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Linguistic Discrimination in Science: Can English Disfluency Help Debias Scientific Research?

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ABSTRACT

The English language now dominates scientific communications. Yet, many scientists have English as their second language. Their English proficiency may therefore often be more limited than that of a 'native speaker', and their scientific contributions (e.g. manuscripts) in English may frequently contain linguistic features that disrupt the fluency of a reader's, or listener's information processing even when the contributions are understandable. Scientific gatekeepers (e.g. journal reviewers) sometimes cite these features to justify negative decisions on manuscripts. Such justifications may rest on the prima facie plausible assumption that linguistic characteristics that hinder fast and easy understandability of scientific contributions are epistemically undesirable in science. I shall raise some doubts about this assumption by drawing on empirical research on processing fluency and its biasing effects. I also argue that directing scientists with English as a foreign language toward approaching 'native-level' English can have the negative consequence of reducing their potential to make scientific belief formation more reliable. These points suggest that one seemingly compelling justification for linguistically discriminating against scientific contributions in 'non-native' English is questionable and that the common insistence by scientific gatekeepers on 'native-like' English may be epistemically harmful to science.

1. Introduction

Most scientific research is now conducted, presented, and discussed in English. In some fields, 98% of all publications are in English (Ramírez-Castañeda 2020). As the current 'lingua franca of science', English provides the scientific community with extensive epistemic benefits by facilitating international knowledge exchange, collaborations, and social criticism (Elnathan 2021).

However, several recent contributions in top science journals have emphasised that the dominance of English in science also comes with challenges (Amano et al. 2021; Romero-

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Olivares 2019; Tong 2022; Woolston and Osório 2019). Not all scientists have acquired English through exposure in early childhood and use English as their first language (henceforth 'L1 English users').[1] Given their more limited exposure to, practice in, and mastery of English, some scientists who use English as their second (third, etc.) language (henceforth 'LX English users') may need to invest much more cognitive work to contribute to international debates than their L1 English using colleagues. They and their manuscripts or talks (henceforth 'contributions') may also suffer *linguistic discrimination*, i.e. they may be treated more negatively based on their LX English (Márquez and Porras 2021; Wolters 2016). For instance, studies found that science journal editors frequently asked for L1-like English in manuscripts (Strauss 2019), and reviewers judged papers with LX English more harshly independently of their content (Lillis and Curry 2015). Other research also indicates that LX-accented English individuals may be viewed as less competent or credible due to their accent (Boduch-Grabka and Lev-Ari 2021).

Some philosophers of science and other researchers have noted that linguistic discrimination in science raises (*inter alia*) ethical concerns regarding potential structural disadvantages and the unfair treatment of LX English users in scientific communities (Contesi and Terrone 2018; Flowerdew 2019; Pronskikh 2018; Wolters 2016). Purely ethical concerns will here be set aside. The focus will be on the *epistemic* costs or benefits that linguistic discrimination may create in science, more specifically, on costs and benefits pertaining to the formation and maximisation of true beliefs[2] (Goldman 1999). For instance, a recent *Nature* article notes that:

> Less fluent language skills […] do not equate to poorer quality of science. Automatic linking of the two skills, sadly, still happens; science written in 'non-native-like' English is rated lower than science written in 'native-like' English. Scientific communities need to make a conscious effort to decouple language skills from scientific quality when working with colleagues and collaborators, reviewing papers submitted to English-language journals, and assessing grant proposals or student/job applications. (Amano et al. 2021, 1121)

Conflating less fluent English language with poorer scientific quality can have significant epistemic costs in science. It may lead scientists to fail to appreciate important contributions or to unduly downgrade high quality research. This can hinder the maximisation of true beliefs in science.

Yet, linguistic discrimination based on LX English is not always epistemically unreasonable.[3] Some manuscripts or talks in LX English may involve so many mistakes that they cannot be understood. Such contributions may be justifiably rejected based on their English-related features because understandability is a precondition for scientific evaluation. These relatively easy cases of epistemically reasonable linguistic discrimination in science will be set aside here.

Difficult cases quickly come to mind. Some scientific contributions in LX English may be well understandable but still contain LX English features such as peculiar word choices (e.g. preposition or article mistakes), grammar (e.g. past and perfect confusions), idiomatic idiosyncrasies (e.g. odd word order, 'false friends'), or unusual pronunciation (e.g. accent or word stress) that do not 'feel natural' to L1 English users and disrupt their 'flow' in extracting information from the contributions (Barroga and Matanguihan 2021). Could such linguistic features of scientific contributions in LX English produce epistemic costs that justify a more negative treatment of these contributions?

The cases at issue are likely very common. This is because most LX English users in the sciences will have studied English at school and will routinely employ it in academia. Their English will therefore often be well understandable. But these researchers may still not speak or write English with L1-level proficiency because they may not have been exposed to English during their early development, or they are based in non-English speaking countries where they can only rarely practice English. Their scientific contributions in English are thus likely to have some LX features that can disrupt the recipient's (reader's or listener's) *processing fluency*, i.e. the experience of mental ease that accompanies information processing (Alter and Oppenheimer 2009). Moreover, there is evidence that some science reviewers, editors, and journals disfavour manuscripts with such linguistic features and insist that in order to improve, for instance, textual flow, an author 'needs a native English-speaker to revise the manuscript' (Marlow 2014; Márquez and Porras 2021; Romero-Olivares 2019).

The goal here is to take a critical look at a particular line of support for this kind of linguistic discrimination. Consider the following simple argument that many scientific gatekeepers may find compelling:

(1) Fluent (i.e. fast and easy) information extraction from scientific contributions is epistemically desirable and so if contributions have avoidable linguistic features that may *disrupt* scientists' processing fluency, these features are epistemically undesirable and constitute an epistemic reason for disfavouring the contributions.
(2) LX English language features (peculiar word choices, grammatical infelicities, idiomatic idiosyncrasies, etc.) in understandable scientific contributions in English are avoidable and may disrupt many scientists' processing fluency.
(3) Hence, LX English language features in understandable scientific contributions in English are epistemically undesirable and constitute an epistemic reason for disfavouring the contributions.

Call this the *Disfluency Argument* against LX English in scientific contributions.[4] The Disfluency Argument has not been explicitly articulated yet in the literature on linguistic discrimination in science. But it may often underlie scientific gatekeepers' insistence that an author needs an L1 English speaker to revise their manuscript (Marlow 2014; Romero-Olivares 2019). Indeed, if they are driven by epistemic concerns (vs. aesthetic preferences or social bias), calls for L1-level English in scientific contributions are hard to make sense of unless they rest on an at least tacit endorsement of the Disfluency Argument or a version thereof. Even many LX English science authors may find it convincing that if the English in their contributions slows down a reader's, or listener's information processing, it requires improvement. It is fair to say, then, that the Disfluency Argument is prima facie convincing and, given its potential role in justifying linguistic discrimination, worthy of critical analysis.

In the following, I introduce two reservations about the Disfluency Argument. The first one focuses primarily on written LX English encountered in scientific articles, for instance, during journal peer-review, and concerns the argument's underlying assumption that more fluent information extraction from understandable scientific contributions is more epistemically desirable than less fluent information extraction. I contend that this assumption lacks sufficient empirical support because there is reason

to believe that processing fluency can result in biased cognition whereas processing disfluency can have debiasing effects. The second reservation that I shall introduce covers both written and spoken LX English. It is that in directing LX English users in science toward approaching L1-level English, the Disfluency Argument can reduce their potential to help make scientific reasoning more reliable: Thinking in a foreign language can make one's judgment- and decision-making more rational, and this effect likely diminishes with increased proficiency in the foreign language. These two points suggest that scientific gatekeepers' common insistence on L1-like English may have a questionable basis and create epistemic costs in science that have not yet been considered in the debate on linguistic discrimination in science.

To clarify, throughout this paper the focus will only be on *well understandable* LX English in scientific contributions that, as noted, may nonetheless often contain disfluent features.[5] LX English that is so poor that it cannot be understood is not relevant here. Moreover, I shall not argue that the potential disfluency related to processing LX English in scientific contributions is epistemically more desirable than the fluency related to processing L1-like English. Instead, I contend that (a) it has not yet been shown that the fluency related to processing L1-like English in scientific contributions is more epistemically desirable than the potential disfluency related to processing well understandable LX English, and that (b) maintaining that the fluency related to processing L1-level English is more epistemically desirable can have epistemically negative consequences. This two-fold point matters because scientific gatekeepers may cite the Disfluency Argument (or versions thereof) to rationalise negative verdicts on contributions where these verdicts are in fact not based on valid scientific concerns but on other factors, including biases (e.g. when a reviewer favours a position opposed by the contribution they are evaluating) (Silbiger and Stubler 2019; Wilcox 2019). Discouraging such rationalisations by highlighting the current lack of support for or potentially unattractive implications of the Disfluency Argument may help make peer-review more reliable.

2. Background on the Disfluency Argument

This section will elaborate on the Disfluency Argument. The aim here is not yet to critique this argument but just to charitably flesh it out so that the then following critical responses have a solid foundation. An example may help appreciate the argument's potential impact. Consider the following fictional scenario.

> A Spanish geneticist (SG) and a British geneticist (BG) have just independently discovered a new way to reduce carcinogenic cell growth. They both each independently write an English paper on their findings and submit them simultaneously to *Science*. Both papers contain the same data and are well understandable. However, SG is not an LX English user and her paper contains subtle deviations from L1 English. The *Science* journal editors read both papers and understand their importance. But they stumble over the subtle differences from L1 English in SG's paper and so accept BG's. SG is informed about the details of the reviewing process and objects. She argues that her paper was not accepted because of her LX English, and since the paper was well understandable, this should have been irrelevant. The editors respond that while the paper was understandable, it contained features that disrupt a reader's processing fluency, delay the extraction of the findings, and could easily have been avoided by having a L1 speaker proofread the manuscript. Fluency in processing

> scientific contributions is epistemically desirable and disfluency-inducing features are epistemically undesirable because a quick communication of results among scientists is vital to boost their potential to check and build on the scientific content. It was thus epistemically reasonable to favor BG's otherwise equal paper. Or so the editors conclude.

Setting aside considerations on structural disadvantages that could be cited to respond that the editors' verdict is unfair, this example helps illustrate the support for the premises of the Disfluency Argument. To begin with, as in SG's case, understandable scientific contributions in LX English will most likely often have features that disrupt the fluency of many readers' or listeners' information processing. LX English writers may make mistakes or use constructions that L1 speakers do not use, and their word choice can be suboptimal (Lev-Ari 2015). Studies found that LX writers also underused collocations (i.e. common word combinations 'bright idea', 'talk freely', etc.) highly salient for L1 speakers (Durrant and Schmitt 2009). And their texts may differ in contextually appropriate configurations of lexis, grammar, or rhetorical patterns determined by pragmatic conventions (Flowerdew 2019). Relatedly, Newmark (1981) writes that even a highly skilled translator

> knows that he cannot write more than a few sentences in a foreign language without writing something unnatural and non-native. He will be 'caught' every time, not by his grammar, which is probably suspiciously 'better' than an educated native's, not by his vocabulary, which may well be wider, but by his unacceptable collocation. (180)

If that is right, then even proficient LX English users in science may often unintentionally produce LX expressions in their English contributions that, even though they are well understandable, induce disfluency in many L1 or highly proficient LX English users and so decelerate their meaning extraction.

Some linguistic features that induce processing disfluency may sometimes be both unavoidable and epistemically beneficial in scientific contributions. Complex mathematical formulas may be hard to process for some people but be required to convey certain scientific content. The Disfluency Argument (and the reasoning by the journal editors in the example above) does not imply that the disfluent features in these cases are epistemically undesirable. It concerns only *avoidable* disfluency-inducing features. And when it comes to disfluency related to English in science, LX English users can usually avoid these features in their contributions by asking an L1 speaker to read a draft of their paper. This lends further plausibility to the journal editors' verdict in SG's case.

To maintain that avoidable linguistic features that impede easy information extraction are epistemically undesirable, the journal editors could have added that the production of true beliefs in science hinges on diverse social criticism. Individual scientists are susceptible to cognitive and social biases, reasoning blind spots, and other cognitive limitations that may undermine reliable collective belief formation and need to be kept in check through social criticism by different individuals' feedback (Peters 2021). Since any avoidable hindrance to swift result communicability impedes social criticism by reducing the number and diversity of people accessing and scrutinising the relevant content, it seems clear that avoidable linguistic features that slow down the uptake of scientific results are epistemically undesirable and their presence in scientific contributions counts as an epistemic reason against the contributions. On the face of it, then, the Disfluency Argument seems hard to deny.

3. Faster and Easier Processing is not Always Epistemically Better

In this section, I evaluate a key assumption underlying the Disfluency Argument, namely that more fluent processing of scientific contributions is epistemically more desirable than less fluent processing. Against this assumption, I will argue that more fluent processing can be epistemically negative by leading people to favour and more readily accept the information they process, lowering their epistemic vigilance about it. Conversely, less fluent processing (e.g. induced by LX English) may counteract this tendency and promote a more critical mindset.

To begin with, intuitively, when information is processed more fluently and quickly, less thought may be devoted to countervailing considerations. This can increase people's likelihood of accepting the information that they process. Such effects of fluency, even when it is induced by superficial, i.e. not content-related features of language are well documented in many psychological studies on different kinds of processing fluency including (i) perceptual fluency (e.g. the ease of identifying a word form, size, etc. due to font properties), (ii) linguistic fluency (the ease of pronouncing words, processing grammar, etc.), and (iii) conceptual fluency (the ease of identifying or retrieving word meanings, reasons, or knowledge structures) (for a review, see Alter and Oppenheimer 2009). For instance, study participants were found to view statements more readily as true when they could process them more fluently because of a stronger figure-ground contrast (Reber and Schwarz 1999). Other studies found that the same aphorisms were more likely to be perceived as true when presented in a rhyming, i.e. more fluent format, than in a non-rhyming form (McGlone and Tofighbakhsh 2000). Participants also judged statements with more text coherence (Rawson and Dunlosky 2002), or orthographic regularity (Whittlesea and Williams 1998) as more likely to be true, and viewed more perceptually fluently processed information as more grammatically correct (Kinder et al. 2003).

These and other data have led some researchers to hold that 'any fluency manipulation [i.e. facilitation] should increase the probability to judge a statement as "true"' (Reber and Unkelbach 2010, 567). That is, the ease of operating on information can *bias* people's responding to the semantics of that information. In the studies just mentioned, individuals' judgments about the truthfulness of information were affected by semantically unrelated, surface features of the linguistic expression of information such as figure-ground contrast, readability, etc. (Alter and Oppenheimer 2009). In the domain of peer-review in science, where it is often unclear whether novel information that one processes is true and the truth or falsity of claims is meant to be judged objectively without prior assumption either way, processing fluency may therefore facilitate unreliable belief formation.

Conversely, other studies found that when participants' information processing was *disfluent*, this mitigated the influence of intuition and biases on their cognition. People presented with information expressed in disfluent fonts (e.g. Comic Sans) or blurred text (compared to easy-to-read material) correctly solved more mathematical problems with less intuitive but correct solutions (Alter et al. 2007), displayed reduced 'confirmation bias', i.e. the tendency to support one's pre-existing views and dismiss or ignore counterevidence (Hernandez and Preston 2013; Ling, Sun, and Gu 2017; Walter et al. 2020), and showed weaker 'causality bias', i.e. the illusion that two events were causally related when they are not (Díaz-Lago and Matute 2018). The epistemically

beneficial effects of disfluency can have a wide scope. For example, participants presented with visually disfluent information were also found to be less susceptible to over-estimations of what they had learned from that information (Pieger, Mengelkamp, and Bannert 2017; Ryffel and Wirth 2018; Xie, Zhou, and Liu 2018), displayed reduced 'mind-wandering' (attentional lapses) (Faber et al. 2017), and were more sensitive to absent information in stimuli material (Sundar, Wu, and Kardes 2019). While caution is warranted when relying on these empirical data as they need to be replicated and confirmed by meta-analyses (Peters, MS),[6] taken together, the findings on the effects of fluency and the data on the effects of disfluency do suggest that in some cases processing fluency biased individuals towards information acceptance whereas disfluency counteracted this and induced a more critical mindset.

But the focus here is on fluency related to processing L1 and LX English. Do the effects of the kind just mentioned carry over to the processing of L1 and LX English? Research on the epistemic effects of fluency related to LX language processing is still scarce. However, existing studies on this issue did similarly find that L1 versus foreign-sounding speech was processed more fluently and led participants to judge L1-language information to be more believable (Lev-Ari and Keysar 2010). Processing fluency related to less foreign-sounding language also elicited more positive affect, which led researchers to 'extend the fluency principle' to foreign-language processing (Dragojevic 2020). Additionally, we currently have no reason to assume that the fluency or disfluency effects related to the processing of, for instance, text fonts differ from the fluency or disfluency effects potentially triggered by L1 and LX English texts, respectively. Furthermore, we already know that fluency effects can occur with diverse stimuli such as figure-ground contrasts, rhyming language, fonts, etc. (Schwarz et al. 2021). And many cases of disfluency tied to processing LX English are in fact instances of the processing disfluency discussed earlier. Returnin 2020 g to speech, L1 English listeners may struggle to hear what a LX speaker is saying due to their accented speech, causing perceptual disfluency (Dragojevic and Goatley-Soan 2022). Similarly, people may struggle when parsing LX English users' sentences because they contain unusual grammar, idioms, or word choices, triggering linguistic disfluency (Bosker et al. 2014). Pragmatic factors or odd LX collocations may also make it difficult for L1 English users to identify and retrieve meanings, reasons, or knowledge structures, causing conceptual disfluency.

If the disfluency tied to processing LX English is an instance of perceptual, linguistic, or conceptual disfluency, and if perceptual, linguistic, and conceptual disfluency can have positive epistemic effects then, given the absence of counterevidence, it is reasonable to assume that the same applies to the disfluency tied to processing LX English texts. After all, in all these cases, disfluent linguistic features decelerate cognition, activate attentional shifts, contravene the tendency to more readily accept information that is fluently processed, and so induce a more alert mindset. Given these commonalities, it would be surprising if perceptual, linguistic, and conceptual fluency and disfluency can produce the epistemic effects outlined above but the fluency and disfluency tied to processing L1 and LX English, respectively, cannot do so. There is thus an abductive basis for holding that the fluency related to processing L1-like English and the disfluency related to processing LX English texts are likely to have the kind of effects at issue as well. Abduction, i.e. the reasoning that begins with incomplete observations and then proceeds to the likeliest explanation for them, is pervasive in everyday life and a

'cornerstone of scientific methodology', as empirical studies can commonly only collect a limited amount of data, from limited samples (Douven 2021). Using abduction in the case at hand, we have grounds to hold that more fluently processed, L1-level English, including English in scientific contributions, is likely to promote information acceptance whereas less fluently processed, LX English can mitigate this. By extension, the key assumption underlying the Disfluency Argument, namely that more fluently processed L1-like English in scientific contributions is epistemically more desirable than less fluently processed LX English, becomes questionable. This is because when scientists can process statements more fluently, for instance, because of the L1-like English in which they are expressed, this may also lead them to more readily believe these statements, including in cases when this is not justified. In contrast, LX English in scientific contributions may lead scientists to process information less fluently and so become more vigilant about it, reducing premature acceptance of the information, which, in turn, can decrease the formation of false beliefs.

3.1. An Objection

It might be argued that even if the fluency related to processing L1 English biases scientists' thinking toward accepting contributions in L1 English when rejections would be more warranted, the *disfluency* related to processing LX English may equally bias their thinking albeit in the opposite direction, namely toward *rejecting* contributions in LX English when acceptance would be more warranted. Relatedly, if reviewers stopped discriminating against contributions in LX English, more contributions with LX features would be published. Since these publications would (given the thought just outlined) likely induce disfluency in readers and so make them more resistant to accepting the authors' statements, the increased publication of contributions in LX English may produce systematic scepticism against LX English researchers. Given this negative outcome, L1-like English in scientific contributions may be epistemically more desirable (even for LX English users themselves) after all.

However, there is an important asymmetry between the two cases. When processing fluency biases scientists toward information acceptance, it does so by reducing their critical engagement with the information, which then facilitates acceptance of content even when it may not be warranted. Fluency thus promotes an oversight of the difference between warranted and unwarranted acceptance. In contrast, when *disfluency* induces a more alert mindset, critical engagement with the information is not reduced but *increased*. This should make it less likely that scientists fall prey to an oversight of the difference between warranted and unwarranted acceptance because they attend *more*, not less, to the information, including to its evidential support, which should counteract cases of unwarranted rejections. This speaks against the notion that LX-induced disfluency may to the same extent bias scientists in the opposite direction than fluency, i.e. toward rejecting contributions in LX English.

To be sure, currently, reviewers may cite LX English features to rationalise their rejections of LX English manuscripts because the Disfluency Argument (or versions thereof) provide cover even justification for such responses. However, the present state of affairs is not the right comparison scenario because what is at issue is what the epistemic effects would be *if reviewers could no longer invoke LX-induced disfluency* to justify rejections

(i.e. if they could no longer use the Disfluency Argument or versions thereof). Granted, disfluency tied to LX English may even then produce an overly critical mindset in reviewers. However, if the Disfluency Argument were no longer available, existing social structures of science could counterbalance this problem because scientific gatekeepers generally need to socially justify their verdicts (Longino 2002). Since the here relevant cases concern only well understandable scientific contributions, this means that reviewers who become sceptical of manuscripts due to their LX English would need to search for more substantial scientific reasons to justify their rejections of them. This is because, if the Disfluency Argument were no longer available, the disfluency induced by LX English alone would no longer be enough to justify rejections. Reviewers whose initial critical response to a manuscript was triggered by LX features would thus be required to increase the depth of their manuscript content analysis, which should counteract unwarranted rejections.

Moreover, while an increased publication of contributions with LX English features may mean that more readers experience disfluency induced by these features, it does not follow that this will promote systematic scepticism about LX users in science. The scenario that the abovementioned objection invokes is only one possible outcome. Another outcome is that when LX causes disfluency in reviewers during manuscript evaluation, it induces a more alert mindset among them that produces more vigilant responses to manuscripts than if a manuscript was written in L1 English. If the reviewers can no longer use the Disfluency Argument, this increased vigilance on their part can help LX English scientists to detect genuine weaknesses with the form and substance of their papers, enabling them to produce higher quality publications. Over time, this can *decrease* scepticism against LX English users because it may put them in a better position to reliably report scientific findings in their publications than authors who encounter less alert reviewers during evaluation. Through their more thoroughly assessed, ultimately potentially higher quality publications and the approval of expertise that a journal publication communicates, scientists that useg LX English may gain in recognition in their fields. The epistemic benefits that LX English use would confer on these scientists in this scenario would go toward *balancing* a currently epistemically unequal state because L1 English users would still retain their epistemic advantage of needing less cognitive effort when writing in English than LX English users do.

If these considerations sound fanciful, notice that we currently simply do not know whether either the potential 'acceptance bias' promoted by the fluency tied to processing L1 English, or the potential 'rejection bias' promoted by the disfluency tied to processing LX English is epistemically more costly or beneficial in science. The relevant research is not yet in. Importantly, however, this inconclusiveness is sufficient for the present argumentative purposes. To see why, recall that the Disfluency Argument assumes that more fluent information extraction is more epistemically desirable than less fluent information extraction. The goal here has been to make explicit that this overlooks that fluent processing may also incline scientists to more readily believe information even when this is not warranted. The Disfluency Argument rests on the implicit assumption that (1) the biasing effect of processing fluency is less epistemically detrimental than the effect of the disfluency related to processing LX English, and that (2) the potential debiasing consequences of disfluency related to processing LX English are less epistemically beneficial than the effects of fluency related to processing L1-level English. Yet, and that is the main

point here, whether this implicit assumption is true remains currently an open empirical question. We have experimental evidence that supports an abductive justification for holding that disfluency related to processing LX English can have significant epistemic benefits in science. For all we can tell, these benefits may outweigh those linked to processing L1-level English in scientific contributions. As a result, the Disfluency Argument is insufficiently supported because it overlooks that in the here relevant cases fast and easy information extraction from scientific contributions may potentially be more epistemically costly than slow and effortful information extraction.

4. The Foreign Language Effect as an Epistemic Tool in Science

The preceding section raised questions about a key assumption underlying the Disfluency Argument and focused on epistemic effects that may result primarily when L1 English users encounter LX English in scientific contributions (e.g. articles). I now want to focus on effects that concern primarily the scientists that themselves use English as an LX. The point I want to make is this: The Disfluency Argument signals to LX English users in science that it would be epistemically beneficial for them to hone their English proficiency so that their intuitive linguistic responding in English approaches L1-like English. In sending this signal, the argument incentivizes LX English users to act in ways that can reduce their potential to make scientific reasoning more reliable, and this is a significant epistemic cost for collective belief formation in science.

To begin with, it might seem clear that whether or not people use their L1 or a foreign language when processing information, this will not influence their judgment- or decision-making since the meaning of the sentences that one entertains when thinking in one's L1 or a foreign language will be the same. However, empirical research suggests otherwise. Thinking in an LX does affect the outcome of judgment- and decision-making. This is known as the 'foreign language effect' (FLE): in many cases, people make more rational judgments and decisions when processing relevant information in a foreign language rather than their L1 (Keysar, Hayakawa, and An 2012). Consider the so-called 'framing effect': When individuals are informed that a certain decision means that 400 out of 600 people will die, they tend to treat this as more concerning than a decision said to mean that 200 out of 600 people will be saved—despite both decisions having the same outcome (Tversky and Kahneman 1981). Studies found that thinking in a foreign language reduced this effect (Keysar, Hayakawa, and An 2012). Similarly, in other experiments, bilinguals using their second language displayed reduced 'loss aversion', i.e. higher willingness to accept hypothetical and real bets with positive expected value (ibid), weaker causality bias (Díaz-Lago and Matute 2018), and a diminished tendency to commit the 'hot-hand fallacy', i.e. to overestimate the likelihood of a positive outcome after a series of prior successes (Gao et al. 2015). Using an LX (vs. L1) also reduced study participants' magical thinking (Hadjichristidis, Geipel, and Surian 2019), increased their consumption of sustainable products (Geipel, Hadjichristidis, and Klesse 2018), made bilinguals less vulnerable to the 'bias blind spot' (the tendency to see biases in others but not in oneself) (Niszczota et al. 2022), promoted less harsh condemnation of social norm violations when they did not involve significant negative consequences (Geipel et al. 2015; Woumans, Van der Cruyssen, and Duyck 2020), and

produced more utilitarian (cognitively controlled) vs. deontological (emotion driven) responses towards certain moral dilemmas (Cipolletti, McFarlane, and Weissglass 2016). Meta-analyses of studies on the FLE confirm that participants who faced moral decision problems in their foreign language were more likely to opt for cognitively controlled, utilitarian decisions than those facing them in their L1 (Circi et al. 2021; Del Maschio et al. 2022).

However, the FLE does not occur in the performance of *all* judgment- and decision-making. Foreign language contexts failed to modify the extent to which people suffered from 'outcome bias' (the tendency to evaluate an action/decision based on its outcomes, not on the process leading to it), the 'representativeness heuristic' (the tendency of judging the probability of an event based on similarity), 'base-rate neglect' (the tendency to ignore base rates when making probability judgments), or the 'conjunction fallacy' (the tendency to give higher chances to a conjunction of entities vs. one of its constituents) (Vives, Aparici, and Costa 2018). Since these biases are not directly related to emotional processing, this evidence has been taken to indicate that the FLE's scope may be limited to judgment- and decision-making in which emotions play a causal role (Hadjichristidis, Geipel, and Keysar 2019). Correspondingly, while several different accounts of the FLE have been proposed, the hypothesis that the LX acts through reducing emotionality is now the commonly favoured explanation (Hadjichristidis, Geipel, and Keysar 2019). The idea is that emotions exert a stronger effect on our judgment- and decision-making when we think in our L1 because an LX is usually acquired in classroom situations where the emotional links to specific words are not as rich as those of words of the L1 used in everyday life exchanges with relatives and friends (Hayakawa et al. 2017). Since emotions feed into certain biased reasoning, reducing emotion by actively thinking in an LX can enable reasoning that is less affected by emotions that one may feel when reasoning in one's L1.

That said, while it is debiasing, the emotion-reducing aspect of the FLE is not always adaptive, as our biased and emotional responding might sometimes result in more accurate conclusions (Gigerenzer 2018), or have socially adaptive consequences (Peters 2022). Using an LX can thus sometimes be suboptimal. Białek et al. (2020) found that thinking in a foreign language decreased accuracy in some instances of deductive reasoning by weakening people's logical intuitions, which are required to detect belief-logic conflicts that commonly trigger reflective processing when necessary to override the incorrect, intuitive response. Yet, while the FLE may not always improve judgment- and decision-making, it is widely accepted that it can in many circumstances be an epistemic tool or 'nudge' to help people make better judgments and decisions (McFarlane, Cipolletti Perez, and Weissglass 2020). It therefore seems clear that having this tool available is epistemically better than not having it available.

With this in mind, the key point here is that several studies suggest that the FLE tends to *diminish* in individuals with extensive use of and immersion and proficiency in the LX. When testing whether emotion words in an L1 or L2 differently primed people's responding (i.e. differently activated emotional associations), Degner, Doycheva, and Wentura (2012) found that the intensity and frequency of bilinguals' L2 use determined whether emotional L2 words automatically activated their affective connotations. Similarly, when testing Croatian-German bilinguals who were highly proficient and immersed in German (their L2), Čavar and Tytus (2018) found that L2 proficiency

was linked to more emotion-driven choices in moral dilemmas, suggesting that the FLE on moral decision-making was reduced with extensive L2 immersion and high L2 proficiency. Relatedly, Dylman and Champoux-Larsson (2020) found that when participants were presented with moral dilemmas in a clearly foreign language that was not culturally influential but acquired at school (i.e. French for Swedish L1 speakers), the moral FLE occurred, but not when participants were presented with the dilemma in a foreign language that was highly culturally influential and frequently used (i.e. English for Swedish L1 speakers). Dylman and Champoux-Larsson therefore conclude that in

> situations where the language clearly is a foreign language, which has been taught as a foreign language, presumably in school, we are able to find the FLE across two different decision making tasks. However, when the foreign language somehow becomes a second language, or starts acting as a second language, for example when the foreign language is highly influential culturally speaking […], no FLE can be found. (2020, 6)

Finally, in a meta-analysis, Stankovic, Biedermann, and Hamamura (2022) report that a higher (vs. lower) reading proficiency in an L2 increased emotional intensity in processing L2 materials, producing less cognitively controlled decisions. These results are perhaps unsurprising. The more one immerses oneself in a foreign language at work, in everyday social interactions, entertainment, etc. the higher the likelihood that one will start thinking in terms of and develop a 'feel' for the language. By the same token, the emotional distancing that the use of an LX enables starts subsiding with higher foreign language proficiency, and consequently the FLE will produce diminished debiasing returns.

These points carry over to proficient LX English users in science. Of course, not all scientists always engage in scientific inquiries in which FLE-relevant biases frequently operate. Not all scientists may explore emotionally relevant topics. However, various scientific fields do deal with such topics (e.g. stereotype research, or genetics of intelligence in psychology). Moreover, many scientists care deeply about the views they advocate and are emotionally invested in defending them (Peters 2021; Thagard 2002). In these cases, the point regarding the FLE's benefits in debiasing people's reasoning should thus hold.

This challenges the Disfluency Argument because the argument signals to LX English users, including those who are already proficient in English, that perfecting their English so that it approaches L1 level is epistemically desirable as it will help them produce scientific contributions that are less likely to induce disfluency in their readers or listeners. What this recommendation, which is implied by the Disfluency Argument, overlooks is that in further perfecting their English mastery, proficient LX English users may risk significantly reducing their chances of experiencing the FLE: The FLE depends on not yet having a full, L1-level 'feel' for the language and, as noted, it begins to subside with extensive exposure to foreign-language contexts and with increasing LX proficiency. Since the Disfluency Argument directs LX English users towards developing L1-level English competence, it directs them towards narrowing their emotional distance to English, increasing their risk of losing out on debiasing effects tied to the FLE.[7]

To clarify, motivating people to become more proficient in English is evidently also epistemically beneficial, as higher proficiency will enable them to become better

understood by others who communicate in English. The point here is that for LX English users who already speak and write English well (as many scientists using LX English undoubtedly do), perfecting their proficiency further so as to reach L1-level mastery also comes with epistemic downsides that can be easily overlooked. That is, when it comes to the debiasing effects of LX English use, there is an inflection point at which an additional increase of English proficiency may tend to reduce these effects, creating epistemic costs. This matters for our thinking about how we want science to be structured to maximise the formation of true beliefs at the group level. Having individuals capable of systematically emotionally distancing themselves from their thought contents via LX use is likely to increase the reliability of collective belief formation in science at the group level. It increases the cognitive diversity in science, and science most likely benefits more if individual scientists have more rather than fewer epistemic debiasing tools at their disposal. There is thus a social epistemological rationale for scientists to be sceptical of the Disfluency Argument, and for LX English users to reconsider whether to strive for L1-level English proficiency.

4.1. An Objection

It might be argued that even if some meta-analyses suggest that LX proficiency reduces the FLE (Stankovic, Biedermann, and Hamamura 2022), two other meta-analyses found that it did not do so (Circi et al. 2021; Del Maschio et al. 2022). Since the overall results on the impact of LX proficiency on the FLE thus seem mixed, it remains unclear whether directing LX-English using scientists toward perfecting their English would reduce their potential to benefit from the FLE.

However, the authors of the two meta-analyses that found no moderating effect of LX proficiency emphasise that very few of the primary studies that they had included used objective measures of L1 proficiency: most employed subjective self-reports, which, in turn, 'differed from each other in many ways, making comparisons across studies problematic' (Del Maschio et al. 2022, 628). Moreover, both meta-analyses could only evaluate the mean proficiency of each sample in each experiment, thus reducing the variability of hundreds of participants to one mean value, which (as the researchers acknowledge) is a meta-analytic approach that is 'likely underpowered', i.e. the analyses likely did not have sufficiently large samples to detect real group differences (Circi et al. 2021, 1137).

Nonetheless, there are important individual variations in the FLE. For instance, while the FLE was found when the L1 and LX belonged to different linguistic branches (i.e. Spanish vs. English), it was not found when they belonged to the same linguistic branch (i.e. Swedish and Norwegian) (Circi et al. 2021; Dylman and Champoux-Larsson 2020; Miozzo et al. 2020). Similarly, studies separately looking at early and late bilinguals found divergent FLE effects on decision patterns (Del Maschio et al. 2022).

However, the argument from the preceding section does not require that the overall evidence on whether LX proficiency attenuates the FLE be conclusive. Some evidence suggests that higher LX proficiency does reduce the FLE. To the extent that the jury is still out on the conditions when this happens, until further notice, it is only prudent to avoid communicating to English-proficient scientists that acquiring the highest English level (i.e. full L1-level proficiency) is epistemically desirable, as such messages may, for all we can currently tell, have the mentioned significant epistemic costs for

them. As it stands, in sending such a message, the Disfluency Argument jumps ahead of the relevant evidence and may produce negative consequences.

5. Conclusion

Scientific contributions in LX English are sometimes subject to linguistic discrimination in that scientific gatekeepers may require the use of L1-like English in them or downgrade contributions that do not display it even when the contributions are understandable. To justify such linguistic discrimination, it might be argued that features of LX English in scientific contributions can disrupt scientists' processing fluency and this is epistemically undesirable, as it may take scientists longer to understand the contributions. In response to this Disfluency Argument, I first considered the argument's assumption that more fluent information extraction from scientific contributions is more epistemically desirable than less fluent information extraction. I reviewed empirical findings that suggestt that (a) processing fluency can in some cases bias people towards accepting the information that they process even when this is not warranted, and that (b) disfluency may mitigate such effects and induce a more critical mindset. This raises the possibility that when scientific contributions are less fluently processed because of LX English, overall epistemically more desirable outcomes may result than if more fluent processing is involved. The Disfluency Argument overlooks this possibility, leaving it an open question as to whether the potentially biasing effects of fluency are more epistemically problematic than the effects of disfluency. Hence, a key assumption underlying the argument remains insufficiently corroborated. Moreover, I noted that the Disfluency Argument also directs LX English users to try to reach L1-like English competence and that this can increase their risk of forgoing the benefits of emotional distancing and debiasing that are connected to the FLE. This, in turn, may reduce the cognitive diversity available in science, which can weaken the reliability of collective belief formation in science and speaks against endorsing the Disfluency Argument. Taken together, the points made here provide reasons to be sceptical about a particular, seemingly compelling justification for linguistically discriminating against scientific contributions in LX English.

Notes

1. Many researchers distinguish between 'native' and 'non-native' English users. However, this distinction is problematic because the proficiency levels within each group of language users can vary greatly and sometimes overlap significantly (Cheng et al. 2021). The 'native' vs. 'non-native' distinction may also encourage racist thinking (Dewaele 2018). I shall thus adopt Dewaele's (2018) 'L1' vs. 'LX' distinction.
2. I adopt a version of Goldman's (1999) veritistic epistemic consequentialism, which holds that a social practice *A* is epistemically more beneficial than practice *B* if (across its applications) *A* produces on average more true (or approximately true) beliefs of interest for a subject *S* than *B*. There are other versions of epistemic consequentialism (e.g. one may aim at maximizing epistemic virtues) or ways of specifying 'epistemic' (Greco 2012).
3. The term 'discrimination' has sometimes an evaluative meaning suggesting that the action referred to is unreasonable or problematic. The notion that I use here is more neutral. It implies only that one person or group is treated more negatively based on a certain

feature, where this negative treatment might in some cases be justified. The key question of the paper is whether the kind of linguistic discrimination specified below is justified.

4. The argument may apply to academic contributions in general. However, some academic disciplines may not be primarily about forming true beliefs, clarity, fast and easy understandability, etc. but about achieving other goals, making the Disfluency Argument less relevant to them than to the sciences. I will thus only focus on scientific contributions.
5. I shall henceforth take this point as read and will from now on omit the qualifier 'well understandable' in front of 'LX English' for brevity's sake.
6. For instance, while the finding that perceptual disfluency could make people less susceptible to over-estimations of what they had learned from disfluently processed information was confirmed by a meta-analysis (Xie, Zhou, and Liu 2018), the same meta-analysis found that, overall, perceptual disfluency did not significantly affect recall and transfer (the application of learned material to new cases). Similarly, another meta-analysis found that hard-to-read font did not improve mathematical reasoning performance (Meyer et al. 2015). Given these mixed results, I shall not put too much weight on the data reviewed here. As explained in section 3.1, this is not needed for my argumentative purposes. Mixed or inconclusive findings on the debiasing effect of disfluency are sufficient.
7. A reviewer suggested that there is a distinction between the context of research and the context of communication: Asking scientists to improve their English in written contributions happens in the context of communication but may not limit how they conduct their investigations (the context of research). They may talk to themselves, keep notes, and speak to their colleagues in a foreign language if they wish, thus benefiting from the FLE. They may only need to use L1-level English in their manuscripts. However, it is not clear that the context of research and the context of communication are independent. It is likely that the norms of publications will also influence how scientists do research. After all, if a scientist is doing her research, thinking, and collaborating with her colleagues in, for instance, Spanish, this will make it harder for her to easily write up the research in English than if she is doing her research, thinking, etc. already in the same language and level of proficiency needed for a L1-level written contribution. The Disfluency Argument will thus likely incentivize scientists to give English a more dominant role even in their research.

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