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Using a foreign language reduces mental imagery

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ABSTRACT

Mental imagery plays a significant role in guiding how we feel, think, and even behave. These mental simulations are often guided by language, making it important to understand what aspects of language contribute to imagery vividness and consequently to the way we think. Here, we focus on the native-ness of language and present evidence that using a foreign language leads to less vivid mental imagery than using a native tongue. In Experiment 1, participants using a foreign language reported less vivid imagery of sensory experiences such as sight and touch than those using their native tongue. Experiment 2 provided an objective behavioral measure, showing that muted imagery reduced accuracy when judging the similarity of shapes of imagined objects. Lastly, Experiment 3 demonstrated that this reduction in mental imagery partly accounted for the previously observed foreign language effects in moral choice. Together, the findings suggest that our mental images change when using a foreign tongue, leading to downstream consequences for how we make decisions.

1. Introduction

Think back to your childhood room: the shape of the window, the color of the walls, where the bed was placed. Now imagine your dream home: the amount of light filtering in and the height of the ceilings. We are equipped with a remarkable ability not only to recreate the past and imagine the future but also to use language to shape and transmit these mental simulations to others. A variety of factors affect the richness of our imagery such as our experiences (Plailly, Delon-Martin, & Royet, 2012) or the concreteness of the language used to describe the event (Paivio, Yuille, & Madigan, 1968). Here, we focus on a novel possibility; namely, that the native-ness of the language may contribute to the vividness of mental imagery. We propose that mental imagery is reduced with the use of a foreign language.

It makes sense that factors such as concreteness of language would affect vividness of imagery. Your image of the shape of the window in your childhood room is more concrete and more vivid than your image of the abstract feeling of safety you might have had in that room. In contrast, it makes little intuitive sense that using a foreign language would reduce mental imagery. If you are told to imagine that *window*, why should it matter if instead you are told to imagine that *ventana*? If you speak Spanish as a foreign language and fully understand that *ventana* means window, the vividness of your image should be determined by your underlying concept of “window” independent of the word used to conjure it up. But there are reasons to believe that in fact, the image of *ventana* would be less vivid than that of *window*.

Using a foreign language may reduce the vividness of mental

imagery due to reduced access to sensory memories, which serve as the ingredients for novel mental representations. Imagining novel scenes relies on some of the same processes as imagining the past (Schacter, Addis, & Buckner, 2007). Neuroimaging studies have demonstrated significant overlap in brain activity when participants are cued to picture future and past events (e.g. Addis, Wong, & Schacter, 2007; Okuda et al., 2003; Szpunar, Watson, & McDermott, 2007). Additionally, patients with deficits in episodic memory retrieval also have trouble imagining novel scenes, further suggesting that a common machinery helps us remember events that have happened in the past and imagine those that have not (e.g. Hassabis, Kumaran, Vann, & Maguire, 2007; Tulving, 1985). Similarly, there are reasons to think that using a foreign language may reduce access to memories and may thereby mute mental imagery.

Marian and Neisser (2000) found that episodic memories are *language-dependent*, such that they are more easily recalled when the language in which the memory was encoded matches that of retrieval. When Russian-English bilinguals were asked to recall past events, their ability to recall was dependent on whether they were asked in the language that the event occurred. They were significantly more likely to recall events that took place in a language environment that matched the language of the cue. Memories are also more detailed, numerous and emotional when the language of encoding matches that of retrieval (e.g. Marian & Neisser, 2000; Matsumoto & Stanny, 2006; Schrauf & Rubin, 1998). For most, the majority of memories will have been encoded in the native tongue, and as such may be accessed less fluidly when using the foreign language.

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If we are correct and using a foreign language does reduce the vividness of mental simulations, this would have important theoretical implications because it could explain why using a foreign language affects the choices that we make (see Costa, Vives, & Corey, 2017; Hayakawa, Costa, Foucart, & Keysar, 2016 for reviews). For instance, using a foreign language has been shown to affect perceptions of risk (Hadjichristidis, Geipel, & Savadori, 2015), self-control (Klesse, Levav, & Goukens, 2015), and moral judgment (e.g. Corey et al., 2017; Costa, Foucart, Hayakawa, et al., 2014; Geipel, Hadjichristidis, & Surian, 2015a). All of these types of choices can be influenced by mental imagery, for instance by making vividly imagined outcomes seem more likely to occur (e.g. Sherman, Cialdini, Schwartzman, & Reynolds, 1985) or making temptations more difficult to resist (e.g. Mischel & Baker, 1975; Tigemann & Kemps, 2005). In the moral domain, it has been demonstrated that reduced mental imagery leads to more utilitarian behavior when participants are presented with dilemmas such as whether to sacrifice one life to save five (Amit & Greene, 2012). A similar increase in utilitarian behavior has been found when using a foreign language (e.g. Costa, Foucart, Hayakawa, et al., 2014), and may result from a common mechanism.

We therefore hypothesized that the use of a foreign language would diminish the vividness of mental imagery and that this would have consequences for choice. We report the results of three experiments testing these hypotheses. Experiment 1 utilized the shortened form of Betts' Questionnaire Upon Imagery (Sheehan, 1967) to evaluate reported vividness when using a native vs. foreign language. Experiment 2 assessed mental imagery through an objective performance task. Lastly, Experiment 3 examined the relationship between language, visualization, and moral decision-making.

2. General methods

To ensure that the foreignness of language was not confounded with any other demographic or self-selection related variables, participants in all experiments spoke both languages and were randomly assigned to complete the tasks in either their native language or their foreign tongue. Within an experiment, all participants had the same native and foreign languages, but the specific language pairings varied across experiments. Language was always treated as a between-subject variable and the entire experiment, including any instructions and interactions with the bilingual experimenter, were conducted in the assigned language. All materials were translated from English to the target language by a native speaker of the target language. These materials were then back-translated into English by a new translator and then checked for comparability by a native English speaker (Brislin, 1970).

In all experiments, a primary concern is that those using the foreign language may not fully comprehend the materials or may not be eligible based on our predetermined criteria. This is especially the case for our online experiments for which we had less control over the subject population (Experiments 1 & 3). After all, it would not be surprising if those using a foreign language visualize scenes less vividly if they are unable to comprehend the descriptions. As such, we included comprehension checks tailored to each study and decided upon exclusion criteria prior to data collection. Details of each experiment's comprehension check are outlined below. Additionally, prior to collecting data, it was decided that participants would be screened out or excluded if they reported that (1) the target native language was not their native language, (2) the target foreign language was their dominant or native language, or (3) they grew up speaking the foreign language in their homes.

3. Experiment 1: Perceived vividness of mental simulations

As a first step to assess the hypothesis that using a foreign language reduces the vividness of mental imagery or simulations, we randomly assigned participants to complete the widely used shortened form of

Betts' Questionnaire Upon Imagery (Sheehan, 1967) in either their native language or a foreign tongue. Participants are asked to mentally simulate a number of different sensory experiences and report how vividly they were able to do so. If using a foreign language reduces the vividness of mental simulations, then those using a foreign language should report less vivid imagery than those using their native tongue.

3.1. Participants and procedure

Data from 359 online participants were included in the analysis. Data from an additional 97 participants were excluded from our analyses for the following reasons: 68 participants were excluded because they had two or more errors when translating five randomly pre-selected items, 21 were excluded because they reported the target foreign language, Spanish, to be their dominant language, and 8 were excluded because they reported that the target native language, English, was not their native language. All included participants were native English speakers who spoke Spanish as a foreign language and did not grow up speaking Spanish at home. On average, participants began learning Spanish at age 20, and the average age at the time of the experiment was 27.6 years old. The majority of participants acquired Spanish through formal classroom schooling. They also reported having spent an average of 6.5 months in a Spanish-speaking country. Participants were asked to rate their language proficiency for both English and Spanish for speaking, listening, writing and reading on a scale from 1 (not at all proficient) to 7 (fully proficient). Average proficiency scores for English and Spanish were 6.91 and 5.04, respectively.

Participants were randomly assigned to complete the experiment in English, the native language ($n = 180$) or Spanish, the foreign language ($n = 179$). Participants were then asked to try and mentally simulate 35 different sensory experiences across seven modalities that can be described as visual (e.g. "the sun as it is sinking below the horizon"), auditory (e.g. "the clapping of hands in applause"), tactile (e.g. "sand"), kinesthetic (e.g. "running upstairs"), gustatory (e.g. "salt"), olfactory (e.g. "fresh paint"), and organic (e.g. "a sore throat"). After each statement, participants were asked to rate the vividness of their mental simulations as one of the following options which were coded as 1 through 7: "no image", "very vague and dim", "vague and dim", "not clear, but recognizable", "moderately clear", "very clear" or "perfectly clear". Those in the foreign language condition additionally had an option to select "do not understand" for each item. Any item that received this response was excluded from that participant's analysis.

3.2. Results and discussion

Within each of the modalities, we averaged across the five items to obtain a vividness score for the seven different categories. In order to test the overall effect of language on vividness, we first averaged across the seven modalities to obtain a grand average vividness score for each subject. Vividness was greater for the native language condition ($Mdn = 6.09$) than the foreign language condition ($Mdn = 5.89$). A Mann-Whitney U test indicated that the difference was significant ($U = 13,602$, $p = .011$, $r = 0.135$). We then ran seven separate Mann-Whitney U tests for each of the modalities with Bonferroni corrections ($\alpha = 0.007$). As Fig. 1 shows, those using a foreign language had lower vividness ratings for the Visual ($U = 13,437$, $p = .006$, $r = 0.144$), Auditory ($U = 13,312.5$, $p = .004$, $r = 0.151$), Tactile ($U = 11,992$, $p < .001$, $r = 0.222$), and Motor ($U = 11,652$, $p < .001$, $r = 0.241$) modalities. There was a marginal effect of language for the Organic modality ($U = 13,995$, $p = .030$, $r = 0.115$). No effect of Language was found for either the Gustatory ($U = 15,724.5$, $p = .692$, $r = 0.021$) or Olfactory ($U = 14,498.5$, $p = .101$, $r = 0.087$) modalities. The same pattern of results emerges when utilizing parametric analyses with the different modalities entered as within-subject dependent variables in a repeated-measures ANOVA. We observe a main effect of Modality such that some sensations were easier to simulate than others ($F(6,$

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