eighteen and eighty-two years old, with an average age of 39.82 (SD 13.8). Ninety-nine participants had finished the lower level of mandatory education, 157 had taken a qualification that gives access to Higher Education (A-level, *baccalauréat*, or *Abitur*), and 180 had completed an undergraduate or postgraduate university degree (see Table 1). We did not collect information on race or ethnicity.

Table 1. Participant characteristics.

Native language	Foreign language	n	Male	Female	oth./no resp.	Age (mean, range)	Education		
							Level 1	Level 2	Level 3
EN	FR	109	53	55	1	36.1 (18–82)	18	44	47
	GE	47	25	21	1	36.6 (18–61)	10	24	13
FR	EN	131	54	77		38.0 (18–75)	14	47	69
	GE	3	1	2		46.3 (37–57)			3
GE	EN	143	69	73		44.8 (18–78)	57	40	46
	FR	3	2	1		60.0 (52–65)		2	2

Materials and procedure

Participant screening, background, and L2 proficiency

The different parts of our study are schematically represented in Fig. 1.

Before beginning the study, participants were presented with a participant information screen in their native language and asked to consent to taking part by clicking the box providing consent and initiating the survey.

Once consent had been provided, participants were given a language assessment in their self-declared strongest L2. For L2 English, participants completed the standardized Oxford Quick Placement Test. For L2 French and L2 German, placement tests developed by language professionals in the Department of Language and Linguistics at the University of Essex, UK, were used with the kind permission of the developers. These tests, comprising 28 (German) or 30 (French) multiple-choice questions on a range of lexical, morphological, and grammatical features, assess proficiency levels between A1 and B2.

Three demographic background questions established participants' age, gender, and educational level. Following Freeman et al. (2021), baseline vaccine hesitancy was assessed by asking participants to indicate on a 6-point scale ranging from 'as soon as possible' to 'never' their intention to be vaccinated with a free and safe vaccine.

COVID vaccine information and vaccine hesitancy measures

Having completed the personal background questionnaire, L2 proficiency test, and baseline vaccine hesitancy assessment, participants were randomly assigned to read one of the three texts that had resulted in a significant improvement in vaccine hesitancy scores in the precursor study, namely the texts that focused on collective benefits (Freeman et al.'s Condition 4), personal benefits (Condition 5), and the safety of the vaccine (Condition 7). These three texts were checked for their appropriateness for L2 readers at low to intermediate proficiency by an experienced English language teacher in the Department of Language and Linguistics at the University of Essex and slightly adapted (i.e., simplified) according to their advice. For example, the phrase 'can seriously disrupt your life' was changed to 'can make your life very difficult', and 'minimizes the chances'

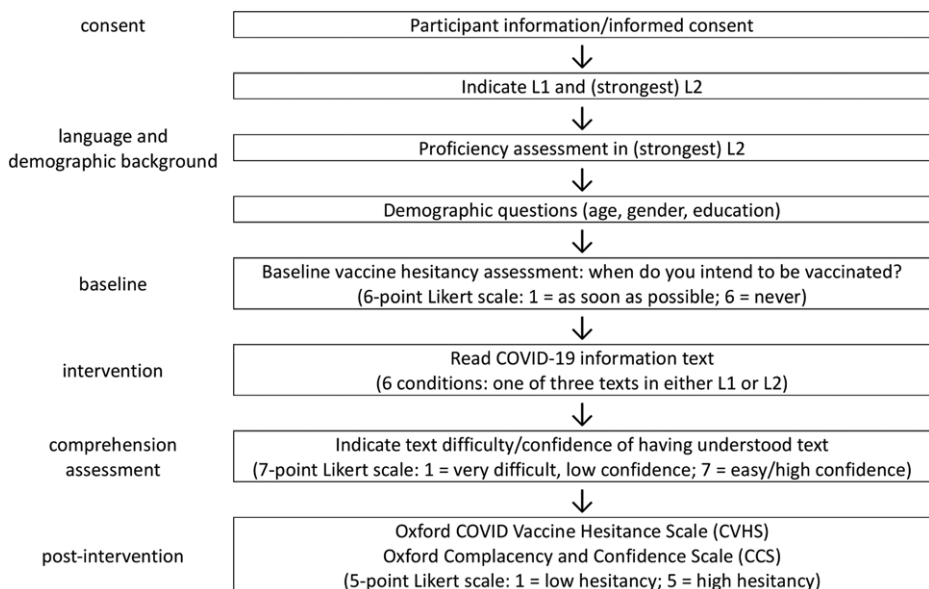


Figure 1. The study.

to 'makes it less likely'. The adapted texts were translated into German and French and subsequently independently back-translated into English to ensure complete equivalence. This work was carried out by professional translators at TTC Wetranslate (<https://ttcwetranslate.com>). The presentation of each text in the L1 or the L2 of the participant was randomly assigned, and each participant read only one text in only one language.

After reading the text that they had been assigned, participants indicated on 7-point scales how difficult they had found it and how confident they were that they had understood it. In the post-intervention phase, participants completed the 7-item Oxford Covid Vaccine Hesitancy Scale (CVHS) and the 14-item Oxford Complacency and Confidence Scale (CCS), both presented in the participants' L1.³

Statistical method

Linear regression models were constructed for post-intervention vaccine hesitancy by means of the LME4 package (Bates et al. 2015) in R 4.1.2 (R Core Team 2021). To arrive at the most parsimonious model, predictors were added step by step, with the more complex model in each case compared to the previous, simpler model. If the model provided a significantly better fit (assessed on the basis of a reduction in the Akaike Information Criterion of at least 2 and a *P* value smaller than .05 in the ANOVA), the predictor was retained in the following step; if not, it was removed.

Outcome variable: vaccine hesitancy

Post-intervention vaccine hesitancy (that is, hesitancy after the informative text had been read) was assessed on the basis of the two scales used in the precursor study, the 7-item Oxford CVHS and the 14-item Oxford CCS. All responses were given on a 5-point Likert scale, with 5 indicating the highest level of vaccine hesitancy, leading to a highest possible score of 35 on the CVHS and 70 on the CCS.

Results

Descriptive results

Given the very low number of participants who did not report English being their strongest L2 in the French ($n = 3$) and German ($n = 3$) L1 groups, statistical analyses were conducted in two separate subgroups: Group A ($n = 156$) consisted of native speakers of English with French ($n = 109$) or German ($n = 47$) as a second language, Group B ($n = 274$) of French ($n = 131$) and German ($n = 143$) native speakers with English as a second language.

Predictor variables: L2 proficiency and baseline vaccine hesitancy

Overall levels of L2 proficiency were rather low, with an average of 27.1% for L2 English, 32.0% for French, and 29.4% for German. These differences were significant ($F(2,433) = 5.850$, $P < .01$, $\eta^2 = 0.026$), with Tukey post hoc tests establishing that average L2 English proficiency was significantly lower than average L2 French proficiency, but that L2 German proficiency did not differ significantly from either of the other two languages.

The populations in the three countries reported different levels of baseline vaccine hesitancy, which was lowest among the English native speakers (mean 3.35, SD 1.605) followed by the German L1 speakers (4.10 (1.841)), with French speakers reporting the highest average baseline hesitancy (4.40 (1.632)). There was a significant difference between populations ($F(2,433) = 15.052$, $P < .01$, $\eta^2 = 0.065$), with Tukey post hoc tests establishing that English natives were less hesitant than French or German natives, while the latter two populations did not differ significantly from each other.

For ease of presentation, the pre-intervention baseline scale was collapsed into three categories for the purpose of the descriptive results reported here (following Freeman et al. 2021—note that the full scale is used in the inferential statistics presented below): *vaccine willing* (who had responded that they would get the vaccine or had got it as soon as possible or as soon as they

had time, $n = 152$), *vaccine doubtful* (who would delay initially or were unsure, $n = 70$), and *vaccine hesitant* (who reported they would delay as long as possible or never get it, $n = 208$).

Outcome variable: vaccine hesitancy

Overall, the average score on the CCS was 40.3 (SD 12.6, range 14–67) and 22.6 (7.8, 7–35) on the CVHS (with higher scores indicating higher levels of vaccine hesitancy on the CVHS and lower levels of confidence in the vaccine on the CCS). Again, English native speakers scored somewhat lower on both scales than French and German native speakers (34.3 vs. 43.8 on the CCS and 19.0 vs. 24.6 on the CVHS). Since both scales were very strongly correlated ($r = 0.89$, $P < .011$) but based on different numbers of questions, we converted them both to z-scores and then averaged them per participant as an overall post-intervention measure of vaccine hesitancy, which was used as our outcome variable in the statistical models described below.

Findings per subgroup of vaccine willingness and treatment condition (text presented in L1 or L2) are presented in Table 2. While overall and from an impressionistic point of view post-intervention vaccine hesitancy did not seem to differ between participants who had read the text in L1 or L2, two individual results appeared to stand out: the vaccine-hesitant population with English as an L1 who had read the information in their L2 responded more negatively post-intervention than those participants who had read it in the L1. A similar tendency, though less pronounced, was found in the vaccine-doubtful population with L1 English. On the other hand, the vaccine-doubtful participants for whom English was an L2 seemed to respond better to information presented in that language, as their reported vaccine hesitancy was noticeably lower than that of speakers who had read it in their L1.

Inferential results: linear regression models

The first predictor to be added was baseline vaccine hesitancy, collected before the other tasks were administered (for the purpose of statistical modelling, categories were not collapsed, using instead the full 6-point scale). This was highly significant ($P < .001$) for both the English L1 (ENL1) and the English L2 (ENL2) group (ENL1: Estimate 0.473; ENL2: Estimate: 0.346). Neither the topic of the text (collective benefit, personal benefit, or safety of the vaccine) nor the L2 of the native English speakers or the L1 of the L2 English speakers, age, educational level, or level of proficiency in their L2 had a significant impact in either group. There was also no difference between the conditions of reading the text in the L1 versus in the L2. In other words, there was no indication of an FLE, either for participants whose L1 was English or for those for whom it was the L2.

Table 2. Post-intervention vaccine hesitancy (z-scores) by pre-intervention baseline and language of treatment.

		Vaccine-willing mean (Std)	Vaccine-doubtful mean (Std)	Vaccine-hesitant mean (Std)
L1 English				
	Text in L1	-1.14 (0.41)	-0.06 (0.29)	0.45 (0.59)
	Text in L2	-1.19 (0.41)	0.00 (0.27)	0.84 (0.39)
	All	1.17 (0.41)	0.03 (0.28)	0.63 (0.54)
L2 English				
	Text in L1	-0.93 (0.57)	0.18 (0.63)	0.76 (0.56)
	Text in L2	-0.81 (0.60)	-0.07 (0.58)	0.80 (0.56)
	All	-0.87 (0.58)	0.05 (0.61)	0.78 (0.56)

Specific populations

While the linear regression models reported above did not support the FLE prediction that a presentation of the text in participants' foreign language might help reduce vaccine-hesitant opinions, the descriptive statistics presented above did point to two interesting subgroups which we would like to zoom in on further. First, it seemed that for native English speakers who were strongly predisposed against taking the COVID-19 vaccine, reading information in their L2 actually reinforced this position more strongly than reading it in their L1. This difference between treatment conditions was found to be significant ($t(43.545) = -2.737, P = .01$). A closer look revealed that the more negative attitude elicited in the L2 impacted the CVHS more strongly ($t(39.455) = -3.430, P < .001$) than the CCS ($t(46) = -1.786, P < .05$).

Similarly, presentation in the L2 English led to marginally lower hesitancy levels overall for speakers who had reported being doubtful pre-intervention ($t(48) = 1.505, P = .069$). The decrease in hesitancy was significant for the CVHS ($t(48) = 1.803, P < .05$) but not for the CCS ($t(48) = 1.142, P = .130$). In this subpopulation, reported vaccine hesitancy was also marginally negatively correlated with L2 proficiency level, indicating that more proficient participants had higher reported hesitancy (Pearson's $r = -0.244, P = .088$).

Discussion

The study presented here was intended to be an initial investigation, scoping to what extent the FLE might be profitably exploited in the context of health campaigns to overcome irrational beliefs related to risk perception. To do so, we chose three texts that had been shown in a precursor study to have a small beneficial effect on vaccine hesitancy in the participant group that was most negatively predisposed against the COVID-19 vaccine pre-intervention (Freeman et al. 2021). Participants who had not yet been vaccinated were recruited through the Qualtrics panel base, following the rationale that the vaccine-willing proportion of this group would be rather small since all adults had become eligible for one or several doses of a free vaccine in the three countries under investigation (France, Germany, and the UK) in the course of 2021. Participants furthermore had to be able to read simple texts in at least two of the three languages under investigation, their L1 and one L2. Importantly, all participants were classroom learners of the foreign languages in question (previous studies of the FLE often do not fully make clear the background of their participants and/or conflate classroom and immersed learners).

After completing a survey eliciting baseline vaccine hesitancy, personal background information, and an assessment of L2 proficiency, participants randomly read one of three texts in either their L1 or their L2. Following this, we administered a vaccine hesitancy instrument consisting of seven questions on vaccine hesitancy (CVHS) and fourteen questions on confidence in the vaccine (CCS).

Participants were separated into two subpopulations: L1 English speakers with L2 French or German ($n = 156$) and L1 French or L1 German speakers with L2 English ($n = 274$). The first insight was that, as had been the case in the precursor study, participants already predisposed favourably towards vaccines did not change their attitudes after having read the texts (irrespective of the language in which they read it). This is unsurprising, given that acceptance rates in this population were high to begin with. Among the most strongly negative vaccine-hesitant population with English as an L2, vaccine hesitancy scores also did not differ as a function of the language in which they had received the information. However, both vaccine-doubtful and vaccine-hesitant English L1 speakers who had read a text in their L2 responded more negatively on these scales than those who had read it in the L1; this tendency only reached significance in the most strongly opposed group. We can only speculate as to the cause for this reactance, but it is possible that there may be some overlap in the UK population between people who hold negative views on immunization and those who are predisposed against foreign language learning. This hypothesis, however, needs to be investigated in future studies.

On the other hand, the intermediate vaccine-doubtful population of French and German L1 speakers responded more positively in terms of their vaccine hesitancy after having read information presented to them in L2 English compared with their native language. This is an interesting and potentially important finding, given that these participants represent the segment of the population in which effecting even small changes in attitudes may result in an eventual decision to take up the vaccine.

Several interpretations of this effect are possible, but all are speculative. On the one hand, there is the possibility that reading an informative text in L2 English did indeed cause the vaccine-doubtful participants to engage slower, more rational thinking processes, thereby allowing them to overcome irrational beliefs about the risk associated with taking the vaccine. The finding that hesitancy levels correlate with L2 proficiency in the group—that is, that the effect is attenuated among more proficient speakers—lends support to this hypothesis. However, if this is indeed the case, it raises the question of why a similar effect was not found for the L1 English speakers—why, indeed, the impact of the treatment condition seemed to have gone the other way in that population.

This suggests the possibility that what we have seen in this survey may not so much be a FLE as an English Language Effect, which may also be at the root of the findings reported by Geipel, Grant and Keysar (2022) and Hayakawa, Pan and Marian (2022) (see above). It is possible that the global status of English as the *lingua franca* of the internet, social media, the sciences, and many other aspects of life may have bestowed a certain symbolic value on this language, which predisposes readers to trust information more when it is presented in English. This is an important assumption, which may also account to some extent for previous findings on the FLE, and future studies should attempt to tease apart factors such as language prestige and learning context from the psychological processes assumed to underpin the FLE.

While the present study demonstrates that the FLE may be used beneficially in real-life situations, such as public health campaigns, there are a number of weaknesses, and the findings can therefore not, as yet, be generalized to a wider audience: due to the limited resources available, the sample size in this investigation is substantially smaller than that in the precursor study, and background factors, such as language combinations, proficiency levels, age, socioeconomic status, were not controlled across subpopulations. Future investigations should attempt to replicate these findings in larger, more carefully controlled samples to investigate whether these initial results hold against more rigorous scrutiny. Furthermore, following Freeman et al., pre- and post-intervention hesitancy levels were not elicited by means of the same instrument. To be able to fully assess any potential change in hesitation levels as a result of having read information, we would suggest that future studies divide up the questions from CVHS and CCS, administering one half before and the other half after the intervention.

Conclusion

The study presented here has shown that the uptake of information related to attitudes surrounding immunization can indeed vary depending on the language of presentation. Participants negatively predisposed towards the COVID-19 vaccine whose L1 was English were even more vaccine-hesitant after having read an information text in their L2 than those who had read the same information in their L1. Conversely, the opposite tendency was found among vaccine-doubtful (although not vaccine-hesitant) participants with English as their L2, that is, reading an information text in L2 led to less negative dispositions than reading it in the L1. This finding suggests that the choice of the language of presentation may be an important factor in health campaigns, not only in that it can reduce language barriers but also in that it can both amplify and attenuate irrationally held and counterfactual beliefs. Future research will have to establish in more detail what other factors have a bearing on these mechanisms, as well as what the role of the learning context, the proficiency level, and the global prestige of the language(s) at hand plays in this process.

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M.S. led all aspects of the study, including conceptualization, data collection, analysis, and writing up. K.R.B. contributed to the research design, interpretation of results, and writing up of the report.

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END NOTES

¹Note that this hypothetical scenario, alongside its somewhat unfortunate name, was developed pre-Covid.
²78.7% of the population in Germany and 60.1% of the population in France have proficiency in at least one foreign language. Specifically, about 25% of Germans and about 20% of French people describe themselves as proficient in an L2, and 40% of Germans and 50% of French people say they have a basic level of proficiency. The distribution of proficiency levels in the UK is similar to that in France but can be found among a smaller segment of the overall population (34.9%). (Source: Eurostat, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Foreign_language_skills_statistics).

³An anonymous reviewer notes that it would have been more appropriate to present the scales at both pre- and post-intervention stages. We agree with this suggestion but decided to follow the approach taken in the precursor study.

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