Belief-biased representations of textual information in bilinguals: Language as a source characteristic

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Abstract

When pursuing a controversial socio-scientific issue, readers are expected to construct balanced representations that include overlapping and opposing information. However, readers' mental representations are often biased towards their prior beliefs. Previous research on such text-belief consistency effects have been conducted mostly in monolingual contexts. The present study investigated whether document language, as a source characteristic, moderates text-belief consistency effects at the situation-model and text-base representation levels. Eighty-seven bilingual readers—selected from a larger initial sample— read two documents on the global spread of English. The documents were either presented in participants' first (Persian) and second (English) languages, or one was presented in Persian and the other one in English. A recognition task was used to assess situation-model strength and text-base strength. Overall, participants built stronger situation models for the belief-consistent information as opposed to belief-inconsistent information. However, document language moderated the text-belief consistency effect. When both texts were presented in English, the text-belief consistency effect was smaller than when both texts were presented in Persian. For the combination of English and Persian texts, the text-belief consistency effect was enlarged when the belief-consistent text was presented in English and the belief-inconsistent text in Persian but disappeared when the text-belief consistent text was presented in Persian and the belief-inconsistent text in English. These results suggest that document language can serve as a strong credibility cue that can eliminate belief effects, at least when the document language and the controversial issue are inherently related.

Keywords Prior beliefs · L2 reading · Document language · Source awareness · Validation

Introduction

In the twenty-first century information society, the "modern reader" (Magliano et al., 2018, p. 343) is afforded the luxury of instantaneous access to immense amounts of information (Kiili et al., 2020). As a result of the unprecedented advances in and dissemination of information technologies, most notably the ever-increasing predominance of the World Wide Web, readers now access vast amounts of social, medical,

and academic information from the click of a mouse or the swipe of a screen (Andresen et al., 2019). These conditions have created a new literacy landscape in which students are frequently required to assess a socio-scientific issue by navigating through varied sources to form a coherent mental representation of the issue from the dense forest of the (ir)relevant and sometimes false information (List et al., 2020). Given that bilingual readers routinely face a constant torrent of information in two languages, they are likely to be even more greatly overwhelmed in this new reading context, which makes it more demanding for them to critically evaluate the trustworthiness and veracity of the information.

The demand might even increase when the multiple documents present conflictual perspectives on a socioscientific controversy. Documents that are part of a socioscientific controversy often provide partial evidence to support one position, make a strong case for an alternative viewpoint, or even provide evidence against an established position. In such a context, it is challenging for readers to form an effective well-informed mental representation based on the multiple

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sources of information. A justified mental representation of a controversial issue discussed in multiple documents would include a representation that covers all relevant perspectives in the controversy and effective argumentative interconnections between overlapping and competing perspectives (Abendroth & Richter, 2020). To achieve such a balanced representation, readers would ideally judge the evidentiary value of the various positions, competing theoretical accounts, and evidence or counterevidence associated with a topic presented across the multiple documents.

However, empirical studies indicate that the common representational outcome of reading multiple controversial texts is a warped partisan representation of the controversy discussed (Britt et al., 1999). One mechanism that contributes to such a biased mental representation lies in the readers' reliance on a routine general comprehension mechanism labelled *validation* (Singer, 2013) according to which the "current message information passively cues the memory retrieval of relevant ideas both from the prior discourse and from world knowledge" (Singer, 2013, p. 361). Central to this mechanism are readers' prior beliefs and their role in readers' assessment of the plausibility of textual information. Readers constantly evaluate the consistency of text information with their beliefs, which are triggered implicitly by the textual input. The common corollary to this consistency-checking process is that readers tend to find information consistent with their beliefs as more plausible compared with information inconsistent with their beliefs, irrespective of the objective plausibility of the information. One consequence of this mechanism is that belief-consistent textual information is processed more deeply and, hence, gains an advantage in the mental representation of a controversy, whereas the belief-inconsistent information is put at a disadvantage (text-belief consistency effect; Maier & Richter, 2013; Richter & Maier, 2017).

Several conditions have been proposed to attenuate such text-belief consistency effects, including readers' prior knowledge, reading goals, metacognitive knowledge, and knowledge of argument structure (Richter & Maier, 2018). Source awareness has also been assumed to influence comprehension of multiple controversial documents and the associated text-belief consistency effects (Richter & Maier, 2017). For practical purposes, the primary factor in reading comprehension is often the content of the text(s), but more often than not, comprehension is affected by factors other than the content, including source awareness (Strømsø et al., 2010). In the context of reading multiple texts presenting conflicting perspectives on an issue, source awareness figures even more prominently, and "disregarding source information … and focusing merely on content may create more confusion than clarity" (Stang Lund et al., 2017, p. 417). Source awareness, as it relates to multiple-texts comprehension, refers to the evaluation and use of available or accessible information about the documents, including information about the author, publisher,

and document type (Bråten et al., 2018, 2019). It also includes information about where and when the document has been created and the purpose for which it is published (Salmerón et al., 2018). Although not acknowledged in the literature on sourcing, in specific contexts, particularly in bilingual reading contexts, sourcing can even include the language in which information is documented. Since languages vary immensely with respect to their perceived epistemic status, document language and the associated credibility judgements could impact comprehension and the resulting mental representation of an event or issue described across multiple controversial documents written in different languages.

In the light of these theoretical considerations, the present study aims to investigate text-belief consistency effects in the context of reading multiple controversial documents written in two different languages.

Theoretical Framework: Two-Step Model of Validation

When reading a text, readers use the textual information and the information retrieved from their long-term memory to construct a situation model (also termed mental model). The term situation model refers to "a coherent representation of the situation referred to in the text and is constructed by drawing inferences" (Seger et al., 2021, p. 3). In other words, the situation model reflects the reader's understanding of the text content. The situation model is distinguished from the text base, which refers to "an abstract representation of the idea units present in the text" (Radvansky, 2005, p. 478). In other words, the text base reflects only the reader's rudimentary understanding of (and memory for) the text but does not connect its content to the reader's prior knowledge.

Text comprehension proceeds incrementally. In this process, the words, phrases, and larger segments of the text passively activate information from the reader's long-term memory including prior knowledge, prior beliefs, and knowledge of the preceding portions of the text (O'Brien & Myers, 1999). As the reader proceeds to the next levels of reading, new message elements are integrated into the evolving situation model. However, a subset of the textual information, which bears semantic associations with the content of the reader's situation model, is more likely to be integrated into the model, whereas the information with weaker semantic connection tends to be ignored (Richter & Singer, 2017). Moreover, readers rely on validation as a mechanism for constantly checking the congruence of the incoming textual information with the content of the constructed situation model. A number of researchers have accordingly conceptualized comprehension processes in terms of a triad of activation, integration, and validation (O'Brien & Cook, 2016; Richter & Singer, 2017; Richter et al., 2020).

Validation—alternatively called *epistemic monitoring* (Richter & Maier, 2017)—is a non-strategic, routine step in

comprehension in which the (im)plausibility of textual information is consistently assessed (Singer, 2013). The basic validation mechanism rests upon readers' implicit tendency to constantly check the consistency of the textual propositions with their prior beliefs and knowledge, triggered passively by textual input. Within this process, beliefs act as filters in information selection, processing, and interpretation by guiding readers to opt for information that is consistent with their prior beliefs and ignore information that is inconsistent with them (Maier et al., 2018a; Wiley, 2005). Therefore, as a basic underlying comprehension mechanism, validation yields the text-belief consistency effect as the default outcome when readers comprehend conflicting information (Isberner & Richter, 2014; Maier & Richter, 2013). The mechanism helps readers regulate their cognitive processing during reading by allocating less cognitive resources to implausible information (information inconsistent with their beliefs) and more cognitive resources to plausible information (information consistent with their beliefs) (Richter & Maier, 2017).

Apart from this routine belief-supported validation process, Richter and Maier (2017, 2018) proposed a second voluntary resource-intensive elaborative processing step directed at resolving inconsistencies between the textual information and their prior beliefs. This second step is assumed to be a slow, goal-driven, motivation-oriented, resource-demanding process, which falls under the strategic control of the reader (Richter & Maier, 2017). This process is conditional and is likely to occur under certain conditions such as when the "fear of invalidity" looms large (Kruglanski & Webster, 1996) or when a reader intends to effectively challenge alternative perspectives (Edwards & Smith, 1996). Additionally, Richter and Maier (2017) suggested that a number of conditions such as task instructions, text presentation mode, reader characteristics, trainings about sourcing information, and enhancing readers' metacognitive knowledge can foster elaborative processing of conflicting information.

Text-Belief Consistency Effect in the Literature

During the spontaneous validation process, readers' prior beliefs become activated through interaction with the textual data. This process, in concert with the two other component processes of comprehension, activation and integration (O'Brien & Cook, 2016), yields a consistency bias in comprehension (Richter et al., 2020). As a result, readers with strong prior beliefs about a controversial issue tend to construct stronger mental representations for belief-consistent textual information compared with belief-inconsistent information (Kessler et al., 2019; Richter & Maier, 2018).

Evidence for a text-belief consistency effect has been accumulated in previous research. For example, Wiley (2005) examined the combined effects of university students' prior beliefs and prior knowledge on representations of

controversial texts in a series of experiments. The results revealed a consistency bias in the recall of arguments. The results also showed that prior knowledge qualifies consistency bias in the representation of the texts, with low-prior-knowledge participants recalling more arguments consistent with their beliefs and the high-prior-knowledge participants showing no bias in the recall of belief-consistent and belief-inconsistent arguments.

As a knowledge-intensive comprehension process, validation is assumed to be tied more closely to the situation model than to the text-base representation of information. Therefore, a memory advantage for textual information consistent with the readers' beliefs has been assumed to vary at the levels of the situation model vs. the text base. In an attempt to test this assumption, Maier and Richter (2013) examined situation-model strength and text-base strength in reading multiple controversial documents. As hypothesized, the results revealed a significantly better situation-model representation for belief-consistent compared with belief-inconsistent information. Conversely, at the text-base representation level, a memory advantage was found for belief-inconsistent information compared with belief-consistent information.

Socioscientific controversies are assumed to be relevant for social groups. To test how in-group identification and prior beliefs impact comprehension of controversial texts, Maier et al. (2018b) investigated situation-model representations across belief-consistent and belief-inconsistent texts. In-group identification was defined as adherence (e.g., in solidarity, individual self-stereotyping) to a university clinical psychology program with a strong focus on psychoanalysis as opposed to cognitive-behavioral therapy. The participants read two texts on the efficacy of either psychoanalysis or cognitive-behavioral therapy as two approaches to psychotherapy. The results revealed a main impact of prior beliefs on the situation-model strength for the belief-consistent text. Additionally, high identifiers were found to display a text-belief consistency effect in the situation models they constructed for the belief-consistent text irrespective of whether the text was socially affirming or threatening. The authors attributed this belief-consistency effect to a defensive mechanism on the part of the readers to enhance cognitive consistency and reduce cognitive dissonance—an aversive state, which occurs when prior beliefs are threatened by textual information contradicting them.

In an attempt to extend text-belief consistency research to populations other than university students, Abendroth and Richter (2020) investigated how high school students comprehend belief-consistent compared with belief-inconsistent textual information. They hypothesized that similar to university students, adolescents' situation-model strength for belief-consistent information would be significantly higher. The results revealed a bias towards belief-consistent information in text comprehension at the situation-model representation. The

results further revealed that high-prior-knowledge participants showed a text-belief consistency effect, whereas low-prior-knowledge participants demonstrated weaker but similar situation-model strength for the texts.

In sum, the text-belief consistency effect is already established in monolingual reading contexts. However, further research is required to assess whether the effect can be replicated in the context of reading cross-linguistic controversial documents that present divergent perspectives on the same topic.

Language as a Source Characteristic

Texts are not merely "bearers of information" (Brante & Strømsø, 2018, p. 776) but are social entities with specific sets of content-external attributes or "metadata" (Goldman & Scardamalia, 2013, p. 256), referred to as source information, that have a direct bearing on how they are interpreted (Britt & Rouet, 2012). In their documents model framework (DMF), Britt and colleagues (Britt & Rouet, 2012; Britt et al., 2013; Perfetti et al., 1999; Rouet, 2006), explained the value of source information in relation to mental representations based on texts presenting divergent perspectives on a single issue. The model acknowledges the importance of attention to source information when dealing with controversial documents on a topic because "the tagging of information about the sources (e.g., the author, the publisher, or the document type) to different perspectives on the issue allows readers to consider the trustworthiness of the information in light of the features of the sources" (Bråten, Strømsø, & Andreassen 2016, p. 1602), which ultimately affects the perceived weight assigned to the information in the reader's mental representation. Apart from the rhetorical goals, the constellation of features that comprises source information include three main conceptualizations of the source: (a) source as it relates to the author, which includes such features as name, position/status, motivation, access/participation, and evaluation, (b) source as it relates to the setting, which includes place and time of publication and the associated culture, and (c) source as it relates to form, which encompasses such features as the type of document and evaluation (Britt & Aglinskas, 2002; Britt & Rouet, 2012).

A glance at the literature on sourcing reveals that the language in which information is documented has not been treated as a source characteristic. This dearth emanates from the fact that the scholarship on sourcing has focused almost entirely on the context of reading multiple documents written in a single language with no cross-linguistic comparisons. However, as indicated by the relevant lines of research on attitudes and persuasion, information and communication, and literacy and discourse, source information is associated with the credibility readers perceive in relation to a document they read (Brante and Strømsø 2018). Given that languages vary immensely with respect to the perceived epistemic status associated with them, each language might induce a different level of credibility in the readers' mind, thus functioning as a source attribute.

As a case in point, English is the dominant language of science. A tremendous amount of paper-based and Internet-based documentation is in English (Dhieb-Henia, 2003) and scholars recognize the risk associated with knowledge being lost if it is not published in English (Meneghini & Packer, 2007). This situation entails a hierarchy of asymmetric relationships among languages representing differentiated power relations in the field of science (Hamel, 2007). To best represent this hierarchical relationship, De Swaan (2001) classifies the languages of the world into four major levels. English, as the sole global language, is recognized as the "hyper-central" world language. The second level consists of a number of "super-central" languages, for example, French, German, Russian, Japanese. The third level includes around a hundred "central" languages, which are often national or regional languages with little or no international clout and diffusion. A high percentage of the languages of the world belong to the fourth level, which are mainly "vernacular" languages holding no official status in their countries of origin.

This hierarchy portrays the current linguistic landscape as it relates to science representation with English being uppermost in the rankings. At the beginning of the twentieth century, the use of English, French and German in science were roughly equal (Ammon, 2001), but currently 75% of academic articles in the humanities and social sciences and around 90% of publications in the natural sciences are published in English. Additionally, the well-accredited scientific and professional outlets with an impact factor are often published in English (Doraie, 2018). As reported by Lillis and Curry (2013), according to the *UNESCO World Social Sciences Report* (2010), 94.45% of SSCI articles published between 1998 and 2007 were published in English followed by German (2.14%) and French (1.25%). These statistics indicate that a substantial share of cutting-edge research finds its way into English-medium publication outlets and a small fraction is published in a few European languages, and less rigorous research is published in local languages, some of which is limited to national reach.

The current linguistic landscape might have implications for the way research output is epistemologically viewed, for example, research published in English compared to local languages such as Persian. We might tend to view English-medium research as more robust and rigorous. In a majority of academic contexts in non-English speaking countries, academic researchers and students are required to assess a socio-scientific issue across a multiplicity of English-medium texts and texts written in local languages. The differential perceptions of the epistemic status of English vs. these local languages might influence the construction of a mental

representation based on the multiple English-based and L1-based texts, especially when presenting conflicting perspectives. These status perceptions and the concomitant differential evaluative judgements of the trustworthiness of the documents might entail differential treatment of belief- consistent vs. belief-inconsistent information across these documents and the mental cross-document representation of their content. This point has not yet been investigated in the literature on belief-consistency effect and multiple-texts comprehension.

The Present Experiment

The present experiment builds upon previous research on text-belief consistency effects to assess how bilingual readers approach comprehending multiple controversial documents written in different languages that present divergent perspectives on a single issue. Ample evidence indicates that readers tend to be biased towards belief-consistent compared with belief-inconsistent textual information (Maier & Richter, 2013, 2014; Abendroth & Richter, 2020). In light of the evidence from this line of research, we predicted that bilingual readers would demonstrate a text-belief consistency effect at the situation-model level when reading multiple documents in a single language (Hypothesis 1).

Moreover, previous studies of text-belief consistency effects have been conducted mostly in the context of reading multiple controversial texts written in a single language. The present experiment proceeds with the assumption that the language in which a document is written could serve as a source characteristic, which might influence the way the document is comprehended. Against this background, we investigated the extent that document language, as a source characteristic, moderates text-belief consistency effects when bilinguals read multiple controversial documents on a single topic across their first (Persian) and second (English) languages. These two languages differ with respect to their position and clout within the hierarchy of languages representing and disseminating scientific knowledge. Accordingly, the two languages have different epistemic status perceptions associated with them and might induce different levels of source credibility. Since this is the first study addressing language as a source characteristic, we chose a controversy that bears an inherent relationship to language as a source characteristic, namely the issue of whether the global spread of English is a natural and positive development or whether it is a politically motivated and negative development. Participants in the present study tended to agree with the first position and disagree with the second position. Therefore, they were also likely to regard English as a source characteristic that signals a high credibility of the source.

Against this background, we hypothesized that because of its higher source credibility, a belief-inconsistent text written in English might still be represented better in readers' mental models than the same text written in Persian. This might lead to a smaller text-belief consistency effect when both the belief-consistent text and the belief-inconsistent text are presented in English compared to when both texts are presented in Persian, implying an interaction of text-belief consistency and document language for comprehension at the situation-model level when both texts are presented in the same language (Hypothesis 2). Moreover, when one text is presented in English and the other in Persian, the combination of a Persian belief-consistent text and an English belief-inconsistent text should lead to a smaller text-belief consistency effect compared to the combination of a Persian belief-inconsistent and a belief-consistent English text, implying an interaction of text-belief consistency and the combination of text language and text stance (what we call language stance) for comprehension at the situation-model level, when both texts are presented in different languages (Hypothesis 3).

The study further investigated two exploratory research questions. Given the inconclusive results reported from previous research regarding a memory advantage for belief-inconsistent information at the text-base representation level (Maier & Richter, 2013, 2014), we investigated whether bilingual readers' text-base representations also differ across belief-consistent vs. belief-inconsistent texts (Research Question 1) and whether text language would moderate a potential text-belief-consistency effect on the strength of the text-base representation (Research Question 2).

Method

Participants and Text-Belief Consistency Check

Participants of the study were 87 undergraduate students (51 females, 36 males) of English as a Foreign Language (EFL) with an average age of 20.31 ($SD = 1.86$). They were selected from a larger number of participants ($N = 131$) who took a prior belief measure assessing the pro-stance and contra-stance towards the spread of English (see the section on Prior Beliefs Measure). The general means for the two stance scores were computed (pro-stance: $M = 3.78$, $SD = 0.83$; contra-stance: $M = 2.42$, $SD = 0.92$). The selected participants' pro-stance scores fell above the general pro-stance mean, whereas their contra-stance scores fell below the general contra-stance mean. In other words, they strongly agreed with the stance of the pro texts ($M = 4.23$, $SD = 0.42$, ratings on a scale from 1 = 'strongly disagree' to 5 = 'strongly agree'), whereas they agreed less strongly with the stance of the contra texts ($M = 1.89$, $SD = 0.51$, ratings on a scale from 1 = 'strongly disagree' to 5 = 'strongly agree'). The participants' agreements to the two sides of the controversy were significantly and strongly different from each other, $t(86) = -25.91$, $p < .001$, $d = 2.77$. Additionally, the contra-stance

and the pro-stance scores for the target participants were significantly different from the theoretical midpoint (3.00) of the response scale (contra-stance: $t(86) = -20.35$, $p < .001$, $d = 2.18$; pro-stance: $t(86) = 27.61$, $p < .001$, $d = 2.96$).

Upon closer inspection of the data, we found that the agreements with the two argumentative stances for a number of participants ($N = 13$) were either identical or highly similar (varied by merely 0.2 of a point from each other). Additionally, nine participants agreed strongly with the contra-stance. The pro-stance scores of these participants ($M = 1.96$, $SD = 0.48$) fell below the general pro-stance mean while their contra-stance scores ($M = 4.13$, $SD = 0.28$) fell above the general mean for the contra-stance scores. These participants were not included among the target participants to ensure a strong manipulation of text-belief consistency. Moreover, 22 participants either failed to meet the criteria for inclusion (their mean scores for the two stances were either above or below one of the computed general means), were absent from the experiment proper, or had provided incomplete personal information on the prior-beliefs measure.

Materials and Measures

Text Materials

Four texts, two English texts and two Persian texts, discussing the global spread of English were used as experimental texts. With the global spread of English, heated debates rage regarding the advantages or disadvantages associated with the process, which have led to an established controversy in applied linguistics and language education with some subscribing to the view that it is a natural benign process (pro-stance) and others arguing that it is a politically driven negative process (contra-stance). Two of the texts—one in English and one in Persian—took a pro-stance on the topic and backed the basic claim by arguing that English is a relatively easier and more flexible language compared with other potential world languages, and it has provided a common means of communication for international trade and a platform for dissemination of scientific knowledge. The other two texts—one in English and one in Persian—took a contra-stance on the issue supporting the claim that English is an inappropriate world language, mainly because of the grammatical and lexical complexities associated with it, the global spread of English entails profound negative consequences, and its dominance is motivated by political hegemony. The texts were constructed based on excerpts taken from academic journal articles, textbooks, and materials from freely accessible websites. To ensure comparability, the texts were kept parallel in writing style, rhetorical structure, and word count.

Each text started with a quick statement of the basic claim followed by five central paragraphs each presenting a key argument that consisted of a minor claim and supporting evidence. The five central paragraphs cumulatively supported the text's major claim. The texts ended with brief concluding statements. The average length of the texts was 946 words and their average readability was 45.41 (computed based on the Flesch Reading Ease formula; Flesch, 1948) indicating that the texts were moderately difficult. To further ensure that the texts were comparable, they were pilot-tested with two independent samples of undergraduate students ($N = 27$ per sample) who rated them with respect to understandability, perceived plausibility of the arguments, interestingness, clarity of stance towards the issue, and the number of arguments (see Table 1 for a summary of text characteristics). A series of t tests were run to detect likely differences across the texts with respect to the characteristics listed above. The results revealed no significant differences across the texts.

Comprehension Measure

A recognition task modelled after Schmalhofer and Glavanov (1986) was used to assess participants' comprehension of the texts at the levels of the situation model and the text base. The task consisted of three types of test items including inferences, paraphrases, and distractors. Twenty four items (eight per item type) were constructed per text. To construct the paraphrase items, specific statements were selected from the texts, their word order was changed and key lexical items in the statements were replaced with synonyms. These items were therefore semantically similar to the statements in the texts but were syntactically and lexically different. In contrast, the inference items were not explicitly stated in the texts but contained information that was needed to be inferred by the participants to construct adequate mental models of the text topic. Finally, the distractor items contained information that was neither directly provided in the text nor could be logically inferred based on the information in the text. However, some superficial information overlap existed between the text and these item types.

The advantage of using a recognition task is that it allows for assessing both text-base and situation-model strength within a single task, although two fundamentally different mechanisms undergird these two constructs (Maier & Richter, 2013). Text-base strength is measured based on the participants' responses to paraphrases from which they simply check the match between the information in the test item and the explicitly stated information in the text. However, situation-model strength is measured based on checking the consistency between the information in the test item and the situation-model representation constructed based on the text content. Specifically, text-base strength was based on the proportion of participants' yes responses to paraphrase items (hits) to their yes responses to distractor items (false alarms). To avoid negative response values and to normalize the distribution of these proportions, they were probit-transformed

Table 1 Characteristics of the experimental texts

Text (Language)	Argumentative Stance	Length[a]	Readability[a]	Plausibility[c] M(SEM)	Understandability[c] M(SEM)	Number of arguments[c] M(SEM)	Clarity of stance[c] M(SEM)	Interestingness[c] M(SEM)
Text 1 (English)	Pro-Stance	930	44.60	4.52 (.14)	5.00 (.10)	4.89 (.11)	5.44 (.12)	4.26 (.30)
Text 2 (English) Text 1	Contra-Stance	936	46.23	4.45 (.15)	4.93 (.12)	4.96 (.08)	5.26 (.15)	4.00 (.35)
(Persian) Text 2 (Persian)	Pro-Stance	962	45.99	4.58 (.15)	5.16 (.12)	5.07 (.18)	5.59 (.11)	4.41 (.26)
	Contra-Stance	955	44.85	4.47 (.18)	5.07 (.12)	5.11 (.19)	5.26 (.22)	3.96 (.26)

[abc] *Note.* Number of words per text. Determined with the Flesch Reading Ease Formula (for the English texts) and the Persian adaptation of the Flesch Reading Ease Formula (Diani, 1369/1990). Pilot-test results based on ratings by two independent groups of 27 participants; the plausibility scale consisted of six items (Cronbach's α = .79/.78); the understandability scale consisted of nine items (Cronbach's α = .78/.83); number of arguments, clarity of stance, and interestingness, each assessed through a single item. All response categories ranged from 1 to 6, except for the number of arguments, which was assessed through an open-ended question

(Cohen, et al., 2003). Afterwards, the probit-transformed proportions of yes responses to distractor items were subtracted from the probit-transformed proportions of yes responses to paraphrase items. The situation-model strength was measured based on the proportions of yes responses to inference items (hits) to yes responses to distractors (false alarms), which were probit-transformed, as explained above. The probit-transformed proportions of distractors were then subtracted from the inference item proportions.

Prior Beliefs Measure

Participants' prior beliefs regarding the controversy discussed in the texts was assessed using a measure that consisted of 10 statements, which were judged on a 5-point Likert scale ranging from 1 *(strongly disagree)* to 5 *(strongly agree)*. Five of the statements argued that the spread of English is a harmful negative process (contra-stance, e.g., "I think the spread of English pushes other languages to the margins and makes them die/disappear"), whereas the other five statements claimed that the spread of English is a positive benign process (pro-stance, e.g., "I do not believe the spread of English makes other languages decline as they can be used alongside English"). The internal consistencies for both sets of items were acceptable (items measuring the contra-stance: Cronbach's α = .88; items measuring the pro-stance: Cronbach's α = .87). The participants' responses to both sets of items were used to define text-belief consistency.

Procedure

Participants' prior beliefs about the controversy were measured 5 weeks prior to the main experiment. The reason for this 5-week interval was to minimize carry-over effects. For the main experiment, the participants read two texts, which varied by language (English/English, Mixed (English/Persian; Persian/English), or Persian/Persian). In each combination,

one text was consistent with the participants' stance regarding the issue (pro-stance text) and one text was inconsistent with their stance on the controversy (contra-stance text). The participants were required to read each text and respond to comprehension items that followed. For each text, two different versions of comprehension items (varied with respect to item order) were constructed to control for possible effects associated with item order. Half the participants received version A of the test items, and the other half received version B. Additionally, the order in which belief-consistent and belief-inconsistent texts were presented varied for each combination. Half of the participants, within each combination, read the belief-consistent text first, and the other half read the belief-inconsistent text first. The text presentation was also varied by language for the English/Persian text combination. The variations by text order, item order, and language order yielded different groupings. The time allocated for reading the texts and answering the corresponding comprehension questions was approximately 1 h.

Design

The core design used to examine Hypothesis 1 and Hypothesis 2 was a 2 (text stance: pro-stance vs. contra-stance, varied within-subjects) × 3 (document language: English vs. Mixed vs. Persian, varied between-subjects) × 2 (level of comprehension: situation-model vs. text-base representation, varied within-subjects) mixed design. All combinations of text orders and question orders were completely counterbalanced across participants.

To test Hypothesis 3, a 2 (text stance: pro-stance vs. contra-stance, varied within-subjects) × 2 (combination of text stance and language: pro-English/contra-Persian vs. pro-Persian/contra-English, varied between-subjects) × 2 (level of comprehension: situation-model vs. text-base representation; varied within-subjects) design was used. Similar to the previous design, all combinations of text orders and

question orders were completely counterbalanced across participants.

The exploratory research questions whether a text-belief consistency effect exists also at the representational level of the text base (Research Question 1) and, if so, whether it is moderated by the document language (Research Question 2) was also tested on the basis of the two designs.

Results

The present study aimed to examine situation-model strength and text-base strength among bilingual readers reading controversial texts within and across English and Persian languages. Descriptive statistics and the intercorrelations among the variables under study are provided in Table 2. Additionally, the mean proportions of the items in the recognition task, which were used to compute the comprehension scores, are presented in Table 3. All hypotheses were tested based on a Type I error probability of .05 (two-tailed). Question order and specific subcategorizations per experimental condition had no impact on participants' comprehension scores at both situation and text-base representation levels. Accordingly, these effects are not presented here and were also excluded from the main analyses.

Hypothesis 1 predicted that bilingual readers would demonstrate a text-belief consistency effect at the situation-model level when reading controversial texts. In line with our expectations, a repeated measures ANOVA revealed a strong main effect for text-belief consistency, $F(1, 84) = 71.04, p < .001$, $\eta_p^2 = .46$. As predicted, participants constructed stronger situation models for the pro-stance text ($M = 2.42, SE = 0.05$) compared with the situation models for the contra-stance text ($M = 1.80, SE = 0.06$). As an exploratory research question, we also investigated whether participants' text-base representations would differ across pro-stance vs. contra-stance texts. No evidence was found for a text-belief consistency effect at the text-base representation level, $F(1, 84) = 1.72, p = .194$.

Table 3 Mean proportions (with standard errors) of yes-responses (per item type) in the comprehension measure

Measure	Inference items	Paraphrase items	Distractor items
Pro-stance text			
English[a]	.88 (.02)	.82 (.03)	.08 (.02)
Mixed[b]	.83 (.02)	.82 (.02)	.07 (.02)
Persian[c]	.85 (.02)	.80 (.03)	.06 (.02)
Total	.84 (.01)	.82 (.01)	.07 (.01)
Contra-stance text			
English[a]	.80 (.03)	.80 (.03)	.10 (.02)
Mixed[b]	.74 (.02)	.87 (.02)	.16 (.02)
Persian[c]	.67 (.03)	.88 (.03)	.16 (.03)
Total	.74 (.02)	.86 (.01)	.15 (.01)

[abc] *Note. n = 21, n = 46, n = 20*

Participants constructed similarly strong text-base representations across the pro-stance ($M = 2.33, SE = 0.06$) and contra-stance text ($M = 2.21, SE = 0.06$).

Hypothesis 2 predicted an interaction of text-belief consistency and text language for comprehension at the situation-model level when both texts are presented in the same language. In particular, because of differentially perceived source credibility judgements, a smaller text-belief consistency effect was expected when the pro-stance and contra-stance texts are presented in English compared to when the texts are presented in Persian. In line with this hypothesis, the results of a General Linear Model analysis revealed a significant interaction of document language and text-belief consistency at the situation-model level, $F(2, 84) = 4.57, p = .013, \eta_p^2 = .10$. Participants constructed approximately similar situation models for the pro-stance texts across the three language groups (English: $M = 2.50, SE = 0.10$; Mixed: $M = 2.37, SE = .07$; Persian: $M = 2.46, SE = 0.11$), but their situation models based on the contra-stance texts significantly varied (English: $M = 2.17, SE = 0.11$; Mixed: $M = 1.75, SE = .08$; Persian: $M = 1.52, SE = 0.12$) (see Fig. 1a). As a

Table 2 Means, standard deviations and intercorrelations of independent variable (varied between-subjects) and dependent variables

Variable	M	SD	1	2	3	4	5	6	7
1 Document language (Contrast-Coded, 2=English; −1=Mixed; −1=Persian)	−.28	1.29	1						
2 Document language (Contrast-Coded, 0=English; 1=Mixed; −1=Persian)	.30	.82	−.21[*]	1					
3 Situation-model strength (Pro-Stance Text)	2.42	.48	.09	−.10	1				
4 Situation-model strength (Contra-Stance Text)	1.80	.56	−.38[**]	.08	.15	1			
5 Text-base strength (Pro-Stance Text)	2.33	.55	−.04	.05	.44[**]	.00	1		
6 Text-base strength (Contra-Stance Text)	2.21	.54	−.05	−.00	.10	.30[**]	−.00	1	

Note. N = 87. Situation-model strength: Probit-transformed proportion of yes-responses to inference items; Text-base Strength: Probit-transformed proportions of yes-responses to paraphrase items

[***]$p < .05, p < .01$ (two-tailed)

result, the text-belief consistency effect was largest when both texts were presented in Persian, $t(19) = 8.34$, $p < .001$, Cohen's $d = 1.87$, smaller when the languages were mixed, $t(45) = 5.61$, $p < .001$, Cohen's $d = 0.83$, and smallest when both texts were presented in English, $t(20) = 2.93$, $p = .008$, Cohen's $d = 0.64$. No such difference was found at the level of text-base representation, $F(2, 84) = 0.04$, $p = .962$ (Fig. 1b).

Hypothesis 3 predicted that the combination of document language and text stance would moderate text-belief consistency at the situation-model level. In line with the hypothesis, the results revealed a significant interaction of document language and text stance, $F(1, 42) = 25.80$, $p < .001$, $\eta_p^2 = .38$. When reading a combination of a Persian contra-stance text and an English pro-stance text, participants constructed stronger situation models for the pro-stance texts ($M = 2.46$, $SE = 0.10$) compared with the situation models for the contra-stance text ($M = 1.39$, $SE = 0.09$), $t(22) = 8.11$, $p < .001$, Cohen's $d = 1.69$ (Fig. 2a). In contrast, when reading a combination of an English contra-stance text and a Persian pro-stance text, participants constructed closer situation models for the pro-stance ($M = 2.27$, $SE = 0.10$) and the contra-stance text ($M = 2.10$, $SE = 0.10$), which were no

Fig. 1 Situation-model strength (a) and text-base strength (memory for text) (b) by language group and text stance. Error bars represent standard error of the mean
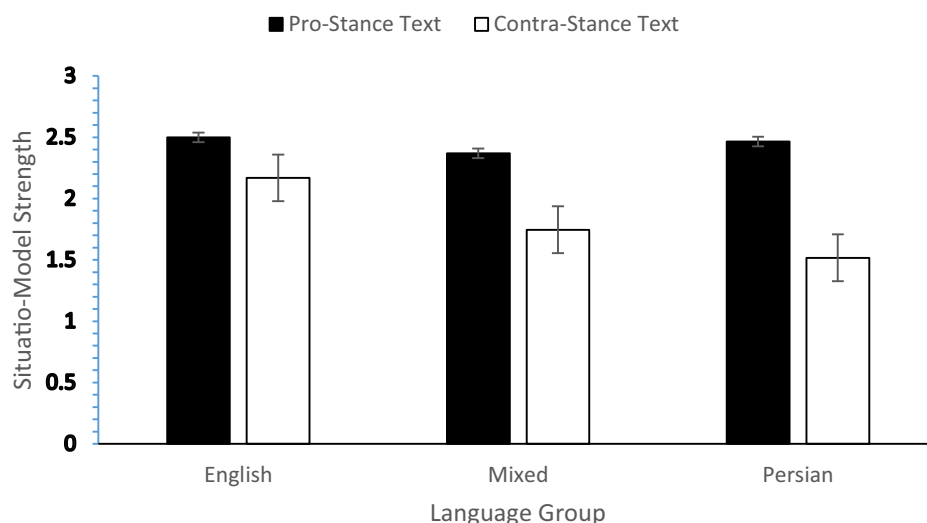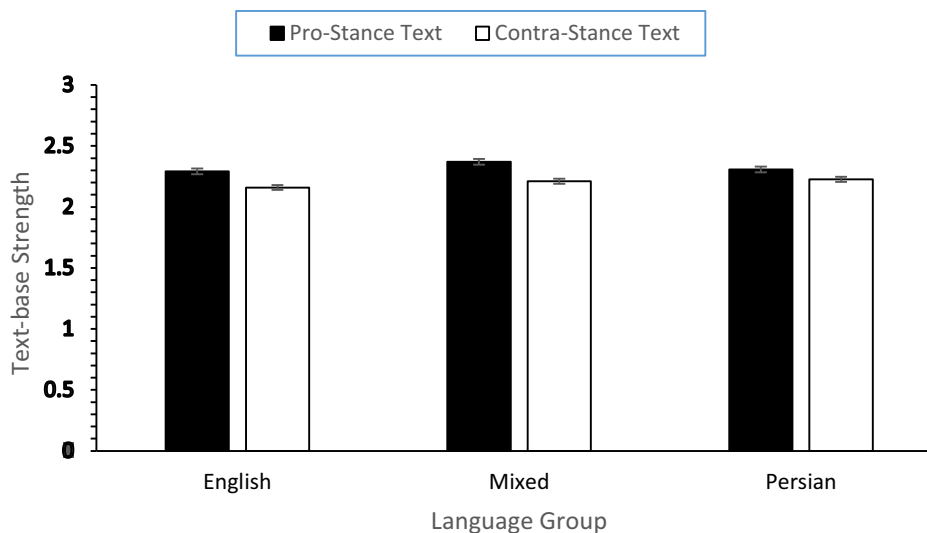
longer significantly different, $t(22) = 1.43$, $p = .167$. Thus, when the contra-stance text was presented in English, the situation-model strength was augmented to the level of the pro-stance text, making the text-belief consistency effect disappear.

As an additional exploratory research question, we also examined whether language-stance would moderate a potential text-belief-consistency effect on the text-base representation. No evidence was found for the interaction of language-stance with the text-belief consistency effect at the text-base representation level, $F(1, 42) = .860$, $p = .359$ (Fig. 2b).

Discussion

The present study examined the situation-model and the text-base strength for belief-consistent vs. belief-inconsistent texts in bilingual readers. Additionally, we investigated whether the language of the documents moderates the text-belief consistency effect. The results indicated that, regardless of the language of the documents, bilingual readers display text-belief consistency effects while reading multiple controversial documents. However, the strength of the effect tends to vary across documents written in different languages.

Fig. 2 Situation-model strength (**a**) and text-base strength (**b**) by text-language combination and text stance. Error bars represent standard error of the mean
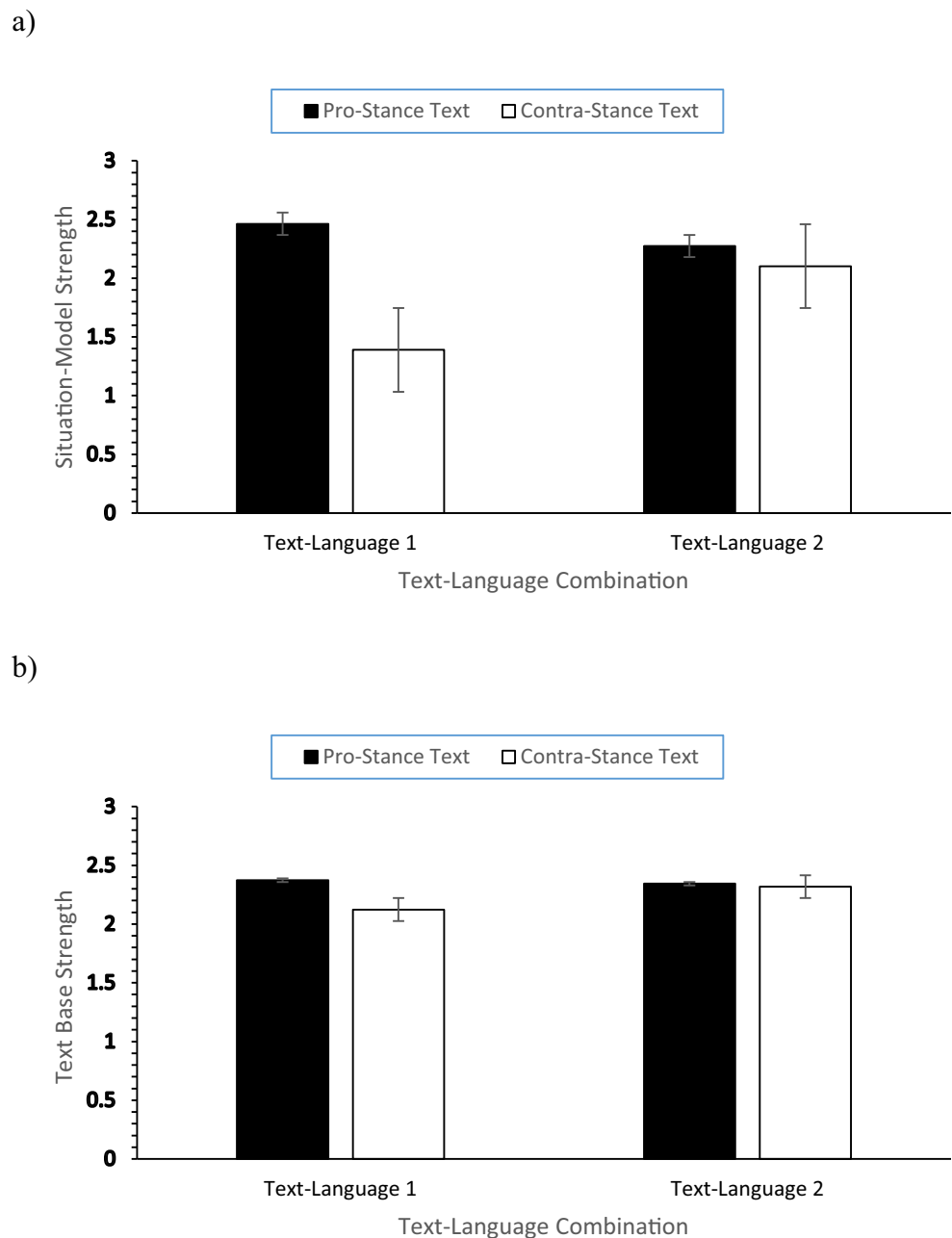
The reported representational bias towards textual information that is consistent with readers' stance is in line with findings from earlier research (e.g., Abendroth & Richter, 2020; Maier & Richter, 2013, 2014), suggesting that readers tend to construct stronger situation models for texts communicating information that is consistent with their beliefs. This belief-bias representation is assumed to be the corollary of a routine validation process integral to and overlapping with text comprehension (Richter et al., 2020). Validation, as a routine, non-strategic process during comprehension (Isberner & Richter, 2014), is used to effectively modulate readers' cognitive investment in text processing leading them to opt for a representation of the information that best suits their purpose and is yielded through the least cognitive effort (Ferreira et al., 2002). The mechanism underlying the process hinges on integrating information that readers find more plausible—more potentially truthful in relation to the contents of the readers' existing mental representations (Lombardi et al., 2013)—into the situation model they construct of a text. In this process, readers' prior beliefs about the topic of the texts function as conceptual filters governing the selection, processing, and interpretation of textual information, which yields a partial one-sided representation of information tainted by readers' beliefs (Maier & Richter, 2014).

The study further investigated whether the representational bias also holds at the text-base level. The results, however, revealed no bias in text-base representation across belief-consistent and belief-inconsistent documents. The text-base representation bias for belief-inconsistent information is interpreted with reference to the principles of the schema-pointer-plus-tag model (Graesser, 1981), which assumes that atypical items are tagged in the memory trace and represented through a distinct memory code (Cohen, 1982). Similarly, because belief-inconsistent information shows a deviation from the readers' schema, atypical in some sense, they are assumed to receive a tagged status in memory representation of textual information, resulting in a reverse text-belief consistency effect (Maier & Richter, 2014). Additionally, conceptualizing comprehension in terms of a two-level representational architecture, the reverse coherence effect (McNamara et al., 1996) predicts that understanding a text may not necessarily proceed equally well at both text-base and situation-model levels. In detail, when comprehension proceeds satisfactorily at the text-base representation level, readers' self-monitoring behaviors are likely to be complicated. Therefore, in light of the sufficient progress registered at the text-base level, the reader fails to work towards a sophisticated situation-model representation (McNamara et al., 1996). Conversely, unsatisfactory comprehension at the text-base representation level encourages readers to engage in knowledge-driven processes to construct a strong situation model (McNamara et al., 1996). This active processing yields a pattern of opposite effects with an improvement in

situation-model representation that weakens the text-base representation (Maier & Richter, 2013). The results of the present study, however, lend no support for these assumptions because no memory advantage was found for belief-inconsistent information compared to belief-consistent information. Based on the findings, building a sophisticated situation model based on an imperfect text-base model is less likely because comprehension is "initiated at the bottom level of text structure" (Hedgcock & Ferris, 2009, p. 17), and it is the text-base model that provides a solid basis for a situation-model representation.

The results further revealed a main effect for document language on the situation-model strength of pro-stance and contra-stance texts. More specifically, although participants constructed similar situation models for belief-consistent texts in the three language groups, their situation-model representations for belief-inconsistent texts were significantly different across these three groups. The results suggest that document language can function as a source characteristic that affects readers' belief-biased representations of textual information. Although more direct evidence is required to warrant the accuracy of such a claim, the status perceptions associated with a language can be argued to differentially affect the evaluative judgements of a document's reliability and validity and the inclusion of the belief-congruent vs. belief-incongruent information presented in the documents into the readers' mental representations. As posited by Bråten et al. (2016), readers tend to tag source information to various perspectives on a controversial issue, which enables them to evaluate the reliability of the information in light of the attributes of the source. This evaluation, in turn, affects the perceived weight assigned to the information in their constructed mental representations. Ideally, readers would engage in the systematic evaluation of all sources irrespective of the stance they take or the position they support. However, the results of this study imply that readers' source evaluation is likely to be biased towards their beliefs because sources that present belief-consistent information might not be judged for credibility or might be judged equally favorably. This bias is implied by the approximately equal weights of the belief-consistent information documented in either Persian or English in the readers' situation-model representations. However, according to the Elaboration Likelihood Model of persuasion, when a message creates discomfort to the self, it encourages people to reflect more deeply on its source (Petty & Briñol, 2012). When the source presents information perceived to discredit readers' beliefs, it tends to be scrutinized for validity and credibility, leading to differential weights for the belief- inconsistent information, documented in sources of various credibility levels in the readers' mental representations. Therefore, in the present experiment, a lower weight associated with belief-inconsistent information presented in Persian as opposed to a higher weight associated with the same information

presented in English might be a function of differential source credibility judgements (more specifically, less favorable credibility judgements for Persian and more favorable judgments for English).

The likely effects of differential credibility judgements is also implied by the cross-linguistic modulatory effects of language-stance on the text-belief consistency effect at the situation-model representation level. More specifically, when reading a combination of a Persian contra-stance text and an English pro-stance text, participants constructed stronger situation models for the pro-stance text compared with situation models for the contra-stance text. In contrast, when reading a combination of an English contra-stance text and a Persian pro-stance text, participants constructed more similar situation models for the two texts. These findings suggests that participants might have treated English-based texts as more reliable. However, a comparison of the situation models for the Persian pro-stance and contra-stance texts reveals that readers' beliefs may have attenuated the cross-linguistic effects of source features. More specifically, the findings suggest that stance-congruent texts written in a language perceived to be superior in status are likely to further consolidate readers' prior beliefs—as part of their evolving mental model (Richter & Maier, 2018)—thus exerting a more significant impact on the mental representations they construct of subsequent stance-incongruent texts. In comparison, the less strong impact of stance-incongruent texts written in a language with a perceived superior status on the mental representations of the succeeding stance-congruent texts suggest that beliefs tend to buffer against the impact of source features on mental representations. In line with the Elaboration Likelihood Model (Petty et al. 2005), the likelihood that people properly assess the source of a message depends on individual and contextual factors. The challenge inherent in exposure to belief-inconsistent information and the fear associated with discrediting one's own beliefs likely serve as strong motivations to think more deeply about the source of such information than sources presenting belief-endorsing perspectives.

Limitations and Directions for Future Research

Like any other study, this study has a number of limitations that need to be acknowledged. The first limitation concerns the topic of the texts. A negative attitude about the spread of English documented in a language other than English likely encouraged a resistant approach in the readers. The results might have been different with a more language-independent socioscientific dispute. Future research should examine whether the language moderates the text-belief consistency effects in other socioscientific issues as well such as the often-researched topics of climate change, vaccinations, or energy sources. These studies should also use other language combinations.

A second limitation is that this study was not based on a balanced design, with equal number of participants favoring one of the two positions in the controversy. Most of the previous studies on the text-belief consistency effect also used imbalanced designs because of the difficulty in finding socio-scientific controversies with strong beliefs on either position of the issue. However, finding such issues and conducting studies based on a balanced design is possible albeit costly and laborious (for an example, see Karimi & Richter, 2021).

Additionally, despite attempts to make the Persian and English texts strictly parallel in terms of argument strength and structure and comparable in understandability, clarity, and interestingness, the results might have been different if Persian renditions of the same English texts (or English renditions of the same Persian texts) had been used.

Conclusion

The present study extends theory and research on text-belief consistency in several ways. The major theoretical contribution of the study is that it provides evidence for document language as a source characteristic, a point that has not been acknowledged in the literature. Additionally, text-belief consistency was explored in a bilingual reading context with documents written in two languages varying in perceived epistemic status and position within the hierarchy of languages representing and disseminating scientific knowledge. Earlier research on text-belief consistency has mostly focused on controversial documents written in a single language.

The findings revealed that readers construct belief-bias representations of controversies, which, as established by earlier research, is yielded by reliance on a routine non-strategic validation process during comprehension (Abendroth & Richter, 2020; Maier & Richter, 2013). Affected by congeniality bias (Eagly & Chaiken, 1993), readers tend to select textual information that endorses their viewpoints and avoid information that aim to discredit or challenge their stances (Knobloch-Westerwick & Meng, 2011). Given that mental representations serve the extra-linguistic purpose of interacting with the world (Schroeder et al., 2008), countering such a bias should be an important goal of instructional programs. Reducing belief bias by increasing readers' selection and processing of belief-incongruent information would enhance their comprehensive understanding of the socioscientific disputes and would encourage a more justifiable mental representation to serve as a basis for rational decision making.

Finally, the results of the cross-linguistic differences in the mental representations of contra-stance texts and similar situation models for the pro-stance texts suggest that readers might appeal to certain heuristic strategies to produce an effortless albeit shallow judgement of the information sources.

Instructional programs should, therefore, focus on promoting more systematic strategies for source evaluation that aim at more rigorous and quality-oriented evaluations of source content (Metzger et al., 2010).

Declarations

Conflict of Interest The authors declare that they have no conflict of interest.

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