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Bilingualism: The foreign language effect does not extend to rational decision making

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This research investigated if the foreign language effect extended to rationality. Four groups (English speaking monolingual group; Polish speaking monolingual group; Bilingual Polish group who were presented with decision task in English; Bilingual Polish group who were presented with decision task in Polish) completed a series of decision scenarios. The results highlighted that: 1) bilingual individuals did not display more rationality in general (or in specific decision scenarios); 2) the presentation of a decision in a non-native language did not aid rational decision making in bilinguals. The paper suggests that the foreign language effect may not increase the chances of bilingual individuals being more rational decision makers in general, but may promote more rational behaviour in specific decision contexts.

Keywords: rationality; the foreign language effect; bilingualism; decision science; cognition

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Background context

On review of the literature, previous researchers have stated that bilingualism is difficult to define in detail, but most seem to agree that it is the knowledge and use of two languages (e.g., Bialystok, 2010). Bilingualism is a rare ability in the United Kingdom as 95% of British citizens can only speak English and are therefore monolinguals (BBC, 2014). Other estimates have suggested that only 7.7% of people in England and Wales can speak another language in addition to English (Office for National Statistics, 2011). Despite these low numbers of bilingualism in Britain, cognitive psychologists have suggested that bilinguals have cognitive advantages over monolinguals (Bialystok, 1999; Chung-Fat-Yim, Sorge, & Bialystok, 2017). Decision making is one particular cognitive ability that has applied aspects to everyday life (e.g., what should I have for dinner?), professional life (e.g., what job should I apply for?) and society (e.g., should Britain stay in Europe?). Despite the importance of such a cognitive ability, the study of how bilingualism affects decision making is a relatively new area of enquiry, with little research existing in the literature. The current research, therefore, aims to investigate if there is a bilingual cognitive advantage in the domain of decision making, as measured by increased rationality.

Decision making

Decision science is an interdisciplinary investigation centred on how people make decisions, the cognitive biases that hinder or help decision making, and how individuals evaluate risk (Curley, Murray, & MacLean, 2015; Curley, MacLean, Murray, & Laybourn, 2018). The most widely accepted model of decision making is the dual process model (Kahneman, 2003). This model states that there are two systems for decision making, system one and system two. System one is an evolutionary old system (Evans, 2008), which is intuitive, fast, sometimes biased, and automatic (Kahneman, 2003). Tversky and Kahneman (1974) studied a number of heuristics and cognitive fallacies (deviations in human judgement from rational norms) that fall under the broad category of system one. The three most well-known heuristics they studied were the representativeness heuristic; the availability heuristic; and the anchoring and adjustment heuristic.

First, when the representative heuristic is being utilised, decision makers ignore base rate information and use stereotypical information to make a decision (Tversky & Kahneman, 1971, 1974). The usage of this heuristic has been shown to lead to a number of fallacies and biases (distortions from objective reality), such as: base rate neglect (ignorance of base rate information); conjunction fallacy (when specific events are seen as more likely to occur than more general events); the gamblers fallacy (misconception of chance being self-correcting); insensitivity to small samples (ignorance of the sample size when evaluating the chances of receiving a sample statistic); and, the inverse fallacy (e.g., inferring the probability of the evidence being correct equates with the probability of the hypothesis being correct e.g., Guthrie, Rachlinski, & Wistrich, 2002; Tversky & Kahneman, 1974; 1983).

Second, the availability heuristic leads to decision makers using the information most salient in their minds to make decisions, and information that is less salient, and potentially more valid, is not considered (Tversky & Kahneman, 1974). Third, the anchoring and adjustment heuristic causes individuals to first utilise numerical starting points (anchors) in their decision process, and then adjust, often inefficiently, from these points. For example, in Tversky and Kahneman's (1974) classic experiment, participants were told that they would be asked to predict the percentage of African countries in the United Nations (UN). However, before they gave their response, they were shown a spinning wheel (numbered from 0 to 100). Unbeknown to the participants, the board was rigged to stop at 10 or 65; these rigged numbers were used as the numerical anchors. The participants who were shown a 10 gave a median estimate of 25%, whereas the group who were shown the numerical anchor of 65 provided a median estimate of 45%. This research showed that decision makers commonly use numerical anchors as a starting point when making a decision, and then adjust, often inefficiently, thus leading to a biased judgement/prediction being reached (Tversky & Kahneman, 1974).

In addition to heuristics, Tversky and Kahneman's (1974) work extends to the study of cognitive fallacies. For example, they investigated framing effects, where decision makers have been shown to choose different outcomes depending on how the decision is presented (positive vs. negative), despite the fact that the same information is presented for the decision regardless of the decision frame (Tversky & Kahneman, 1986). Furthermore, a number of different intuitive responses can fall under the category of system one reasoning (Kahneman, 2003). System one reasoning can lead to accurate decision making in simple and well-rehearsed decisions, but can lead to error in more complex decision scenarios (Tversky & Kahneman, 1974).

System two on the other hand is slow, rational, and effortful (Kahneman, 2003). Despite being effortful, system two processes can be promoted in a number of ways. For instance, decision makers were shown to be less likely to be affected by framing effects when they were asked to "think like a scientist" (Thomas & Miller, 2012, p.143). Further, a number of pieces of research have shown that factors such as experience, expertise, and motivation can lead to a reduction in the use of heuristics (Chan & Wang, 2014; Zhang, Zhai, Cheung, & Lee, 2014). A recent paper by Costa et al. (2019) suggested that another method of increasing rationality was for decision makers to make decisions in a language that differed from their native language; this will be discussed further in the following section.

Does bilingualism promote rational decision making?

Building on the idea that bilinguals differ from their monolingual counterparts in performance on many cognitive tasks, it has been proposed that their decision making processes

may also differ. Previous research has indicated that language context is essential for our understanding of how people facing a decision evaluate the options presented. Many studies thus far found that decisions made in a foreign language, as compared to those made in native language, are more rational; this is known as the foreign language effect (Bilous, 2013; Costa, Foucart, Arnon, Aparici, & Apesteguia, 2014; Keysar, Hayakawa, & An, 2012; Costa et al., 2019; Hayakawa, Costa, Foucart, & Keysar, 2016).

Further, Keysar et al. (2012) studied the effects of bilingualism on a framing task. In a framing task, when the decision is framed in terms of gains, participants typically display risk aversion (taking the decision that minimises risk). Conversely, when the decision is framed in terms of losses, people are more likely to display risk-taking behaviour (maximising risk). Keysar et al. (2012) found that when participants took part in framing tasks in a second language, as opposed to their first language, their risk aversion and risk-taking behaviours were reduced. The researchers concluded that when conducting a decision-making task in a second language, participants utilised system two (rational thinking), whereas when the decision was performed in their primary language, system one was employed (intuitive thinking). Confirmatory evidence for their explanation comes from Bilous (2013) who also found that when bilinguals make decisions in a foreign language, they are more likely to be rational, and less likely to make risky decisions. Using a similar framing task to Keyser et al. (2012), Costa et al. (2014) found that participants who received the frame in their foreign language were still affected by the framing effect. However, they found that the framing effect was smaller in individuals in the foreign language condition in comparison those who were presented with the decision in their native language. Similar results were also found when they investigated the foreign language effect in an ambiguity aversion (biased towards known risks over unknown risks) task (Costa et al., 2014).

Costa, Vives, and Corey (2017) extended previous research by showing that the processing of a foreign language may cause decision makers to move their mode of cognition from system one to system two, thus increasing their rationality. Their reasoning is that a foreign language is processed less automatically than a native language, which could also lead to a more deliberative mode of thinking (i.e., the use of system two; Costa et al., 2017). In addition, Costa et al. (2017) argued that bilingual decision makers are more likely to process information in an emotional manner in their native language in comparison to a foreign language, thus suggesting that this emotionality will trigger system one to govern reasoning when evaluating a decision in the native language (Pavlenko, 2005). Emotional responses, both subjective and physiological, to emotional expressions have been shown, previously, to decrease when stimuli is presented in a foreign language when compared to when stimuli is presented in a native language (e.g., Ayciceği & Harris, 2004; Dewaele, 2004; Harris, Aycicegi, & Gleason, 2003; Puntoni, de Langhe, & van Osselaer, 2009). Furthermore, it has been proposed that bilinguals, while making decisions in their second language, are more likely to use system two of the dual process model (Kahneman, 2003).

However, a number of factors have been found to mediate the relationship between emotional processing and the mode of cognition used during decision making. For instance, Caldwell-Harris (2014) argues that the context in which languages are learnt and used may influence the emotional reaction that specific words may trigger. Therefore, factors such as the age of inquisition and proficiency levels of a second language may influence the mode of cognition utilised by the decision maker (Caldwell-Harris, 2014; Dewaele, 2010). Individuals who learnt a language earlier in life and/or who are highly proficient in a language, may be more likely to processes the language in an emotional manner (Caldwell-Harris, 2014; Dewaele, 2010). For example, the phrase "mein hamster ist gestorben" means my hamster is dead in German. If you are a native English speaker and learnt that phrase whilst living in Germany as a child from a sad friend of yours, you may associate the phrase with sadness. If, however, you learnt the phrase in your thirties on a language learning app, it may not have the same emotional resonance. Therefore, the association between mode of cognition and bilingualism may be moderated by the context in which a second language is used and learnt (Caldwell-Harris, 2014; Dewaele, 2010).

Nevertheless, the dual process model may explain the foreign language effect, as the way the information is presented (i.e., foreign vs. native language) may have an influence on the mode of cognition that governs the decision maker. For instance, when decisions are presented in the decision makers' native language, decision makers may process the language easily and thus make an intuitive decision (Costa et al., 2017). Whereas, when decisions are presented in a foreign language, the decision maker may need to think about the language of the decision and may also have less of an emotional response, thus increasing the chances of system two being utilised during the decision process (Costa et al., 2017).

The occurrence of the foreign language effect seems to depend on the type of decision scenario, however. Costa et al. (2014) showed that in an experiment using the ticket/money loss scenario, all participants were equally affected by the framing manipulation regardless of the language the problem was presented in. In this scenario, participants are told either that a woman has lost tickets to a show, or that the woman has lost the money equivalent to buying a ticket to a show, then participants are asked if the woman should buy more tickets. Previous research has shown that decision makers are more likely to state that the woman would buy more tickets when she has lost money in comparison to when she has lost tickets. This is because the loss of the money is not accounted for in relation to the total amount spent on the tickets, whereas when tickets are lost, the amount spent on the lost and potential tickets is combined to form an overall ticket expenditure (Costa et al., 2014). A similar framing task (the Discount task), however, yielded different results that were in line with the foreign language effect. In the discount task, decision makers are shown scenarios relating to the discount of items, and it is commonly found that individuals are not persuaded by the amount of the discount but rather the proportion of the discount on the overall item (Costa et al., 2014).

The authors, tentatively, explained that the ticket/money task was the only task that did not ask the participant to imagine

that they are the actor of the scenario. Rather it presented a hypothetical person as the actor and participants had to put themselves into this person's shoes, which could have affected the level of emotional involvement. Further, these results suggest that the emergence of the foreign language effect may be decision context dependent.

Previous research, however, has been confined to investigating the foreign language effect in specific decision scenarios, testing only one type of heuristic or cognitive fallacy at a time. This research is limited and cannot generalise the foreign language effect beyond the specific heuristic or cognitive fallacy of interest. System one consists of a plethora of non-rational strategies (Kahneman, 2011), and the attenuation of one type of bias or fallacy because of the foreign language effect does not suggest the attenuation of all of system one. Further, Gigerenzer (1991) and Simon (1956) suggested that we have a plethora of heuristics adapted to multiple environments. Therefore, when studying the influence of a decision being presented in a foreign language on the mode of cognition, multiple decision scenarios (each associated with the promotion of a particular heuristic/fallacy) should be tested.

Current Research and hypothesis

The current research therefore has two main aims. First, the current research hopes to extend on the work of previous research by investigating the influence that the foreign language effect has on the usage of heuristics and the likelihood of falling into a fallacy trap. In addition, the research hopes to explain the foreign language effect through the use of dual process model of decision making, highlighting that decisions presented in a foreign language are more likely to promote system two (or rational) reasoning. Second, the research aims to test if the foreign language effect can be extended to rationality more generally, by presenting participants with a number of decision scenarios that have been utilised in previous research when testing different heuristics and fallacies (availability heuristic, the representativeness heuristics, framing effects, etc.). The reasoning for this is because most of the previous research has investigated the effects of the foreign language effect on the usage of specific heuristics and fallacies, rather than on the effects it has on the more general mode of cognition (system one versus system two). These aims informed the following hypothesis:

Bilinguals (from Poland) presented with decisions in a foreign language (English) will be significantly more rational than the other three groups (i.e., English speaking monolingual's shown decisions in English; Polish monolinguals shown decisions in Polish; and, Polish bilinguals shown decisions in Polish).

Method

Design

A 2 × 2 between subjects design was used. The first factor was language ability (monolingual vs. bilingual) and the second factor was language presentation (English vs. Polish). The dependent measure was called rationality and was measured by the number of rational decisions made by the participants over a series of eight questions: minimum = 0; maximum = 8. Analyses of the influence of the foreign language effect on the usage of specific heuristics/fallacies took the form of tests of associations with binary variables ('0' score for a biased decision and '1' for a rational decision).

Participants

In 2017, it was estimated that 889,000 Polish individuals stayed in the United Kingdom (UK), meaning that Polish individuals are the biggest non-British group currently residing in the UK (Blake, 2018). Native English speakers and Polish participants were therefore the focus for this study.

Altogether, 140 participants took part in the study, 70 in the English monolingual group, 21 in the Polish monolingual group, and 49 in the Polish/English bilingual group. Of the bilingual group, 26 completed the study in their native language (Polish), and 23 completed the study in their foreign language (English).

There were 44 males, 95 females, and one participant did not state their gender. The mean age of the sample was 29.40 years (*SD* = 9.44 years). There was a variety of education levels within the sample and across both groups, ranging from compulsory schooling only, to PhD level. The English-speaking monolingual group had lived in the UK for a mean of 25.79 years (*SD* = 11.28 years). Of the 49 members of the bilingual group, 38 (77.6%) lived in the UK, with a mean duration of 8.74 years (*SD* = 5.67 years). All Polish monolingual participants lived in Poland at the time of testing and never before had lived in an English-speaking country. Of the English monolingual group, 65 (71.4%) have studied at a UK university, and 29 (59.2%) of the bilingual group have studied at a UK university.

Participants were recruited through the Edinburgh Napier University Psychology Participant Pool, advertisements on social media sites, and through posters displayed on university campuses. The inclusion criteria were that participants should either speak only English, only Polish, or be fluent in both English and Polish only (i.e., no further languages). Participants were also required to be 18 years of age or over and have access to the internet to complete the study online.

Materials

Language categorisation.

Materials were created in both the English language and the Polish language, with the English documents being translated by author BP, whose native language is Polish and is as fluent in English as a native speaker. The translations were cross-checked by an independent Polish-English bilingual speaker.

All materials were presented using the online survey platform Qualtrics. The first question asked participants if they fluently spoke English only, Polish only, or if they could speak both languages fluently (each option was presented in English and Polish, so participants had the context of the other options). From this point on, the English monolingual participants only saw materials

written in English, the Polish monolingual participants only saw materials in Polish, with the Polish/English bilingual participants seeing either English or Polish only, with an alternating algorithm directing participants accordingly.

Ethical materials and demographics questionnaire.

The information form contained details of the study, the participants' rights, and a reminder of the inclusion criteria. The consent form required confirmation that the participant had read and understood the information sheet, and were freely willing to take part in the study. A demographics questionnaire contained 16 items in relation to the participant's gender, age, education level, country of residence, and location of higher education institution (where appropriate). These questions were asked to help situate the sample tested, and to make assertions about the level of English participants may have been educated in. Finally, the debrief form contained further information about the study, with the option for participants to submit their final answers.

Need for cognition scale.

Participants then completed the Need for Cognition scale (Cacioppo, Petty, & Kao, 1984). This measure was included in this study to determine if thinking style/preference (analytical or not) is related to decision-making style (rational or bias), or if it at least acts as an explanatory co-variate in differences. This consists of 18 short statements about thinking and problem-solving, which require the participant to select the answer that best suits their habits on a nine-point scale from 'very strong agreement' (scored +4) through to 'very strong disagreement' (scored −4), with 'neither agreement nor disagreement (scored 0) as the middle option. Example statements include 'I would prefer complex to simple problems' and 'thinking is not my idea of fun' (reversed scoring). Those who score highly on this measure are more likely than low scorers to frequently enjoy and engage in thought elaboration and deliberation. They also have more confidence in their thoughts and arguments (Cacioppo & Petty, 1982). A Cronbach's Alpha, however, indicated that the Need for Cognition scale had a low internal consistency (a =.340) when the current data set was being utilised. Such a low reliability of the scale in the current sample is in line with previous research showing similar levels in heterogenous samples of participants from different socio-economic and educational backgrounds (Shepperd, Emanuel, Dodd & Logan, 2016) but in contrast with those studies using student samples (Caccioppo, Petty, Kao, 1984; Sadowski & Gulgoz, 1992). As the reliability of this measure was so poor, it was excluded from further analysis.

Decision making task and scoring. The decision making task was an adaptation of the influential research by Tversky and Kahneman (1983), modernised by the researchers. Eight short statements were presented one at a time, followed by two to four answer options, from which the participant chose one. The answer selected indicates if the participant made a rational or biased decision. An example statement used is 'Alex has an analytical mind, and is good in debates with excellent communication skills. Is Alex more likely to be a lawyer or a nurse?'. This question tests the representativeness heuristic. Given that there are around five to six times more nurses than there are lawyers both in the UK and Poland, the correct answer here would be that Alex is more likely a nurse. However, given the specific description of Alex, participants may more easily associate their skills with that of a lawyer than that of a nurse. This would also show that the participant had disregarded baseline population statistics and had instead equated the representation of the character description with a higher probability of practicing law. Participants received one point on the dependent variable of 'rationality' if they selected 'nurse' as their answer, and zero points if they selected 'lawyer'.

Another example statement measures the availability heuristic (hereafter called availability heuristic 1). The question asks 'You go on holiday to the United States of America, what are you most likely to die from, a firearm or pneumonia?'. Given the media coverage of firearm crimes in the USA, there is likely more information on that available to the participant, leading them to select this as their answer. However, on average, there are over 57,000 cases of deaths by pneumonia reported annually, as opposed to just over 15,000 deaths by firearm. The participant would receive one point on the rationality scale for selecting the answer of 'pneumonia', and zero points for selecting 'firearm'.

The remaining six items on the decision making task were similar in nature, each testing a different heuristic/fallacy as follows: framing effect question (risk averse); inverse fallacy; a second availability heuristic (availability heuristic 2); conjunction fallacy; base rate neglect, and gambler's fallacy; all with appropriate answer options. Each participant could have a total score between zero and eight, with the higher scores indicating more rational decision making.

Self-reported language proficiency test. The self-report language proficiency test was provided to the bilingual participants only. It consisted of nine items adapted from the Language and Social Background Questionnaire (LSBQ) developed by Anderson, Mak, Keyvani Chahi, and Bialystok (2017). Two simple questions asked where the participant had learned English (e.g., home, school, community, etc.), and at what age they started actively using English. Two items required participants to select the quantity they speak, listen, read, and write in English, on a scale of 0 (no English, all Polish) to 100 (all English, no Polish), both at home and at university/work. Two questions asked participants to rate their speaking, understanding, reading, and writing skills in comparison to a native monolingual speaker, with 0 indicating non-native like, and 100 = native like. Bilingual participants were asked to complete this rating for both the Polish and English languages. Finally, three questions asked participants how frequently they switch between both languages when engaging with parents/family, friends, and social media, on a five-point scale from never to always. This measure was used to allow comparisons of language ability and immersion, and also to allow the exclusion of non-fluent bilingual participants from the sample.

Procedure

The materials were presented online using Qualtrics, and the link to the survey was electronically distributed. The survey therefore took place at a time and place that suited the participant, and on the device of their choosing. When a participant engaged with an advertisement of the study and clicked on the survey link, they were directed to the first question and had to select if they spoke only English, only Polish, were fluent in English and Polish, or of they spoke any other languages. Those who selected the final option were directed to a screen with text that thanked them for their interest and time but informed that they were ineligible to continue with the study. From this point on, English monolinguals were presented with English materials, Polish monolinguals were presented with Polish materials, and half of the bilingual participants saw the English materials, with the other half seeing the Polish materials.

The information sheet was then displayed with the option to continue to the consent form. The consent form had two options, to take part, or not to take part, those selecting not to were thanked for their time and the study ended. Following the submission of consent, the demographic questions were displayed. Again, if the monolingual speakers selected an option that indicated that they spoke another language, they were thanked and exited from the study. After the demographic questionnaire was completed, the Need for Cognition scale was presented, followed by the decision-making task. The monolingual groups then submitted their answers after reading the debrief form. The bilingual group were led to the self-rated language proficiency task before reading the debrief form and submitting their data.

The survey took approximately 15–20 minutes to complete. Only fully completed and submitted entries were analysed, with incomplete submissions deleted from the Qualtrics platform. The data were organised using Microsoft Excel and statistically analysed using SPSS 23.

Ethical Approval: Ethical approval for the study was provided by the School of Applied Sciences Research Integrity Committee at Edinburgh Napier University.

Results

Language proficiency

In order to ensure that the two groups of bilingual speakers, those who were presented with scenarios in their native language (Polish) and those who were presented with scenarios in their foreign language (English), did not differ in their language proficiency levels, an analysis of difference was conducted. Tables 1 and 2 present descriptive and inferential statistics for the bilinguals' proficiency levels and their use of both languages in everyday activities, respectively.

There are no significant differences in English language and Polish language proficiency between bilingual participants who were presented with decision in English comparing to those who were presented with decisions in Polish.

Table 2 also shows that when it comes to the use of language in everyday activities, there were no significant differences in activities carried out at work or university and in most of those carried out at home. Also, the age at which participants started to actively use their second language was not significantly different. There was, however, a significant difference (p = .047) in *speaking* where bilinguals who were randomly assigned to make decisions in Polish, spoke Polish at home more than they spoke English. This difference can be seen as negligible in the context of the remaining measures.

Table 1
Language proficiency indicators of the bilingual group (decisions presented in English vs. Polish).

	English Proficiency			Polish Proficiency		
	Decisions made in English *M (SD)*	Decisions made in Polish *M (SD)*	*Sig.*[b]	Decisions made in English *M (SD)*	Decisions made in Polish *M (SD)*	*Sig.*[b]
Speaking[a]	76.52 (19.45)	67.60 (22.04)	ns	95.22 (10.39)	96.25 (6.47)	ns
Comprehension[a]	87.83 (11.26)	77.20 (20.31)	ns	98.26 (3.88)	96.80 (6.90)	ns
Reading[a]	88.70 (12.54)	80.00 (19.36)	ns	97.83 (5.18)	98.40 (3.74)	ns
Writing[a]	79.13 (21.09)	71.25 (21.53)	ns	94.78 (13.10)	95.20 (9.18)	ns

Note.

[a] Participants were asked to rate their proficiency level in a scale of 0–100 relative to a native speaker of a given language.

[b] significance indicated for a t-test or non-parametric equivalent (Mann-Whitney U test) when required.

* significant at p <.05; ns - non-significant.

Table 2.
Language use in the bilingual group (decisions presented in English vs. Polish).

		Decisions made in English M (SD)	Decisions made in Polish M (SD)	*Sig.*[d]
	Age[a]	17.04 (7.22)	18.96 (8.89)	ns
Activities at home[b]	Speaking	61.00 (32.10)	40.00 (32.75)	*
	Listening	60.91 (30.22)	51.67 (31.30)	ns
	Reading	63.91 (23.30)	55.60 (31.63)	ns
	Writing	66.36 (25.92)	60.00 (33.52)	ns
	TV	75.45 (23.41)	66.09 (31.15)	ns
	Radio	77.23 (33.08)	76.84 (31.28)	ns
Activities at work and/or university[b]	Speaking	88.64 (16.12)	82.08 (29.34)	ns
	Listening	88.64 (17.81)	86.52 (24.79)	ns
	Reading	95.45 (11.43)	86.80 (25.77)	ns
	Writing	94.10 (15.01)	87.92 (25.02)	ns
Switching between languages[c]	With parents and family	2.96 (1.11)	2.88 (1.10)	ns
	With friends	3.17 (0.89)	3.00 (0.87)	ns
	On social media	2.43 (1.16)	2.40 (1.23)	ns

Note.

[a] Age from when participants started actively using their second language.

[b] Participants were asked to indicate the proportion of their use for English and Polish in daily life on a scale from 0 to 100 where 0 indicates that a given activity is carried out in all Polish and 100 indicates activity being carried out in all English.

[c] Participants were asked about how often they were switching between the two languages while communicating with family/friends or on social media on a scale from 1 to 5 where 1 indicates 'never' and 5 indicates 'always'

[d] significance indicated for a t-test or non-parametric equivalent (Mann-Whitney U test) when required.

* significant at $p < .05$; ns - non-significant.

Differences in rationality score between language ability and language presentation

Descriptive statistics relating to rationality scores across each of the two conditions of the IVs: language ability (bilingual vs. monolingual) and language presentation (English vs. Polish), are presented in table 3. For rationality, the higher the score, the more rational the participant.

The data were non-parametric according to the Shapiro-Wilk tests of normality (all $p < .05$). Due to the violation of the assumption of normality, a generalized linear model was used. The type of model chosen was ordinal logistic as the data had a non-normal distribution and could be ordered from most rational (highest score was six) to least rational (biased: lowest score was zero).

Initially, it was found that the model did not significantly outperform the null model [x^2 (3) = 2.59, p = .46]. Each of the main effects and interactions were then investigated. First, it was found that the language presentation factor had no significant effect on the rationality score [x^2 (1) = .143, p = .71]. Second, it was found that the language ability factor did not have a significant effect on the rationality score [x^2 (1) = .001, p = .97]. Third, it was found that the interaction between the language ability and language presentation factor did not have a significant effect on the rationality score [x^2 (1) = 2.45, p = .12].

The foreign language effect on specific heuristics/fallacies

To follow up the previous analysis, multiple tests were conducted to analyse if the foreign language effect enhances rationality in specific decision scenarios commonly associated with promoting a heuristic/fallacy. As each question was analysed separately at this point, the measure of rationality was expressed in binary form (rational choice versus biased choice). The aim was to test for association between this rationality score (zero = biased choice;

Table 3.
Rationality scores across groups.

	Rationality Score			
	English monolingual	Polish monolingual	Bilinguals completing tasks in English	Bilinguals completing tasks in Polish
Median	3.00	2.00	2.00	2.50
Minimum	0.00	1.00	1.00	2.00
Maximum	5.00	5.00	6.00	5.00
Mean	2.67	2.43	2.39	2.81
Std. Dev.	1.32	1.29	1.27	1.02

Table 4.
Associations between language group and rationality for each heuristic/fallacy

Heuristic/Fallacy	X^2	p	ϕ
Representativeness	4.51 [a]	.20	.17
Inverse fallacy	5.56 [a]	.08	.22
Framing (risk averse)	3.27 [a]	.36	.16
Gambler's fallacy	.70 [a]	.93	.06
Conjunction fallacy	.78 [b]	.85	.08
Base rate neglect	2.47 [b]	.48	.13
Availability heuristic (1)	4.87 [b]	.18	.19
Availability heuristic (2)	3.56 [b]	.31	.16

Note. [a] Fisher-Freeman-Halton exact test conducted as 37.5% had an expected count below 5; [b]chi-square test.

one = rational choice) and language group (English speaking monolingual presented with decision in English; Polish bilingual presented with decision in English; Polish bilingual presented with decision in Polish; Polish monolingual presented with decision in Polish) in each of the decision tasks (e.g. for each heuristic and fallacy). Analyses suitable for categorical data were therefore conducted. Table 4 presents associations between language group and rationality for each heuristic/fallacy. No significant associations were found.

Additional Analysis

Additional analysis investigated if there was a correlation between the numbers of years lived in the UK for polish Bilinguals (Mdn = 10) and the rationality score (Mdn = 2); only bilingual individuals who answered yes to currently living in the UK were included in this analysis. Both scores were non-parametric according to Shapiro-Wilk's test of normality ($p < .01$). A Spearman's Rho correlation was conducted and found that no significant relationship existed [$r_s(30) = -.205$; $p = .14$].

Discussion

The aim of this current study was to investigate whether the foreign language effect extends to rationality. The main hypothesis, therefore, was that bilinguals (from Poland) presented with decisions in a foreign language (English) would be significantly more rational than the other three groups (i.e., English speaking monolingual participants presented with decision-making tasks in English; Polish monolingual participants shown the tasks in Polish;

and Polish bilingual participants shown the tasks in Polish). The results showed that these groups of participants did not differ in their level of rationality, thus leading to the null hypothesis being retained.

There are three main possible explanations that can be drawn from the results: 1) the Polish bilingual group may have integrated well in Britain and they no longer need to utilise system two to process the English language (cultural integration explanation); 2) the foreign language effect may not affect rationality when it is measured in a global manner (the global rationality explanation) and may be limited to attenuating the usage of specific heuristics/fallacies that were not investigated in the current study; or, 3) the foreign language effect does not extend to decision making at all (the lack of influence explanation). Each of these explanations is discussed below.

The first possible explanation relates to the cognitive adaptation of Polish immigrants and their integration into Britain. This explanation is based on the influential work by Gigerenzer and Goldstein (1996), where they propose that too much knowledge on a particular topic can have a negative effect on the ability of the decision maker to make accurate decisions. They tested this assumption by giving participants a series of German city pairs, and asked them to choose which city had the most inhabitants. Participants with little prior knowledge of the German cities were poor at choosing the city with the largest number of inhabitants, and too much knowledge of the German cities also led to poor performance. However, individuals who had a middling knowledge of German cities gave the highest percentage of correct answers (Gigerenzer & Goldstein, 1996). It was concluded that if a decision maker has no knowledge of either cities, they would have to guess which option to choose, and if a decision maker recognises both decision outcomes (i.e., knows both cities), they may not be able to decipher the option that is most likely to have the highest number of inhabitants. Whereas, knowledge of one of the cities (Berlin) but not the other city (Bonn) will allow the decision maker to choose the recognised city over the non-recognised city, thus allowing the decision maker to choose the correct option. This counterintuitive less or more method of decision making works because recognised cities may be known for having a larger population (Gigerenzer & Goldstein, 1996).

Further, Gigerenzer and Goldstein's (1996) work on this more is less effect may explain why the foreign language effect may not have influenced rationality in the current study. For instance, the median number of years that Polish bilinguals had lived in the UK was 10, during this time they may have become accustomed to the English language and no longer had difficulty or delays in processing the English language. Therefore, the Polish bilingual group tested in the current study may have processed the English language in a similar manner to English speaking monolinguals and may also have processed the Polish language similarly to Polish monolinguals. Consequently, meaning that bilinguals in the current study were as likely to use intuitive decision making processes as monolinguals in each of the respective languages.

The results of this study, however, suggest that there was no significant association between the amount of years spent in the UK and rationality score, thus highlighting that the cultural integration explanation may not be adequate enough to explain the lack of significance in the current study.

In relation to the second explanation, when comparing the current study that investigated rationality in a general manner (through a number of decision scenarios that promoted intuitive reasoning) with previous research that has been centered on how the foreign language effect may influence specific cognitive fallacies, it can be suggested that the foreign language effect may not generalise to rationality when it has been measured in a more global way. In other words, making a decision in a foreign language may decrease the chances of a decision maker being influenced by framing effects (Costa et al., 2014), but will not increase the chances of them be rational in every decision context.

Previous research from Costa et al. (2014) lends support to this explanation. For instance, it was found that the foreign language effect led to a decrease of framing effects in their discount task, but did not lead to more rationality in their ticket/money loss scenario. Further, the foreign language effect did not influence rationality in the framing task utilised in this study (a different framing task from the Costa et al. (2014 study), once again highlighting that the foreign language effect may not influence rationality in every decision scenario. In summary, the current study lends support to the idea that the foreign language effect does not influence our chances of displaying rational behaviour in every decision context, and that the influence that the foreign language effect may have on our rationality may be decision context dependent; the current study may have just not used decision contexts that positively (i.e., promote rational decision making) interact with the foreign language effect. Nevertheless, future research is needed to test the claim that rationality can be influenced by the foreign language effect in specific decision contexts. This is because the current study failed to show that the foreign language effect can attenuate the chances of decision makers utilising heuristics/fallacies in specific decision scenarios.

Our final explanation of the findings is that the foreign language effect does not extend to the area of decision making at all. Further, when it comes to previous research on bilingualism and decision making, indeed, bilinguals seemed to show differences when studying specific decision scenarios that promoted particular heuristics and/or cognitive fallacies (Bilous, 2013; Costa et al., 2014; Costa et al., 2017; Hayakawa et al., 2016; Keysar et al., 2012). These results, however, have not been confirmed by the current investigation and we therefore call for more research in the area in order to be able to comment, with confidence, on how the foreign language effect influences rationality.

Based on the analyses in the current study, therefore, the global rationality explanation and lack of influence explanation may be the best contenders for explaining the relationship between the foreign language effect and rationality. However, when taking these results in context with the wider literature, it seems that the global rationality explanation may provide the most promise. This is because the current study found that the foreign language effect did not attenuate the usage of specific heuristics/fallacies, whereas previous research has shown that the foreign language effect can

attenuate the usage of particular heuristics and cognitive fallacies (Bilous, 2013; Costa et al., 2014; Costa et al., 2017; Hayakawa et al., 2016; Keysar et al., 2012). Nevertheless, more research is needed to decipher which of these explanations (the global rationality explanation vs. the lack of influence explanation) best describes the relationship that the foreign language effect has on rationality.

Limitations and suggestions for further research

There are limitations in the current study that need to be considered. The study did not evaluate an actual language proficiency level of the participants; only a self-reported fluency level was obtained. Also, the language use of monolingual speakers was not assessed. This approach was used as it is in line with previous literature on bilingualism (e.g., Elston-Güttler, Paulmann & Kotz, 2005; Gollan & Acenas, 2004; Gollan & Silverberg, 2001). Future research, however, should measure proficiency levels using established English proficiency tests and/or test how well the participants understand the decision scenarios used (such measures were previously used by Costa et al., 2014). Inclusion of both of these measures in further studies would also allow a more in-depth investigation of how different levels of proficiency may impact rational thinking. A more complex, exploratory, and correlational, rather than differential, analyses in future research would be particularly interesting as it has been previously suggested that bilingualism should not be considered as a categorical variable but as a multi-dimensional experience (Luk & Bialystok, 2013).

Conclusion

In conclusion, of the three possible explanations for these findings, there is two plausible account for the current results: 1) the foreign language effect may not affect rationality when it is measured in a global manner (the global rationality explanation) and may be limited to attenuating the usage of specific heuristics/fallacies that were not investigated in the current study 2) the foreign language effect does not extend to rationality. Additional analyses found: 1) that the foreign language effect did not attenuate the use of the specific heuristics/fallacies used in the current study; 2) that the number of years bilingual individuals have lived in the UK does not correlate with rational decision making. Nevertheless, future research is needed to confirm which explanation (the global rationality explanation vs. the lack of influence explanation) best describes the relationship between the foreign language effect and rationality. The current piece of research has been insightful in placing potential parameters in the foreign language effect (i.e., that the foreign language effect may be context dependent) and has generated potential hypotheses/explanations for the academic community to study further.

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