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## **Breaking Magic: Foreign Language Suppresses Superstition**

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## **Breaking Magic: Foreign Language Suppresses Superstition**

In three studies we found that reading information in a foreign language can suppress common superstitious beliefs. Participants read scenarios either in their native or a foreign language. In each scenario, participants were asked to imagine performing an action (e.g., submitting a job application) under a superstitious circumstance (e.g., broken mirror; four-leaf clover) and to rate how they would feel. Overall, foreign language prompted less negative feelings towards bad-luck scenarios, less positive feelings towards good-luck scenarios, while it exerted no influence on non-superstitious, control scenarios. We attribute these findings to language-dependent memory. Superstitious beliefs are typically acquired and used in contexts involving the native language. As a result, the native language evokes them more forcefully than a foreign language.

Keywords: superstition, bilingualism, emotions, language, the foreign language effect.

Daily life abounds with superstitious beliefs which The American Heritage Dictionary (“Superstition,” 2015) defines as “irrational beliefs that an object, action, or circumstance not logically related to a course of events influences its outcome.” Consider, for example, the belief that broken mirrors bring bad luck while four-leaf clovers bring good luck. Although superstitious beliefs and rituals can have positive outcomes (e.g., they may reduce grief and anxiety [e.g., Norton & Gino, 2014; Zhang, Risen, & Hosey, 2014] and improve golf putting [see Damisch, Stoberock, & Mussweiler, 2010; Lee, Linkenauger, Bakdash, Joy-Gaba, & Proffitt, 2011; but also see Calin-Jageman & Caldwell, 2014]), they also have a negative side. Between \$800 million and \$900 million are lost in the US every time Friday falls on the 13<sup>th</sup> of a month because people are reluctant to travel, make major purchases, or conduct business (Roach, 2004). The situation is equally bleak across the Atlantic. A UK study found that on ominous Fridays, compared to the previous Friday of the same month, traffic flow decreased while car accidents increased (Scanlon, Luben, Scanlon, & Singleton, 1993). In the present studies we demonstrate that using a foreign language can suppress superstitions.

Superstitious beliefs are good examples of “being of two minds” (e.g., Sloman, 1996, 2014). Upon detection of an ominous sign, such as a broken mirror, the intuitive mind signals danger while the rational mind maintains that this belief is unfounded (for a review of dual-process theories of magical thinking, see Risen, 2015). Risen and Gilovich (2007), for example, found that students instructed to respond intuitively felt that exchanging a lottery ticket increased its chances of winning. However, when other students were instructed to respond rationally, all of them correctly replied that the ticket’s chances remained unaltered (unpublished study, mentioned in Risen, 2015). Superstitious beliefs, therefore, seem to reside in intuition and can be attenuated by rational thinking.

What if it were possible to suppress superstitions directly by weakening the intuitive signals that prompt them in the first place? We claim that the use of a foreign language—i.e., a language that has been learned in a classroom context rather than by immersion in a culture (Pavlenko, 2012)—might help achieve this. We base our claim on prior research showing that when people use a foreign language their intuitive system is less alert, less swift to recognize that something is good or bad (see Hadjichristidis, Geipel, & Surian, 2017; for reviews on how foreign language use affects judgment and decision making see Caldwell-Harris, 2015; Costa, Vives, & Corey, 2017; Hayakawa, Costa, Foucart, & Keysar, 2016; Pavlenko, 2017). For example, people discuss longer about embarrassing topics (Bond & Lai, 1986) and are less reluctant to use swearwords (Dewaele, 2004). Moreover, people are more willing to sacrifice a stranger to save five other people (Cipolletti, McFarlane, & Weissglass, 2015; Costa et al., 2014; Geipel, Hadjichristidis, & Surian, 2015a), more tolerant of harmful behaviors (Geipel, Hadjichristidis, & Surian, 2015b), and more permissive of helpful behaviors that are underpinned by dubious motives (Geipel, Hadjichristidis, & Surian, 2016).

We argue that these effects can be traced to language-dependent memory (Marian & Neisser, 2000; Thomson & Tulving, 1970). Moral and other sociocultural norms, such as politeness norms, are acquired early in life through communications in the native language (Rottman & Young, 2015). Such norms and related experiences are therefore encoded in the native language and, as a result, are more forcefully evoked by the native than by a foreign language (Geipel et al., 2015a). Common superstitious beliefs are also acquired early in life primarily through interactions with parents and friends in the native tongue (see Conklin, 1919; Emme, 1940; Maller & Lundeen, 1933; Vyse, 2014). We thus predicted that the native language would also evoke superstitious beliefs more forcefully than a foreign language.

## **Study 1**

In Study 1 we presented participants with scenarios in which they had to imagine performing an action under a circumstance that is typically associated with bad luck. Their task was to rate how bad or good they would feel. We asked participants about their feelings (rather than, say, about the probability that the action would result in a negative outcome) because we wanted to tap directly into their magical intuitions (see Nemeroff, 1995). We predicted that using a foreign language would attenuate negative feelings, which would support a suppressed magical intuition. We confirm that for all studies we treated participants in accordance to the ethical principles of the Declaration of Helsinki.

### **Methods**

#### Participants

We recruited 181 students (127 females, 50 males, 4 unknown,  $M_{\text{age}} = 20.91$ , age range: 18–45)<sup>1</sup> from a linguistic high school, the Free University of Bolzano, and the University of Trento. Of these, 106 were randomly assigned to the foreign language condition (German or English) and 75 to the native language condition (Italian). We assigned more participants to the foreign language condition as a precautionary measure against data loss due to miscomprehension. We examined two foreign languages to ensure that an eventual language effect is not tied to a particular foreign language. Participants in the foreign language conditions were asked to rate their foreign language skills in reading and understanding, each on a 5-point scale (1 = almost none, 2 = poor, 3 = fair, 4 = good, 5 = very good; adapted from Caldwell-Harris & Ayçiçeği-Dinn, 2009). The mean rating across these scales was 3.46, CI [3.32, 3.62]. They were also asked to report when they started learning the foreign language. The average age of beginning foreign language education was 11.71 years, CI [10.18, 13.28],  $Mdn = 9$  years.<sup>2</sup>

## Materials and procedure

Study 1 was administered through paper-and-pencil questionnaires and was conducted in classrooms. Participants were presented with two scenarios, which contained circumstances that in the Italian culture are associated with bad luck (Grande, 2012): walking under a ladder and breaking a mirror. Each scenario was presented on a separate page; the ladder scenario was presented first and the mirror scenario second. The exact wording of the English versions of these scenarios and the associated questions were as follows:

Ladder. Imagine that you have an important exam and you feel nervous. Before you enter the university building, you accidentally walked under a ladder. How would you feel about taking the exam under this condition?

Mirror. Imagine that you have to submit an important job application. On the day of the submission, your mirror in the bathroom breaks. How would you feel about submitting your job application under this condition?

The wording of the questions was adapted from Rozin, Markwith, and McCauley (1994). Participants had to respond on a 9-point scale ranging from 1 (very bad) to 9 (very good), which was supplemented with figurines from the Self-Assessment Manikin of affective valence (SAM; Lang, 1985; see Figure 1). This intervention has been shown to neutralize the anchor contraction effect or rather the tendency to report more intense emotions when the anchors of the scale are labeled in a foreign rather than the native language (see de Langhe, Puntoni, Fernandes, & van Osselaer, 2011, Study 8). This tendency would bias judgments in the opposite direction to that which we would expect from our hypothesis.

[Figure 1 near here]

We embedded the two scenarios in questionnaires written entirely in Italian, German, or English. The different language versions of the scenarios were constructed by bilinguals and were checked by independent bilinguals for consistency and equivalence. To ensure that eventual findings are not due to miscomprehension, following the main task, we asked participants assigned to the foreign language conditions to translate the scenarios. An Italian native speaker who was blind to the purpose of the study checked the translations. In case of mistranslation, a participant's response to the associated scenario was treated as a missing value. There were 31 such cases (28 for the ladder scenario—several participants mistranslated “ladder” as “stairs” or “staircase”—and 3 for the mirror scenario). Finally, all participants were asked to fill out a set of demographic questions.

## **Results**

Preliminary analyses revealed that the use of a foreign language, as compared to the native language, had a similar influence on feelings irrespective of the particular foreign language used (German or English);  $F(1, 148) = 0.53, p = .696$ . We thus collapsed the two foreign language conditions into a single one, and conducted a 2 (Language)  $\times$  2 (Scenario) mixed-factor ANOVA. The main findings are illustrated in Figure 2.

[Figure 2 near here]

As expected, the scenarios elicited less negative feelings in the foreign language ( $M_{FL} = 5.29, CI [5.06, 5.52]$ ) than in the native language ( $M_{NL} = 4.62, CI [4.38, 4.85]$ ),  $F(1, 150) = 16.33, p < .001, f = .33$ . This effect was qualified by a Language  $\times$  Scenario interaction,  $F(1, 150) = 4.77, p = .030, f = .18$ . Pairwise comparisons (since there are two comparisons, the alpha level should be adjusted at .025) revealed a significant foreign language effect for the mirror scenario ( $M_{FL} = 5.17, CI [4.86, 5.47], M_{NL} = 4.38, CI [4.13, 4.63]$ ),  $F(1, 176) = 13.77, p < .001, f = .28$ , and a



marginally significant effect for the ladder scenario ( $M_{FL} = 5.24$ , CI [4.98, 5.51],  $M_{NL} = 4.85$ , CI [4.58, 5.13]),  $F(1, 151) = 4.11$ ,  $p = .044$ ,  $f = .17$ . There was no main effect of scenario,  $F(1, 150) = 2.46$ ,  $p = .119$ ,  $f = .13$ .

Following the advice of a reviewer, we repeated this analysis including age and gender as covariates. Although there is mixed evidence as to whether age is associated with superstitious beliefs (see Vyse, 2014), studies show that females typically report more superstitious beliefs than males (see Conklin, 1919; Maller & Lundeen, 1933; Vyse, 2014). Four participants were excluded from the analysis because they did not report their gender. The ANCOVA revealed a significant effect of both age,  $F(1, 146) = 4.84$ ,  $p = .029$ ,  $f = .18$ , and gender,  $F(1, 146) = 9.81$ ,  $p = .002$ ,  $f = .26$ . Importantly, after controlling for age and gender, the effect of language condition remained statistically significant,  $F(1, 146) = 15.18$ ,  $p < .001$ ,  $f = .32$ . The scenarios elicited less negative feelings in the foreign language ( $M_{FL} = 5.23$ , CI [5.01, 5.45]) than in the native language ( $M_{NL} = 4.62$ , CI [4.40, 4.84]). No other effects were statistically significant.

## **Study 2**

In Study 1, we found that reading information in a foreign language reduces negative feelings towards bad-luck scenarios. In Study 2, we aimed to replicate this finding and extend it to good-luck scenarios. We predicted that foreign language would prompt more neutral attitudes towards both types of superstitious scenarios. We also sought to discount the possibility that the results are due to a response bias. Previous studies have shown that reading information in a foreign (vs. a native) language decreases confidence in one's judgments (e.g., Geipel, Hadjichristidis, & Surian, 2015b; Muda, Niszczoła, Bialek, & Conway, 2017). This reduced confidence could, in turn, bias participants' responses towards neutral ratings. To assess this possibility, we included a non-superstitious, control scenario. We predicted that foreign language

would exert no influence on the control scenario. Study 2 tested a different population, German native speakers.

## **Methods**

### Participants

We recruited 142 volunteers (94 females, 34 males, 14 unspecified,  $M_{\text{age}} = 24.42$  years)<sup>3</sup> from e-mail distribution lists from the Free University Berlin and the University of Osnabrück. Of these, 76 were randomly assigned to the foreign language condition (English) and 66 to the native language condition (German). We excluded 10 participants from the analyses because they indicated that they were not native German speakers. As in Study 1, participants in the foreign language condition were asked to rate their foreign language skills in reading and understanding, each on a 5-point scale. The mean rating across these scales was 4.53, CI [4.36, 4.70]. These participants were also asked to state when they commenced learning English. The average age of beginning foreign language education was 8.86 years, CI [8.29, 9.43],  $M_{\text{dn}} = 9$  years.

### Materials and procedure

Study 2 was conducted by means of an online survey. Participants evaluated six scenarios: three bad-luck scenarios, two good-luck scenarios, and one control scenario (see Table 1). The scenarios were presented one at a time, each on a separate page. Once participants judged a scenario and moved to the next one, they could not revert to previous pages and make corrections. The bad-luck and good-luck scenarios involved superstitions that are common in the German culture (“Welcher Aberglaube,” 2015). The scenarios were created by German-English bilinguals and were checked by two independent German-English bilinguals for consistency and equivalence. The order of presentation of the six scenarios was randomized separately for each

participant. Participants responded to bad-luck scenarios on a 9-point scale ranging from 1 (neutral) to 9 (very bad), and to good-luck and neutral scenarios on a 9-point scale ranging from 1 (neutral) to 9 (very good). The reason we used unidirectional scales was to avoid odd/humorous responses (e.g., I would feel great about giving an exam on the day my bathroom mirror broke), which would add noise to the data. As in Study 1, the scales were supplemented with SAM figurines (Lang, 1985).

[Table 1 near here]

After the superstitious scenarios, participants were presented with a filler task (unrelated questions about preferences), followed by a scale that measures magical beliefs (adapted from Wiseman & Watt, 2004), which all participants received in their native language. The magical beliefs scale comprises 6 items: “Do you say “fingers crossed” or actually cross your fingers?,” “Do you sometimes carry a lucky charm or object?,” “Do you sometimes knock on wood or touch wood?,” “Would you be anxious about breaking a mirror because it is thought to cause bad luck?,” “Are you superstitious about the number 13?,” “Have you avoided walking under a ladder because it is associated with bad luck?.” Participants responded to each question on a 5-point scale ranging from 1 (No, absolutely not) to 5 (Yes, absolutely). The reason for including this scale was to examine whether language exerts an influence on feelings prompted by superstitious scenarios above and beyond individual differences concerning magical beliefs. Thus, in Study 2 we controlled for magical beliefs directly, rather than through age and gender. Following the main task, participants in the foreign language condition were asked to translate the superstitious scenarios. There were no cases of mistranslations, which is consistent with the high self-reported proficiency scores. Finally, all participants were asked to fill out a set of demographic questions.

## Results

We first focused on the superstitious scenarios. For each participant, we calculated a mean score for good-luck scenarios and a mean score for bad-luck scenarios. In both cases lower scores signify more neutral attitudes. The main findings are illustrated in Figure 3.

[Figure 3 near here]

We submitted the scores to a 2 (Language)  $\times$  2 (Superstition type: good-luck vs. bad-luck) mixed-factor ANOVA. (We were originally planning to conduct an ANCOVA with magical beliefs as a covariate, but this was not possible because the assumption of homogeneity of regression slopes was violated). As expected, superstitious scenarios elicited more neutral attitudes in the foreign language ( $M_{FL} = 3.42$ , CI [3.06, 3.78]) than in the native language ( $M_{NL} = 3.95$ , CI [3.57, 4.33]),  $F(1, 130) = 3.97$ ,  $p = .048$ ,  $f = .18$ . There was no Language  $\times$  Superstition type interaction,  $F(1, 131) < 0.01$ ,  $p = .977$ ,  $f < .01$ . That is, foreign language neutralized attitudes towards good-luck and bad-luck scenarios to a similar extent. There was a main effect of superstition type: Good-luck scenarios received higher ratings ( $M = 5.37$ , CI [4.97, 5.77]) than bad-luck scenarios ( $M = 2.01$ , CI [1.75, 2.26]),  $F(1, 130) = 260.76$ ,  $p < .001$ ,  $f = 1.42$ .

We then analyzed the control scenario. As expected, there was no language effect ( $M_{FL} = 5.48$ , CI [4.79, 6.16],  $M_{NL} = 5.46$ , CI [4.73, 6.19]),  $F(1, 128) < 0.01$ ,  $p = .970$ ,  $f < .01$ . This finding suggests that the language effect detected with the superstitious scenarios is not reducible to a response bias, which skews the responses of the participants in the foreign language condition towards neutral ratings (here, ratings close to 1). Notice that the mean affect rating of the control scenario was high ( $M = 5.47$ ), higher than the mean rating of the good-luck ( $M = 5.37$ ) or bad-luck scenarios ( $M = 2.01$ ). Hence, this item was particularly suitable for detecting

such a bias (i.e., the failure to detect a language effect with the control scenario cannot be ascribed to a floor effect).

Subsequently, we considered the results of the magical beliefs scale (Cronbach's alpha = .65). A preliminary analysis revealed no significant differences between the language conditions ( $M_{FL} = 2.15$ , CI [2.00, 2.30] vs.  $M_{NL} = 2.39$ , CI [2.19, 2.59]),  $F(1, 121) = 3.61$ ,  $p = .060$ ,  $f = .14$ . However, hierarchical regression analyses suggested that magical beliefs moderated the effect of language on feelings for the superstitious scenarios. In the first step of the regression model we included language and magical beliefs as the predictor variables, and feelings as the outcome variable. These predictors accounted for a significant amount of variance in feelings,  $R^2 = .33$ ,  $F(2, 120) = 29.90$ ,  $p < .001$ . We then added the interaction term (Language  $\times$  Magical beliefs), which accounted for a significant proportion of the remaining variance,  $\Delta R^2 = .04$ ,  $\Delta F(1, 119) = 7.85$ ,  $p = .006$ ,  $b = -.26$ ,  $t(119) = -2.80$ ,  $p = .006$ .

We followed up on these results by conducting a least squares regression using the MODROBE macro (Hayes & Matthes, 2009). We found a significant Language  $\times$  Magical beliefs interaction,  $b = -.80$ ,  $p = .006$ . The Johnson-Neyman technique (e.g., Johnson & Fay, 1950) identified that at low and moderate levels of magical beliefs language has no influence on feelings, but as magical beliefs rise ( $\geq 2.46$ , on a 5-point scale where 5 indicates maximum magical beliefs) the language gap becomes significant (see Figure 4).

[Figure 4 near here]

### **Study 3**

Our aim with Study 3 was to further discount the possibility that our results are due to response bias. Although Study 2 provided initial support—the language effect was absent in the control scenario—the content of that scenario was different. In contrast to the superstitious

scenarios that involved events whose outcomes were both consequential and uncertain (exam, job interview, etc.), the control scenario concerned a mundane event, travelling by train. To redress this, in Study 3 we created four control scenarios that closely matched the superstitious scenarios of Study 2 (one control scenario concerned an exam, another a job interview, etc.) and four new superstitious scenarios (see Table 2). Because in Study 3 the superstitious and control scenarios were closely matched in terms of content and number, we included them in a single analysis. We predicted a language by scenario type interaction, whereby foreign language would promote more neutral feelings towards the superstitious scenarios but exert no influence on the control scenarios. In Study 3, we recruited participants from the Socio-Scientific Panel, a noncommercial online access panel of native German speakers from Germany, Austria, and Switzerland. Participants of this panel are predominantly non-students, which further helps testing the generalizability of our hypothesis.

## **Methods**

### **Participants**

We recruited 435 participants (279 females, 154 males, 2 unspecified,  $M_{\text{age}} = 38.2$  years).<sup>4</sup> Of these, 218 were randomly assigned to the foreign language condition (English) and 217 to the native language condition (German). Participants in the foreign language condition were asked to rate their foreign language skills in reading and understanding, each on a 5-point scale. The mean rating across the two scales was 4.03, CI [3.96, 4.11], indicating good foreign language skills. They were also asked to report when they started learning English. The average age of beginning foreign language education was 12.1 years, CI [11.14, 13.24],  $M_{\text{dn}} = 10$  years. We excluded 27 participants from the analyses because they indicated that they were not native German speakers.

## Materials and procedure

Study 3 was conducted by means of an online survey. Participants evaluated eight scenarios: four superstitious scenarios (two bad-luck and two good-luck ones), and four control scenarios (see Table 2). The scenarios were presented in two blocks, each comprising two superstitious scenarios (either bad-luck or good-luck) and two control scenarios. For the block containing the bad-luck scenarios (and two control scenarios) we used a 9-point scale ranging from 1 (neutral) to 9 (very negative), while for the block containing the good-luck scenarios (and two control scenarios) a 9-point scale ranging from 1 (neutral) to 9 (very positive). Once again, we supplemented the scales with SAM figurines (Lang, 1985). The presentation order of blocks, and the scenarios within them, were randomized separately for each participant. As in Study 2, the scenarios were presented one at a time, each on a separate page. Once participants judged a scenario and moved to the next one, they could not revert to previous pages and make corrections. Participants were subsequently asked to complete a filler task (unrelated questions about preferences), and then the magical beliefs scale of Study 2, which they all received in their native language. Finally, participants filled out a set of demographic questions.

[Table 2 near here]

## Results

We first considered participants' affect ratings. We submitted them to a 2 (Language)  $\times$  2 (Scenario type: Superstitious vs. Control) mixed-factor ANCOVA, with magical beliefs as a covariate. (Unlike Study 2, in Study 3 all the necessary conditions for using magical beliefs as a covariate were satisfied.) We predicted a Language  $\times$  Scenario Type interaction; namely, that foreign language would promote more neutral ratings towards superstitious scenarios while it would leave control scenarios unaffected. The analysis revealed a main effect of scenario

type,  $F(1, 405) = 23.24$ ,  $p < .001$ ,  $f = .24$ , but no effect of language,  $F(1, 405) = 0.42$ ,  $p = .517$ ,  $f = .10$ . Importantly, the analysis revealed the predicted Language  $\times$  Scenario type interaction,  $F(1, 405) = 9.93$ ,  $p = .002$ ,  $f = .16$ .

We scrutinized this interaction with two analyses of covariance (in both, the covariate was magical beliefs), one for superstitious scenarios and one for control scenarios. For superstitious scenarios, we conducted a 2 (Language)  $\times$  2 (Superstition type: good-luck versus bad-luck) ANCOVA. Figure 5 illustrates the main results. The analysis revealed a main effect of language,  $F(1, 405) = 5.08$ ,  $p = .025$ ,  $f = .11$ . Replicating the findings of the previous studies, overall, superstitious scenarios elicited more neutral attitudes in the foreign language ( $M_{FL} = 3.69$ , CI [3.52, 3.86]) than in the native language ( $M_{NL} = 3.96$ , CI [3.79, 4.13]). Furthermore, we found no Language  $\times$  Superstition type interaction,  $F(1, 405) = 3.32$ ,  $p = .069$ ,  $f = .10$ . Like in Study 2, the use of a foreign language neutralized bad-luck and good-luck superstitions to a similar extent. Finally, we found a main effect of superstition type,  $F(1, 405) = 44.97$ ,  $p < .001$ ,  $f = .33$ . As was the case in Study 2, participants assigned higher (i.e., more extreme) ratings to good-luck than to bad-luck scenarios.

[Figure 5 near here]

We then analyzed the control scenarios with a one-way ANCOVA. As in Study 2, there was no effect of language condition ( $M_{FL} = 2.45$ , CI [2.27, 2.63],  $M_{NL} = 2.32$ , CI [2.14, 2.50]),  $F(1, 405) = 1.12$ ,  $p = .291$ ,  $f = .05$ .

Finally, we considered the results of the magical beliefs scale (Cronbach's alpha = .72). A preliminary analysis revealed no significant differences between the two language conditions ( $M_{FL} = 2.20$ , CI [2.09, 2.31] vs.  $M_{NL} = 2.22$ , CI [2.11, 2.32]),  $F(1, 406) = 0.04$ ,  $p = .847$ ,  $f = .009$ .



Unlike Study 2, additional analyses revealed that in Study 3 magical beliefs did not moderate the effect of language on feelings with regards to the superstitious scenarios.

## **General Discussion**

Three studies support our hypothesis that foreign language suppresses common superstitious beliefs. In Study 1 foreign language attenuated bad-luck superstitions, while in Studies 2 and 3 both bad-luck and good-luck superstitions. The present findings are not reducible to miscomprehension (responses associated to mistranslations were discarded) or a rating scale bias (there was no language effect with non-superstitious/control scenarios). Instead, our results are consistent with the view that foreign language suppresses intuition. Previous research has shown that foreign language attenuates emotional responses (see Pavlenko, 2012) and suppresses socio-moral norms (for evidence, see Introduction). The present results add that it can also suppress emotions associated with superstitious beliefs.

The present findings are also consistent with the view that foreign language prompts systematic processing, perhaps by triggering psychological distance and/or cognitive disfluency (e.g., Costa et al., 2014; Keysar, Hayakawa, & An, 2012). Although we did not address this possibility directly, and thus this possibility remains open, we are skeptical about it. First, in the present study we used an affective scale which should tap directly into people's intuitions (see Nemeroff, 1995). Second, research using abstract reasoning tasks suggests that foreign language either leaves performance unaffected (Costa et al., 2014) or hinders it (Takano & Noda, 1993, 1995; see also Turula, 2016). For example, Takano and Noda (1993) asked participants to perform arithmetic calculations and spatial reasoning tasks (target tasks), while answering questions posed to them in either a foreign or a native language (distractor task). When the distractor task was presented in a foreign versus native language performance in the target tasks

decreased. Indeed, Takano and Noda (1995, p. 657) coined “foreign language effect” to signify: “a temporary decline of thinking ability during foreign language processing.”

Why does foreign language weaken affect-based intuitions? The answer may lie within memory processes (see Hadjichristidis et al., 2017). Intuitive, or “System 1” thinking, is linked to associative memory (e.g., Kahneman, 2011; Sloman, 1996). This refers to a repository of ideas and links between these ideas, which are reinforced or weakened through learning. Following Kahneman (2011), with the term “ideas” we aim to capture concrete and abstract ideas, images, affect, and so forth. When an idea is activated, the activation spreads to other ideas through the network’s links. The network of activated ideas at any point in time represents what is mentally accessible to a person at that time, and, thus, what may influence that person’s judgment and choice. Specifically, according to Kahneman (2011) intuitive thinking entails heuristics, which, in turn, involve the substitution of a target attribute (e.g., how risky is a nuclear power plant?) with an attribute that is more mentally accessible at the time of judgment (e.g., how do I feel about nuclear power plants?). In sum, intuitive thinking depends on mental accessibility, and mental accessibility depends on associative memory.

Associative memory, in turn, depends on language (Marian & Neisser, 2000; Schrauf & Rubin, 2000). For example, Marian and Neisser (2000) asked Russian native speakers who later immigrated to the United States to recall specific life events. When interviewed in Russian, participants retrieved more experiences from the Russian-speaking period of their lives; when interviewed in English, participants retrieved more experiences from the English-speaking period of their lives. Therefore, it appears that experiences are encoded together with the linguistic context in which they occur, which, for foreign language users, is mostly the native language (see Caldwell-Harris, 2015; Puntoni, de Langhe, & van Ossaer, 2009). Because of that, a

foreign language might elicit memories and associated emotions less forcefully than the native language.

Cognitive load, which is increased when reading information in a foreign rather than in the native language (see Hasegawa, Carpenter, & Just, 2002), might also contribute to the suppression of affect-based intuitions. Studies have shown that an introduction of cognitive load in the early stages of information processing (e.g. by asking participants to perform a distractor task simultaneously with the target task) can diminish people's ability to attend to emotional aspects of a target stimulus (Van Dillen, Papiers, & Hofmann, 2012; see also Kron, Schul, Cohen, & Hassin, 2010). For example, Gilbert and Hixon (1991, Study 1) found that cognitively busy participants show reduced stereotype activation with respect to non-busy participants. Perhaps an early application of cognitive load also attenuates feelings that are typically triggered by superstitious circumstances. Notice that reading information in a foreign language involves an early (concurrent) application of additional cognitive load.

The present studies permit a test of this hypothesis. Specifically, self-rated proficiency could be used as a proxy of cognitive load (we thank an anonymous reviewer for suggesting this). The lower the self-rated proficiency, the higher the cognitive load, and, thus, the more neutral the feelings towards the superstitious scenarios. The results provide only weak support for this hypothesis. From all studies, only in Study 1 we found a significant correlation between proficiency and feelings (lower proficiency was associated with less negative feelings towards bad-luck scenarios).<sup>5</sup> Future research could revisit this hypothesis by using objective measures of proficiency, such as standardized foreign language tests, and tests of language processing ability.

Would foreign language attenuate other types of magical thoughts? Based on the language-dependent memory explanation, we expect that its effect would generalize to situations

involving verbal stimuli that, through learning, have come to elicit positive or negative feelings (see Hadjichristidis, Geipel, & Savadori, 2015). For instance, we expect an attenuation of nominal realism, which stands for the tendency to presume that a name or label embodies the essence of the object that it refers to (Piaget, 1929). For example, Rozin, Millman, and Nemeroff (1986) found that participants were reluctant to consume sugar from a bottle that was labeled “Sodium Cyanide” with a red “Poison” sticker underneath it, even in a condition in which it was clear that the label was meaningless. We expect that if this experiment were to be repeated with labels written in a foreign language, the observed reluctance would diminish. However, a foreign language may exert less influence on personal superstitions (e.g., an athlete’s idiosyncratic pre game ritual), as their acquisition does not involve language, or cases of tempted fate (e.g., wearing a Harvard sweater before knowing whether you have been admitted in that university) as it is not a name or action per se that is aversive but rather the role it plays in the context.

What other positive effects can be obtained by using a foreign language? Also, would its effect always be beneficial? We have already discussed evidence showing that foreign language use can hinder performance in abstract reasoning tasks. For tasks that typically evoke intuition, we propose that the end result of foreign language use would depend on what becomes suppressed: deleterious intuitions (e.g. racial stereotypes) or positive ones (e.g. polite manners). Using a foreign language might prove beneficial in the former case and disadvantageous in the latter. Importantly, the use of a foreign language may offer a novel solution to combat biasing intuitions. Instead of activating rational thought to monitor and correct them, it may attenuate them directly. We argue that this is because intuitions are deep-seated in one's native language. This is crisply illustrated by the Irish avant-garde writer Samuel Beckett who stated that writing

in a foreign language (French) “allowed him to escape the habits inherent in the use of native language” (Charles 1986:27”).

## Footnotes

<sup>1</sup> A power analysis was performed for sample size estimation using G\*Power (Faul, Erdfelder, Buchner, & Lang, 2009). The effect size was  $f = .25$  (medium effect, estimated),  $\alpha = .05$ , and power = 0.90. The projected sample size needed is approximately  $N = 130$  for a between participants comparison (2 groups, 2 measurements,  $r = .5$ ).

<sup>2</sup> Following the advice of a reviewer, we examined whether an early (vs. late) start of foreign language education is associated with more extreme feelings towards the superstitious scenarios. In each study we grouped participants into early or late bilinguals on the basis of a median-split. This factor did not influence feelings toward the superstitious scenarios: Study 1,  $F(1, 72) = 1.22, p = .272, f = 0.13$ ; Study 2,  $F(1, 62) < 0.01, p = .957, f < 0.01$ ; Study 3,  $F(1, 202) = 0.74, p = .392, f = 0.06$ . This may be because foreign language education typically does not involve emotional contexts, which are thought to be central for a language to come to feel emotional (see Caldwell-Harris, 2014; Dewaele, 2010).

<sup>3</sup> A power analysis was performed for sample size estimation using G\*Power (Faul et al., 2009). The effect size was  $f = .30$  (medium effect, based on Study 1),  $\alpha = .05$ , and power = 0.90. The projected sample size needed is approximately  $N = 90$  for a between participants comparison (2 groups, 2 measurements,  $r = .5$ ).

<sup>4</sup> A power analysis was performed for sample size estimation using G\*Power (Faul et al., 2009). The effect size was  $f = .18$  (small effect, based on Study 2),  $\alpha = .05$ , and power = 0.90. The projected sample size needed with this effect size is approximately  $N = 327$  for an ANCOVA (2 groups, 1 covariate).

<sup>5</sup> Here are the details of the correlations. We first summed the scores of a participant's self-ratings in reading and understanding (each scale ranged from 1 = almost none, to 5 = very

good). The highest possible score is 10, which we also assigned to the participants in the native language conditions (see Geipel et al., 2015a). For each study, we computed the correlation between proficiency scores and affect ratings towards the superstitious scenarios. The correlation was statistically significant in Study 1,  $r(149) = -.17$ ,  $p = .045$ , but not in Study 2,  $r(126) = -.03$ ,  $p = .775$ , or Study 3,  $r(408) = .03$ ,  $p = .568$ .

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Table 1

## English Versions of the Materials Used in Study 2

Scenarios	Description
Bad-luck scenarios	
Friday the 13th	Imagine that you are planning to visit a friend who lives abroad. You are at the airport, waiting to take your flight. Today is Friday the thirteenth. How would you feel about taking the airplane under this condition?
Mirror	Imagine that you have to submit an important job application. On the day of the submission, your bathroom mirror breaks. How would you feel about submitting the application under this condition?
Black cat*	Imagine that you have to take an important exam and you feel nervous. Before you go into the exam, a black cat crosses your path from left to right. How would you feel about taking the exam under this condition?
Good-luck scenarios	
Four-leaf clover	Imagine that you have an important job interview and you feel very nervous. Just before the interview you try to relax at a park nearby. As you are walking back, you find a four-leaf clover in the grass. How would you feel about giving the job interview under this condition?
Falling star	Imagine that you are going to a party and someone for whom you have romantic feelings will be there too. You are not yet sure whether this person has feelings for you. It is late in the evening and you just arrived at the party. You look up to the sky, and see a falling star. How would you feel about meeting the person you like under this condition?
Control scenario	
Control	Imagine that you are going to visit your family that lives in a different city. While you are waiting for the train to arrive, you meet a person you know. How would you feel about traveling under this condition?

Note. \*In Germany, a black cat crossing your path from left to right is considered to bring bad luck, while if it crosses your path from right to left then it is considered to bring good luck.



Table 2

## English Versions of the Materials Used in Study 3

Scenarios	Description
Bad-luck scenarios	
Mirror	Imagine that you have a surgery at the hospital. On the day of the surgery your bathroom mirror breaks. How would you feel about having the surgery under this condition?
Black cat	Imagine that you have to take your practical driving test, which you expect to be difficult. Just before your driving test, a black cat crosses your path from left to right. How would you feel about taking your driving test under this condition?
Good-luck scenarios	
Four-leaf clover	Imagine that you have an important presentation at work and you feel nervous. If the presentation goes well it could lead to a promotion. As you practice your talk at a park nearby, you find a four-leaf clover in the grass. How would you feel about giving the presentation under this condition?
Falling star	Imagine that you are going to a party and someone that you like will also be there. You are not yet sure whether this person has feelings for you. It is late in the evening and you just arrived at the party. You look up to the sky and see a falling star. How would you feel about meeting the person you like under this condition?
Control scenarios*	
Blocked sink	Imagine that you have to submit a job application. On the day of the submission, you notice that the kitchen sink is blocked. How would you feel about submitting the application under this condition?
White dog	Imagine that you have to take an exam. Before you take the exam, you see a man with his white dog standing in front of the building where the exam will take place. How would you feel about taking the exam under this condition?
Tulips**	Imagine that you are searching for a new apartment to rent. You found a nice one and you are on your way to hand in the documents which the owner requested. While walking towards the rental agency you notice a public garden with tulips. How would you feel about handing in your forms under this condition?
Airplane	Imagine that you have a job interview and you are well prepared. Just before the interview you have a coffee. While walking back from the café to the location where the interview will take place, you look up to the sky and see an airplane. How would you feel about giving the job interview under this condition?

Note. \* The blocked sink and white dog scenarios were presented in the bad-luck scenarios block, while the tulips and airplane scenarios in the good-luck scenarios block. The scenarios were created and translated in the same manner as in Study 2. \*\*In Germany, when a prospective tenant applies for a property, even if all his/her documents are in order, there is no guarantee of a positive outcome.

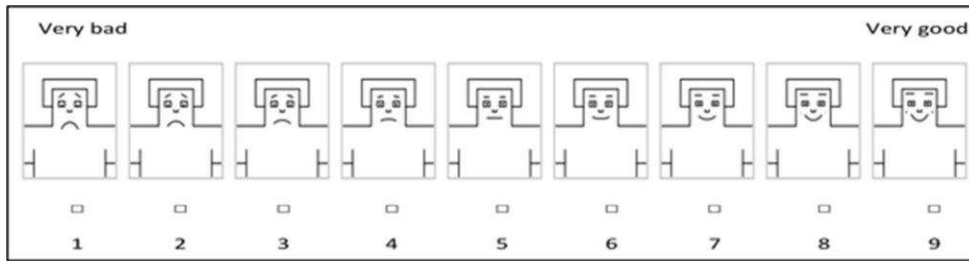


Figure 1. Self-Assessment Manikin scale of affective valence (SAM, Lang, 1985) as used in Study 1.

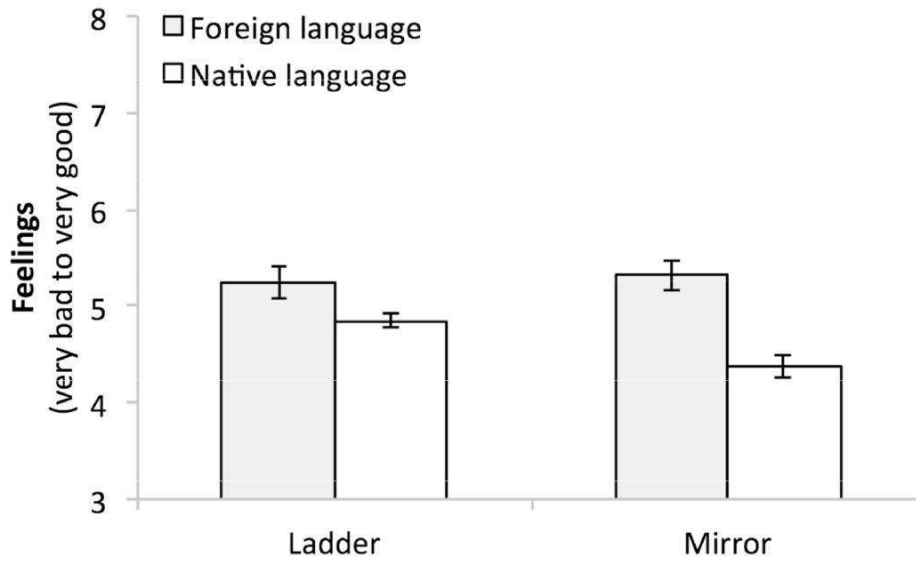


Figure 2. Mean feelings (1 = very bad to 9 = very good) by scenario and language condition (Study 1). The native language was Italian and the foreign language was either German or English. Error bars indicate standard error of the mean.

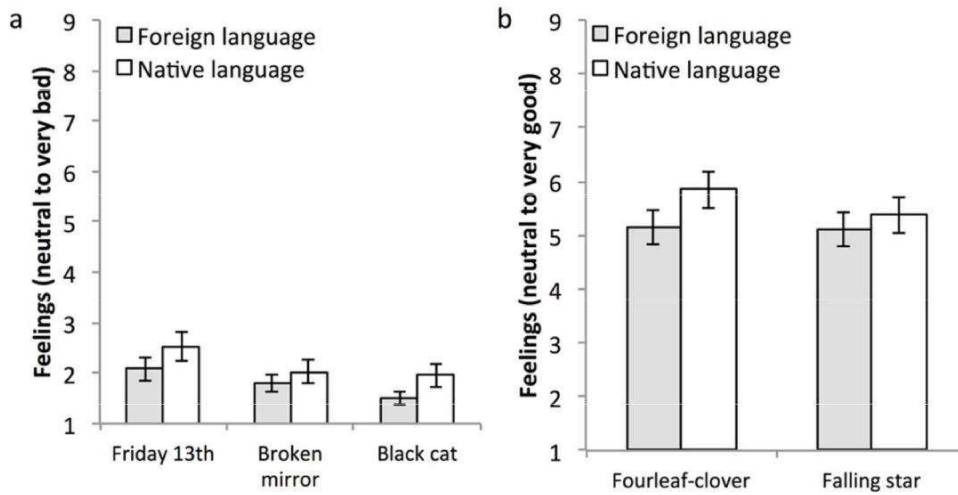


Figure 3. Mean feelings for (a) bad-luck scenarios (1 = neutral to 9 = very bad) and (b) good-luck and control scenarios (1 = neutral to 9 = very good) by language condition (Study 2). The native language was German and English the foreign language. Error bars indicate standard error of the mean.

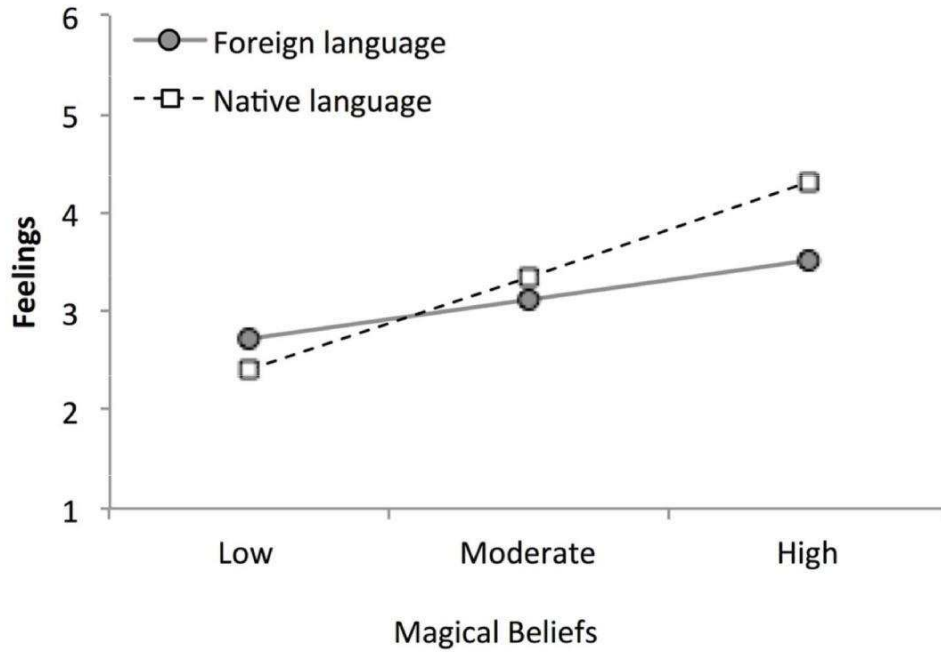


Figure 4. Illustration of the interaction between language and magical beliefs. The plot shows that the foreign language effect is significant only for participants who score high in magical beliefs. Feelings range from 1 (neutral) to 9 (very bad/good).

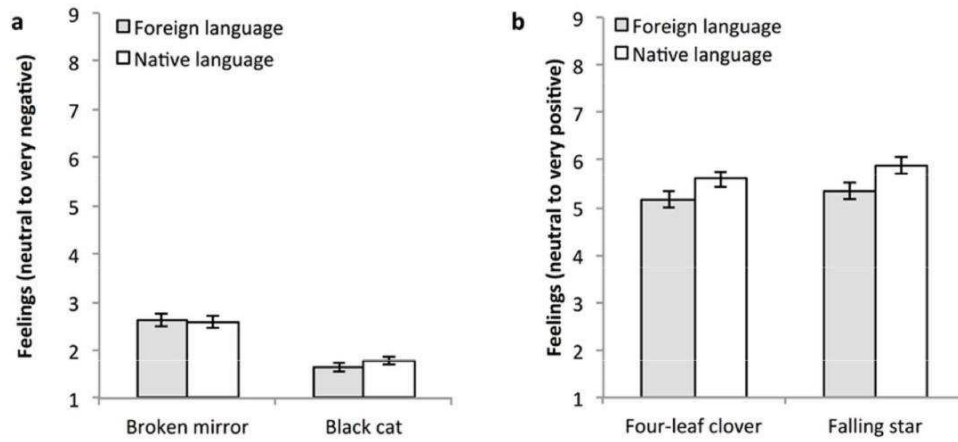


Figure 5. Estimated marginal mean feelings for (a) bad-luck scenarios (1 = neutral to 9 = very negative) and (b) good-luck (1 = neutral to 9 = very positive) by language condition (Study 3).

The native language was German and English the foreign language. Error bars indicate standard error of the mean.