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The framing effect in a monetary gambling task is robust in minimally verbal language switching contexts

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Abstract

Decision-making biases, in particular the framing effect, can be altered in foreign language settings (foreign language effect) and following switching between languages (the language switching effect on framing). Recently, it has been suggested that the framing effect is only affected by foreign language use if the task is presented in a rich textual form. Here, we assess whether an elaborate verbal task is also a prerequisite for the language switching effect on framing. We employed a financial gambling task that induces a robust framing effect but is less verbal than the classical framing paradigms (e.g., the Asian disease problem). We conducted an online experiment (n = 485), where we orthogonally manipulated language use and language switching between trials. The results showed no effects of foreign language use or language switching throughout the experiment. This online result was confirmed in a laboratory experiment (n = 27). Overall, we find that language switching does not reduce the framing effect in a paradigm with little verbal content and thus that language switching effects seem contingent on the amount of verbal processing required.

Keywords

Framing effect; foreign language effects; financial gambling; decision making under risk; language switching

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Introduction

The wording of a problem can influence human decision-making behaviour, even when irrelevant to the problem's rational solution (Kahneman, 2003). A major example for such apparently irrational behaviour is the well-replicated framing effect: Describing a decision-making problem in terms of potential gains leads to more risk-aversive decisions than presenting it in terms of potential losses (Tversky & Kahneman, 1981).

The framing effect is classically assessed with the "Asian Disease" problem, in which individuals are asked to choose which one of two different types of medicines should be developed to fight the spread of a fatal disease. One type of medicine will help all infected individuals with 60% probability and none of them with 40% probability, whereas the other medicine will help 60% of the infected individuals for sure. When the two medicines are described in terms of potential survivors (gain frame), participants are more likely to choose the "sure" medicine, whereas when the two medicines are described in terms of potential deaths (loss frame), participants choose the risky alternative more frequently. This pattern is robust over different samples and types of problems (Kühberger, 1998; Rönnlund, Karlsson, Laggnäs, Larsson, & Lindström, 2005). The framing effect is typically interpreted in the framework of dual process theories, which hypothesise

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that decisions arise from the interplay of rather fast, intuitive, and emotional processes, on the one hand, and rather slow, and rational processing on the other hand (Kahneman, 2003). The framing effect demonstrates apparent irrationality since participants in the gain frame choose the sure option more often than in the loss frame, although options are numerically equivalent in both frames.

Two recent studies have shown that the framing effect can be diminished or even completely abolished when a problem is presented in a foreign language (Costa, Foucart, Arnon, Aparici, & Apesteguia, 2014; Keysar, Hayakawa, & An, 2012). In the initial study by Keysar and colleagues (2012), participants responded to the Asian disease problem either in their native language or in a foreign language and showed a robust framing effect in their native language, but not in the foreign language. Keysar et al. suggested that this resulted from increased emotional distance in a foreign language (see also Hayakawa, Costa, Foucart, & Keysar, 2016; Pavlenko, 2012 for reviews on emotional processing and bilingualism), leading to a stronger reliance on analytic processes in both frames and thus equally balanced choices of the risky and sure options in both frames.

Using a similar design, we recently found that switching between languages also leads to a reduction of the framing effect, with no concurrent effects of foreign language use per se (Oganian, Korn, & Heekeren, 2016). In our study, native speakers of German with knowledge of either English or French showed a framing effect in both their native and foreign languages. However, the framing effect was reduced when participants switched between languages prior to answering the Asian Disease problem (i.e., when task and instructions were presented in different languages). This result led us to suggest that in addition to increasing emotional distance, foreign language contexts can also alter decision processes via recruitment of cognitive control processes. This notion is in line with recent findings of improved executive control in a language switching context (Wu & Thierry, 2013), as well as (modestly sized) effects of font disfluency onto the framing bias (Korn, Ries, Schalk, Oganian, & Saalbach, 2017). In our study, the language switching effect was independent of participants' foreign language proficiency, (Oganian et al., 2016), unlike the effects of increased emotional distance in foreign language settings, which are generally largest at low proficiency levels (Pavlenko, 2012). For example, moral decisions are also affected by foreign language use and by proficiency (Corey et al., 2017; Costa, Foucart, Hayakawa, et al., 2014; Geipel, Hadjichristidis, & Surian, 2015). This difference further supports the notion that foreign language use and language switching may alter decision biases via separate pathways.

All of the above-mentioned studies of foreign language effects on framing employed the Asian disease task, or variants thereof. These tasks are not only emotionally taxing, but also very elaborate verbally. Are both aspects, emotional content and rich verbal descriptions, necessary prerequisites of foreign language and language-switching effects on framing?

Winskel, Ratitamkul, Brambley, Nagarachinda, and Tiencharoen (2016) addressed this question for foreign language effects, but not language switching effects, in two experiments with native Thai speakers with English as a foreign language. Winskel and colleagues compared the framing effect between the two languages in the classic Asian Disease problem, a less emotional but textually elaborate financial crisis problem, and a less emotional and textually minimal financial gambling problem (adapted from De Martino, Kumaran, Seymour, & Dolan, 2006). That is, the Asian Disease and financial crisis problems were text-based, and the financial gambling problem was presented graphically with minimal text.

For both textually elaborate problems, the framing effect was reduced in the foreign language, replicating the foreign language effect in an emotionally shallow version of the Asian Disease problem. In contrast, in the graphical version of the problem, the framing effect was of equal magnitude in both languages. The authors concluded that although the effect of a foreign language does not require an emotionally taxing task such as the Asian Disease task, a rich linguistic context is necessary for foreign language effects to occur. We have acquired pilot data that replicated the results by Winskel et al. in German-English bilinguals ($n = 51$) with the graphical, linguistically shallow financial framing task: A robust framing effect emerged that did not differ between native and foreign language versions of the task.[1]

Importantly, however, the study by Winskel and our pilot study did not explicitly manipulate language switching. It remains therefore an untested hypothesis whether language-switching effects on framing require a textually rich task. On the contrary, it is possible that even in a verbally sparse format of the problem language switching will lead to stronger cognitive control (Wu & Thierry, 2013) which in turn would induce balanced involvement of rational and emotional decision processes in both frames. In this case, we would expect to observe a reduction in the framing effect following language switching in a minimally verbal version of the task, such as the financial gambling task. A plausible alternative is that language switching only exerts an influence on decision-making under risk if the task requires more extended verbal processing.

Here, we report two experiments in which we tested the hypothesis that language switching reduces the framing effect in a financial gambling task (De Martino et al., 2006). In a first online experiment, we concurrently manipulated the language of the task as well as the consistency of the language context, by intermixing trials in participants' native and foreign languages. A second laboratory

Table 1. Participants' profiles for Experiments 1 and 2.

	Language group	Experiment 1 (online)		Experiment 2 (laboratory)
		German/English	German/French	German/English
Participants	*N*	320	166	27
	% female	56	68	33
	Age (*SD*)	34 (11.9)	34 (11.5)	28 (5.1)
Lextale (Mean, *SD*)	German	–	–	93.15 (4.5)
	English	–	–	73.4 (11.14)
Foreign language characteristics[a] (Mean, *SD*)	Reading	5.3 (1.16)	4.1 (1.4)	5.22 (0.8)
	Writing	4.7 (1.25)	3.3 (1.28)	4.74 (1.1)
	Speaking	5.0 (1.21)	3.6 (1.44)	4.66 (.83)
	Listening	4.6 (1.23)	3.2 (1.31)	5 (0.73)
	Mean proficiency	4.88 (1.12)	3.53 (1.26)	4.9 (0.74)

[a]On a scale from 1 (*no knowledge*) to 7 (*native-like*).

experiment was conducted to replicate the results of Experiment 1.

Experiment 1

Methods

Online data collection. Participants were recruited via the panel of the non-commercial online survey system Sosci (www.soscisurvey.de; Leiner, 2016). Participants of this panel do not receive monetary reimbursement and participate out of interest. The task was programmed and presented through the interface provided by the Sosci system. Prior to the launch of an experiment with the Sosci panel, independent and anonymous reviewers check the experiment for ease of understanding and clarity of the visual design. We thus optimised the experiment based on feedback from three reviewers.

Participants. Initially, 510 (309 female, mean age 35 years) participants were presented with a version of the financial framing task, which included switching either between German and English or between German and French (the same participants also completed an optimism task, see Oganian, Heekeren, & Korn, this issue). The recruitment text was in German. We included French to ensure coverage of a foreign language with rather low proficiency, as German participants in the SoSci pool typically have a relatively high proficiency in English. At the beginning of the online survey, participants were asked to indicate their level of English and French proficiency on a scale of 1–7. This was done only to ensure that participants would not receive the questionnaire in an unknown language (i.e., proficiency self-report 1 or 2). Beyond this restriction, participants were then randomly assigned to do either the German–French or the German–English version of the task and the language in which they would receive the task instructions (see also Oganian et al., 2016 for a description of the randomisation procedure and for demographics of another, independent Sosci sample; the Sosci system ensured independence by sending the recruitment text to different subsets of the panel members). Participants with no sufficient knowledge of either language were thanked for their interest and excluded from further participation. Participants were told that the study examined decision-making in foreign and native language contexts and that thus different languages might be used in the questionnaire. Participants' foreign language proficiency was additionally assessed in more detail at the end of the experiment, using part A of the language history questionnaire by Li, Sepanski, and Zhao (2006). Participants' data were excluded from all analyses if they did not fulfil at least one of the following criteria: (1) German is the only mother tongue, (2) current residence is a German-speaking country, (3) age lies between 18 and 60 years, and (4) no prior knowledge about the framing effect, as shown by the answer to a probing question at the end of the study. Based on these criteria, 8% of all participants were excluded from further analyses. A summary of participants' details is presented in Table 1.

Financial gambling task. In each trial of the financial gambling task (adopted from De Martino et al., 2006), participants received an initial amount of 75 or 100 Euro and two choice alternatives. They decided between a sure option, which was framed as either keeping or losing 20%, 40%, 60%, or 80% of the initial amount, and a gamble option, depicted as a pie chart, in which they could either keep or lose the entire amount. In the *loss frame* condition, the sure option was provided in terms of the probabilities to lose the initial amount, whereas in the gain frame condition, it was described in terms of probabilities to keep the initial amount, whereas the pie chart always depicted the probability to loose in red, and the probability to win in green. An example trial is displayed in Supplementary Figure 1. Crucially, in the keep and lose conditions, win/loss probabilities were

chosen such that the expected values of both options were equal. In the catch trials, expected values differed between the sure and the gamble options (there were four catch trials: percentages in the gambles were set to either 5 or 95% of the initial amount and the sure amount was framed as either keep or lose). After participants made a choice, or if they did not respond within 4 s, the next trial was presented.

Task trials were preceded by task instructions and an initial practice trial, the language of which was randomised across participants. Each participant received half of the trials in their native language (German) and the other half in a foreign language (English or French). The order of native and foreign language trials was intermixed, such that half of the trials for each language followed another trial in the same language, and half followed a trial in the other language. Thus, this experiment followed a within-subject design with factors trial language (native language, foreign language), language switching (switch, non-switch), and frame (gain, loss). Each participant responded to 36 trials, including equal numbers of trials in each frame and in switch and non-switch conditions of each language, as well as 4 catch trials. Each participant received a random subset of %keep and total amounts during the task, resulting in many repetitions of all possible trial types across all participants.

Data analysis. We analysed participants' choices with logistic mixed-effects models and participants' reaction times with linear mixed-effects models. In both models, the random factor structure included random intercepts and random slopes for the highest-order interaction (Barr, 2013). Data were analysed using the lme package (Bates, Maechler, Bolker, & Walker, 2014) within the free software package R (R Core Team, 2015).

Prior to analysis, single trials with missing responses and participants that missed responses on more than 80% of the trials were excluded (only 13 participants, which is less than 3% of all data). Data from one participant who responded to the questionnaire twice were also excluded. Reaction-time based outliers were defined for each participant and task condition separately as trials in which RTs were more than 2.5 *SD* away from mean. Less than 1% of trials were excluded based on this criterion. After all exclusions, 442 participants were admitted to further analyses with an average of 30 trials per participant (22–32 per participant, 90% of participants responded on more than 87% of the trials [28 trials]). We would like to note that on average participants were as likely to miss native language as foreign language trials, $t(479) = .46$, $p = .64$. Thus, misses did not produce any significant distortion of the data.

Results

Choices. Participants chose the sure option significantly more often than the gamble option in the gain frame (57% sure) than in the loss frame (38% sure), $b = -.87$, $SD = .09$, $z = -10.06$, $p < .001$. None of the other main effects and interactions were significant (ps > .1). Participants' choice behaviour is summarised in Table 2.

Thus, we found neither a foreign language effect nor a language switching effect onto framing in the financial gambling task. Analysis of catch trials indicated that participants chose the correct option (with the higher expected value) on 70% of catch trials, irrespective of the trial language, indicating that they understood the task in all languages.

Reaction times. Participants responded faster in the gain than in the loss frame, $b = 85.45$, $SD = 36.23$, $\chi^2(1) = 5.56$, $p = .018$. They were also faster during non-switch than during switch trials, $b = 218.28$, $SD = 35.66$, $\chi^2(1) = 37.5$, $p < .001$, and they were faster in native than in foreign language, $b = 73.15$, $SD = 35.48$, $\chi^2(1) = 4.25$, $p = .036$ (see Table 2). Moreover, the significant interaction of switching and language, $b = -167.8$, $SD = 51.11$, $\chi^2(1) = 10.78$, $p = .001$, indicated that the effect of language switching was stronger when switching into the foreign language (RT difference: 187 ms) than when switching into the native language (RT difference: 53 ms). Crucially, however, neither the language of a trial nor language switching between trials interacted with the factor frame (ps > .1). Thus, while the results show effects of slowing during foreign language use and after language switching, these factors did not affect the choice pattern of the framing effect itself.

Control analyses. To ensure that the lack of foreign language or switching effects on framing in our study was not due to the different foreign languages (English/French), we conducted a number of control analyses for participants' choices and reaction times. First, we repeated the analyses with an additional between-subject factor for the foreign language used. Foreign language in task (English/French) did not affect participants' decisions and reaction times (all ps > .2 for decisions and RTs, see Supplementary Table S1 for mean choices and RTs).

Furthermore, additional analyses showed that the framing effect increased for larger percentage of initial amount to keep values ($p < .01$) and marginally also for larger total amounts offered ($p = .80$), but that none of these variables altered the influence of foreign language or language switching on framing.

In summary, we found no effect of language switching for financial framing. This stands in contrast to our recent results (Oganian et al., 2016) for more textual framing questions. We also found no effect of foreign language use per se onto financial framing, a result in line with the findings by Winskel et al. (2016) and our pilot study.

To ensure that the lack of a switching effect was not due to the online data collection method and not due to a limited number of trials per participant, we conducted a

Table 2. Results of Experiments 1 and 2.

Experiment 1 (online)						
	% Sure choice		Reaction time (s)			
	German (L1)	English/French (FL)	German (L1)		English/French (FL)	
			M	*SD*	*M*	*SD*
Switch						
Gain	58	57	2.77	1.2	2.85	1.31
Loss	37	39	2.85	1.32	2.88	1.33
Framing effect (gain—loss)	21	18	0.08		0.03	
Non-Switch						
Gain	55	58	2.72	1.27	2.64	1.28
Loss	37	40	2.79	1.28	2.73	1.28
Framing effect (gain—loss)	18	18	0.07		0.09	
Experiment 2 (laboratory)						
	% sure choices		Reaction time			
	German (L1)	English (FL)	German (L1)		English (FL)	
			M	*SD*	*M*	*SD*
Switch						
Gain	59	57	1.45	0.62	1.48	0.643
Loss	48	48	1.52	0.67	1.52	0.658
Framing effect (gain—loss)	11	9	0.075		0.039	
Non-Switch						
Gain	60	59	1.44	0.63	1.43	0.601
Loss	46	48	1.54	0.64	1.53	0.657
Framing effect (gain—loss)	14	9	0.093		0.09	

replication experiment in a laboratory setting with a larger number of trials per participant. This also allowed reimbursing participants contingent on their gambling choices. Thus, whereas choices in the online experiment were hypothetical, real money was at stake in the laboratory experiment (see Camerer & Mobbs, 2017 for a discussion of differences between hypothetical and real financial decisions).

Experiment 2

Methods

Participants. Twenty-seven (9 female, mean age 28) German native speakers with second language English participated in this study. All participants acquired English in high school and had medium to high proficiency in English, as tested with the same language history questionnaire as participants of Experiment 1 (Li et al., 2006) prior to the experiment, as well as the LEXTALE test of English and German proficiency (Lemhöfer & Broersma, 2012). The two tests showed a high degree of consistency ($r = .51$, $p = .007$). Participants with prior knowledge of the task (as indicated in a post-experiment questionnaire), a history of psychiatric disorders, or additional mother tongues were excluded from further data analysis, resulting in exclusion of two participants. Participants' profiles are summarised in Table 1.

Participants were recruited through advertisements on the campus of Freie Universitaet Berlin and through mailing lists and received either monetary compensation or course credit. The internal ethics committee of Freie Universität Berlin approved the study and participants signed an informed consent prior to participation.

Task design. Participants participated in a lab version of the financial gambling task of Experiment 1 (see Supplementary Figure 1). Participants completed 384 trials, which were pseudo-randomly distributed across 3 blocks and consisted of 256 experimental trials and 128 catch trials. Each participant received half of the trials in their native language (German) and the other half in a foreign language (English or French). The order of native and foreign language trials was intermixed, such that half of the trials for each language followed another trial in the same language, and half followed a trial in the other language. Thus, this

experiment followed a within-subject design with factors trial language (native language, foreign language), language switching (switch, non-switch), and frame (gain, loss), exactly as Experiment 1. In the lab experiment, participants were first presented with the initial amount (25, 50, 75, or 100 Euro) for 4 s. Then the gamble options (where 20%, 40%, 60%, or 80% of the initial amount could have been lost) were presented for 4 s, during which they could respond. After an inter-trial interval of 2.5 s, the next trial followed. At the end of the experiment, one trial was randomly chosen and an amount corresponding to the participants' choice on that trial divided by 10 was paid out. Participants saw each possible trial (resulting from combining all initial amount values with % to keep and the conditions switching, language, and frame) twice.

Analyses and outlier exclusion. Similar to the online experiment, participants' choices were analysed in a logistic mixed-effects model with fixed factors language, switch, and frame, as well as random intercepts and the maximum interaction slope for all factors within subject. Participants' reaction times were analysed in a linear mixed-effects model with the same factor structure applied to the model as for participants' choices.

Reaction-time based outliers were defined for each participant and task condition separately as trials with RTs more than 2.5 *SD* away from mean. In all, 1.5% of all trials were excluded based on this criterion.

In addition, three participants chose the option with the higher expected value in less than 50% of the catch trials (for both languages). Excluding these participants from analyses did not change the pattern of results.

Results

Choices. Participants showed a robust framing effect (see Table 2), $b = .71$, $SD = .15$, $z = 4.9$, $p < .001$, that is, they chose the risky option more frequently in the loss than in the gain condition. This effect was unaffected by trial language ($p = .44$) and switching condition ($p = .44$) and no other effects were significant. An analysis of the catch trials indicated that participants chose the correct option (with the higher expected value) on 87% of catch trials, irrespective of the trial language, indicating that they understood the task in all languages.

Reaction times. Participants' decisions were faster in the gain than in the loss frame, $b = 93.66$, $SD = 34.34$, $\chi^2(1) = 7.4$, $p = .006$, whereas all other effects were not significant (all ps >.1). To summarise, Experiment 2 found no effects of language or language switching on financial framing, thus replicating Experiment 1.

Control analysis: Effect of block. The large number of trials in this experiment allowed us to test whether the effects of trial language or language switching would be altered during the course of the experiment. To test this, we repeated our analyses with an additional factor for the experimental block, as the experiment was divided in two consecutive blocks. We found that participants became more risk-averse over the course of the experiment, as indicated by a main effect of block, $b = -.5$, $SD = 0.23$, $z = -2.16$, $p = .03$. However, we found no interactions of the factor block with trial frame, language, or language switching. Participants also became faster over the course of the experiment, $b = -159.76$, $SD = 62.3$, $\chi^2(1) = 6.45$, $p = .01$, but—importantly—block number did not interact with any other effects on reaction times (all ps >.1). Overall, we found that the repeated presentation of the task did not alter the (lack of) influence of foreign language or language switching on framing.

Discussion

The aim of the current study was to test the hypothesis that switching between languages abolishes framing effects in a financial gambling task that only included limited verbal information (De Martino et al., 2006; Winskel et al., 2016). In two experiments, one online and one in a laboratory setting, we found no support for this hypothesis. That is, a robust framing effect was apparent in participants' foreign and native languages—independent of language switching. This result complements the recent findings by Winskel et al. (2016), who showed that foreign language use per se did not diminish the framing effect in the same task as we used here, but without explicitly controlling or manipulating language switching.

Unlike the studies that first demonstrated the effects of foreign language use and language switching onto framing (Costa, Foucart, Arnon, et al., 2014; Keysar et al., 2012; Oganian et al., 2016), we here employed a within-subject paradigm with relatively little verbal content and repeated administration of the same task structure to each participant. Winskel et al. (2016) reported that foreign language use does not affect the framing effect under such conditions. They suggested that this lack of evidence might be due to the minimal verbal content of the task, which makes the task easy to grasp even in a foreign language. We hypothesised that language switching might increase task demands and recruit additional cognitive control and lead to more intensive intake of the verbal aspects of the task, thereby inducing a reduction of the framing effect. Indeed, participants' responses were slower in the foreign language and on switch trials in Experiment 1, suggesting that our manipulation did induce an increase in cognitive load during the task (Whitney, Rinehart, & Hinson, 2008). However, this slow-down was not accompanied by a reduction of the framing effect. In Experiment 2, switching and foreign language use had no effect on reaction times. This was likely due to the relatively higher foreign

language proficiency of participants in Experiment 2 than the proficiency of participants' across the two foreign language conditions of Experiment 1, which might have helped them to get used to the repetitive verbal content of the task, eliminating switching and foreign language costs.

At a superficial level, our results stand in apparent contrast to the work by Wu and Thierry (2013), who found that the performance of bilingual participants improved in a nonverbal executive control task when task trials were intermitted by presenting words in two different languages (rather than words in a single language). A major difference to our present study, however, is that Wu and Thierry displayed a random set of unpredictable words, which thus induced more linguistic processing than the repetitive presentation of the same words in the financial gambling task. The difference between our and the results of Wu and Thierry may indicate that the use of a repetitive task per se does not abolish the effects of language switching, as long as the verbal information in the task remains sufficiently novel. This is an important point, as within-subject designs will be pertinent to elucidate the precise cognitive and neural mechanisms behind foreign language and language switching effects.

Overall, the results of our study show that language switching effects cannot be induced by the minimally verbal task setup used here, suggesting that language switching effects require a rich and informative language context, as was recently shown for foreign language effects. Future research is required to delineate how much and what type of verbal information is required to induce foreign language or language switching effects.

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Supplementary material

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Note

1. In our study, native speakers of German performed a financial framing task in either their native language (n = 24) or their second language English (n = 27), such that language was manipulated between-subjects and frame within-subjects. Similar to Winskel et al. (2016), we found framing effects of similar magnitude (Native language group: gain 63%, loss 52% sure choices; Foreign language group: gain 73%, loss 62% sure choices) in both groups, as indicated by a significant main effect of frame, $b = -0.54$, $SD = .13$, $\chi^2(1) = 17.1$, $p < .001$, but no significant main effect of language ($p = .13$) or interaction of language and frame ($p = .63$).

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