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The time course of moral decision making in bilinguals' native and foreign language

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Previous work has shown that moral decision making depends on whether moral dilemmas are presented in the native or a foreign language (Foreign Language effect). In that work, the focus was on bilinguals' final decision, but the tasks used, failed to capture the processes involved over time. The aim of this study was to examine the time course of moral decision making in bilinguals' native and foreign language prior to and after their moral decision. In a visual-world eye-tracking experiment, 82 Dutch-English bilinguals listened to 20 moral dilemmas (e.g., would you kill one to save five?) in their native or foreign language, while looking at two pictures containing key people involved in the dilemmas. These pictures illustrated (1) the person/people that is/are sacrificed, and (2) the person/people that is/are *not* sacrificed, depending on the participants' decision which was measured with yes/no-questions. The Foreign Language effect was replicated for the decisions on the personal dilemmas. Importantly, the eye gaze data showed that in the native language, listeners looked at the person who they did *not* sacrifice, whereas in the foreign language, they looked at the people who they sacrificed. A speculative explanation is that bilinguals might have experienced guilt in the native language, and therefore focused attention on the person they did not sacrifice, while in the foreign language they might have experienced less guilt because they focused attention on the people they sacrificed. More research is needed to understand the influence of factors such as emotion reduction and cognitive load on moral decision making.

KEYWORDS

moral decision making, eye-tracking, bilingualism, foreign language effect (FLE), emotion

Introduction

People constantly assess their own and other people's behavior in terms of morals. In the quest for the foundational principles of human moral cognition, cognitive scientists have typically asked participants to read or listen to artificial moral dilemmas about life and death after which they had to judge the appropriateness of the proposed moral action and whether they would take this action or not by selecting "yes" or "no" (e.g., [Greene et al., 2001](#); [Greene, 2008](#)). Using such a task has, among other things, shown that moral decision making depends on the language in which the moral dilemma is presented, also known as the Foreign Language effect ([Keysar et al., 2012](#); [Costa et al., 2014](#)). Note, however, that this effect has not been replicated in studies using realistic moral dilemmas (e.g., [Kyriakou and Mavrou, 2023, in press](#); [Yavuz et al., under review](#))¹ or for bilinguals in societies in which the second language plays a prominent role (e.g., [Brouwer, 2019](#); [Dylman and Champoux-Larsson, 2020](#); [Del Maschio et al., 2022](#); [Stankovic et al., 2022](#); [Kirova et al., 2023](#)). In those studies, the emphasis was on bilinguals' final decisions and not on the processes that led to these decisions or what happened afterwards, except for [Kyriakou et al. \(2022\)](#) who examined

¹ Yavuz, M., Küntay, A., and Brouwer, S. (under review). The effect of foreign language and psychological distance on moral judgment in Turkish-English bilinguals.

participants' reflection after their moral decisions. Research has thus failed to capture decision processes involved over time. The aim of this study was therefore to examine the time course of moral decision making in bilinguals' native and foreign language. More specifically, I investigated visual attention allocation while making a moral decision.

In the last two decades there has been an increasing interest to uncover the mechanisms underlying moral decision behavior. According to the prominent Dual-Process theory (Kahneman, 2003), thinking consists of an interplay between fast, effortless, and automatic processing (i.e., so-called System 1) and slow, deliberate, and controlled processing (i.e., so-called System 2). This dichotomy has also been applied to moral decision making (e.g., Greene and Haidt, 2002). Typically, moral dilemmas have been presented to participants who were forced to choose between two types of decisions: utilitarian or deontological. Utilitarian decisions are dependent upon the expected consequences of the moral action (i.e., choosing the "greater good"), whereas deontological decisions are determined by the intrinsic nature of the moral action (i.e., following a fundamental moral principle). Utilitarian decisions are associated with controlled System 2 processing and deontological decisions with automatic System 1 processing. However, the precise nature of the interaction between the two processes is yet unclear (e.g., Koop, 2013; Bialek and De Neys, 2016).

To get insight into the underlying processes involved in moral decision making, Greene et al. (2008) presented two types of moral dilemmas to participants: personal and impersonal. According to Greene et al. (2009) the difference between the two dilemmas is that personal dilemmas involve personal force (directness/personalness) which means that "an agent applies personal force to another when the force that directly impacts the other is generated by the agent's muscles, as when one pushes another with one's hands or with a rigid object" (p. 365), whereas these features are absent in impersonal dilemmas. The well-attested Footbridge dilemma (Foot, 1967) is an example of a personal dilemma in which five workmen are on a train track who are about to be killed by an oncoming train. The only way to save the five workmen would be to push a large man off a bridge onto the tracks, thereby sacrificing him, but stopping the train. The impersonal version of this dilemma is the Switch dilemma, in which moving a switch can change the direction of the train, thereby sacrificing one man instead of five workmen.

The presence of a Foreign Language effect appears to be dependent on the type of moral dilemma (but see Geipel et al., 2015). Costa et al. (2014) presented the personal Footbridge and the impersonal Switch dilemma to bilinguals in their native or in their foreign language. They found that, on the Footbridge dilemma, more participants pushed the large man onto the tracks (i.e., utilitarian decision) when the dilemma was presented in their foreign than in their native language. This pattern was, however, not demonstrated on the Switch dilemma. The authors argued that emotionality is an important factor for the presence of the Foreign Language effect, as previous work has shown that brain areas associated with emotion were activated during the Footbridge dilemma but less so during the Switch dilemma (Greene et al., 2008). Since this seminal study, the Foreign Language effect has been replicated with many different native-foreign language pairs (e.g., see Circi et al., 2021; Del Maschio et al., 2022; for

meta-analyses; Geipel et al., 2015; Chan et al., 2016; Cipolletti et al., 2016; Hayakawa et al., 2017; Wong and Ng, 2018; Brouwer, 2020; Andrade, 2021; but see Cavar and Tytus, 2018; Brouwer, 2019; Dylman and Champoux-Larsson, 2020 for a failure to replicate the effect).

There have been several explanations for the Foreign Language effect, but there are two dominant ones in line with the Dual-Process account (Greene and Haidt, 2002; Kahneman, 2003). The first explanation entails that using a foreign language induces more utilitarian decisions than a native language due to emotional distance (e.g., Harris et al., 2003; Dewaele, 2004; Costa et al., 2014; Kyriakou et al., 2022). This reduction might be due to the naturalistic, emotionally rich environment in which the native language is acquired as opposed to the classroom setting with limited emotional experience in which a foreign language is typically acquired (Keysar et al., 2012; Pavlenko, 2012; Hayakawa et al., 2017). The second explanation that has been suggested is an increase in cognitive load when processing a foreign language (Segalowitz, 2010), which elicits a more focused state of processing (e.g., Alter et al., 2007; Oppenheimer, 2008) and therefore elicits more utilitarian decisions.

Most of the studies on the Foreign Language effect presented participants with written moral dilemmas. Recently, a few studies exposed participants to moral dilemmas in auditory form and replicated the Foreign Language effect (Brouwer, 2019, 2020; Miozzo et al., 2020; Muda et al., 2020). In both modalities, participants' task was to make a decision whether they agreed or disagreed with a proposed moral action. A couple of brain studies have assessed the temporal dynamics during moral decision making (Sarlo et al., 2012; Gan et al., 2016; Wolff et al., 2019), but they only focused on participants' native language. In order to shed light on the time course of moral decision making in the native and foreign language, the eye-tracking technique, and more specifically the visual world paradigm, can be used (e.g., Cooper, 1974; Tanenhaus et al., 1995). This technique is able to assess visual attention allocation to pictures related to moral dilemmas at different moments in time.

To my knowledge, only two studies on moral decision making in the native language have used eye-tracking (Kastner, 2010; Skulmowski et al., 2014). In Kastner, the Footbridge and Switch dilemma were first presented in written form to participants after which images of the key people involved in the dilemmas appeared, whereas in Skulmowski et al., participants were exposed to different versions of the same type of dilemmas in a virtual reality setting with avatars. The relative time participants spent on looking at the side of the sacrificed individual or group (e.g., the large man in the Footbridge dilemma) was compared to the other side (e.g., the workmen in the Footbridge dilemma). Both studies measured participants' eye gaze to the pictures at different moments in time. Kastner looked at participants' eye gaze behavior *after* they made a decision. She demonstrated that participants who were willing to push the man off the bridge onto the tracks (i.e., utilitarian decision) looked less at the man, thereby avoiding to look at the person they had sacrificed. However, Skulmowski et al. focused on participants' eye gaze *prior* to their decision. In contrast to the results of Kastner, they found that participants spent more time looking at the sacrificed avatar in order to reassure themselves

of making a “right” decision (p. 13). These findings reveal the importance of looking at the moral decision process both prior to and after participants’ decision, as the allocation of visual attention appears to be different depending on the moment in time. In addition, these studies focused only on the native language, while previous work has shown that moral decision making can be different in a foreign language (e.g., Costa et al., 2014).

The aim of the current study was threefold. First, I investigated whether the Foreign Language Effect, an increase in utilitarian decisions in the foreign language compared to the native language, can be found in an eye-tracking set-up. Second, I examined the time course of bilinguals’ moral decisions by looking at their visual attention allocated to pictures related to the moral dilemmas in their native and foreign language. Third, the eye gaze data were linked to whether bilinguals made utilitarian or deontological decisions. To investigate these three aims, Dutch-English bilinguals took part in a visual world eye-tracking experiment. They were asked to listen to personal and impersonal moral dilemmas in their native or foreign language after which they were presented with two pictures of the key people involved in the moral dilemmas (e.g., the man and the five workmen in the Footbridge dilemma). Participants’ decisions and their eye-gaze were measured to the key pictures prior to and after their decision. When people make a *utilitarian* decision on the Footbridge dilemma, it means that they decided to sacrifice the man and therefore the five workmen were not sacrificed. In contrast, when people make a *deontological* decision on the Footbridge dilemma, it entails that they decided to *not* sacrifice the man and therefore the five workmen were sacrificed.

It was, first of all, expected that the Foreign Language effect would be found on the personal moral dilemmas, but not the impersonal ones as they are less emotionally aversive (e.g., Greene et al., 2001; Costa et al., 2014). The hypotheses for the eye-tracking data were based on the findings by Skulmowski et al. (2014) and Kastner (2010), depending on the time window (i.e., prior to or after the decision). Following Skulmowski et al., it was hypothesized that people will be looking more at the sacrificed person/people *prior* to their decision. Following Kastner, it was expected that people will be looking more at the person/people who are *not* sacrificed *after* their decision. Finally, it was expected that this pattern might depend on the language in which the moral dilemma was presented and/or people’s type of decision (i.e., utilitarian or deontological), as previous research has shown there is an overall increase in utilitarian decisions in the foreign language compared to the native language (e.g., Costa et al., 2014; Brouwer, 2020). However, the direction of these possible effects were open, as no previous eye-tracking studies on moral decision making have taken these factors into account.

Method

Materials, data, analyses scripts, and model outputs are available at osf.io/wdtca.

TABLE 1 Participants’ characteristics in the native and foreign language condition.

	Native language	Foreign language	<i>t</i> -test
N	41	41	
Gender	26F	28F	
Age	24.9 (7.95)	22.44 (2.73)	$t_{(80)} = -1.85, p = 0.07$
Age range*	18–55	18–29	
Education	95.12% higher	95.12% higher	
Age of English onset	11.09 (1.83)	11.12 (1.23)	$t_{(80)} = 0.07, p = 0.94$
English proficiency			
LexTALE	80.34 (13.15)	81.22 (10.47)	$t_{(76)} = 0.33, p = 0.74$
Speaking	3.41 (0.54)	3.61 (0.54)	$t_{(80)} = 1.62, p = 0.11$
Listening	3.68 (0.47)	3.85 (0.47)	$t_{(80)} = 1.63, p = 0.11$
Writing	3.39 (0.66)	3.56 (0.59)	$t_{(80)} = 1.23, p = 0.22$
Reading	3.68 (0.56)	3.88 (0.45)	$t_{(80)} = 1.71, p = 0.09$

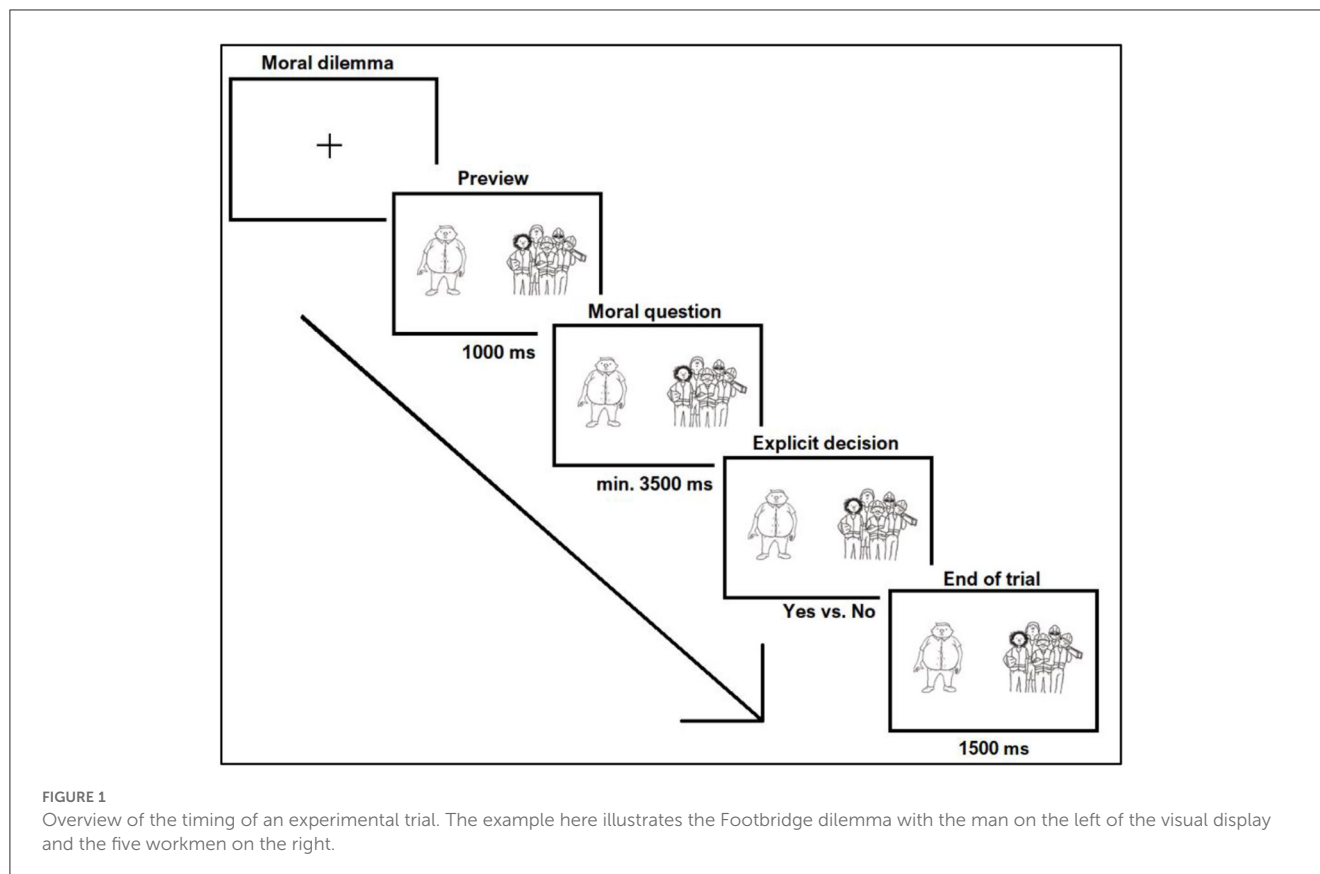
*The study was run during the COVID-19 pandemic which is why it was not possible to balance the language conditions in terms of age range. In the native language condition, only two participants were 53 and 55 years old, whereas all the other participants were in their late teenage years or in their twenties. Excluding the data from these two older participants did not change the pattern of the main findings.

Participants

In total, 83 participants took part in this study, but one participant was excluded due to not having Dutch as the first language. Of the 82 participants (54 females, $M_{AGE} = 23.67$ age range = 18–55 years), 41 took part in the native language condition while 41 took part in the foreign language condition (see Table 1 for an overview of participant characteristics in both conditions). All participants were native Dutch speakers who learned English as a second language at the mean age of 11 years. They participated on the LexTALE test to assess their English proficiency level (Lemhöfer and Broersma, 2012). They also self-rated their English proficiency for speaking, listening, writing, and reading abilities in a questionnaire. Independent *t*-tests showed no differences between the conditions with respect to age, age of English onset, and English proficiency level (all $p > 0.05$). They all had normal or corrected to normal vision. Participants received course credits or a gift card of 10 Euros. The experimental protocol was approved by the independent ethics committee of the Radboud University.

Materials

The same 20 moral dilemmas, 10 personal and 10 impersonal, as in Greene et al. (2008) were presented to participants, except that they were presented auditorily instead of in written form. Most of these dilemmas were about an individual or group that must be sacrificed in order for another individual or group to survive. As outlined in the Introduction, personal dilemmas involved personal force, whereas this was not the case for impersonal dilemmas. In addition to the 20 moral dilemmas, two non-moral stories with



multiple-choice questions were auditorily presented in order to check whether participants paid attention and to assess participants' comprehension ability in English (Hayakawa et al., 2017). None of them had to be removed.

The dilemmas and stories were originally written in English. They were translated into Dutch by two native Dutch speakers who are highly proficient in English (C2 level). The translations were compared and adjusted in consultation. The dilemmas were recorded using Adobe Audition[®] by a female native Dutch actress (23 years old) whose English proficiency was at C2 level. The actress recorded both the Dutch and the English version of the dilemmas to prevent any influence of speaker characteristics on the results.

Forty pictures (500 × 500 pixels, all the same size) were drawn with black lines on a white background by a professional artist (see <https://www.annerombouts.nl>). The visual display always consisted of two pictures presented next to each other in the middle of the screen. The two pictures displayed key people or objects that were involved in the dilemmas. The two most suitable pictures for each moral dilemma were selected by three researchers until they reached consensus. The negative aspects of the moral dilemmas, such as killing or dying, were never visible in the pictures.

Procedure and design

Participants were tested in the eye-tracking lab of [anonymous for review]. An SR Research Eye-link 1,000 Plus eye-tracker (sampling rate at 1 kHz) was used to collect participants' eye

gaze data. The presentation of the auditory and the visual materials was controlled with OpenSesame[®]. The auditory stimuli were presented over headphones. After a calibration procedure, participants received written instructions on the screen. They were asked to listen to moral dilemmas (personal and impersonal, within-subjects) in their native or foreign language (between-subjects) and respond to the question posed after each moral dilemma.

An overview of an experimental trial can be found in Figure 1. First, a fixation cross appeared on the screen while the participants listened to a moral dilemma. After that, the visual display with two pictures of key people or objects involved in the moral dilemma was shown for 1,000 milliseconds (preview time). Next, participants were presented with an auditory yes/no question about the moral dilemma. On a button box, they had to indicate their moral decision: "yes" was a utilitarian decision and "no" a deontological decision. The position of the pictures and the yes/no options were counterbalanced. When participants made their decision on the button box, the two pictures remained on the screen for 2,000 ms until the next trial initiated. The eye-tracking part took about 20 min.

The moral dilemmas were pseudo-randomized in eight different lists per language condition. Each list always started with the Footbridge or the Switch dilemma, of which the order was counterbalanced, and ended with the two comprehension questions. Personal and impersonal dilemmas were presented maximally three times in a row.

After the eye-tracking task, the participants were asked to participate in the LexTALE test (Lemhöfer and Broersma, 2012)

TABLE 2 Mean percentages, SDs and frequencies of utilitarian decisions on personal vs. impersonal dilemmas in the native vs. the foreign language.

Dilemma type	Language					
	Native (N = 41)			Foreign (N = 41)		
	M	SD	N	M	SD	N
Personal	46	19	19	56	21	23
Impersonal	59	14	24	56	12	23

and fill out a short questionnaire. In this questionnaire, they were asked questions about their age, gender, level of education, language background and if they had any vision and/or hearing problems. It took the participants approximately 45 min to complete the whole experimental process.

Results

Separate analyses were conducted on the decisions and the eye-gaze data in R (version 4.3.0; R Core Team, 2023) using the packages ggplot2 (Wickham, 2016) and lme4 (Bates et al., 2015). In addition, the type of decision and the eye-gaze data were linked to each other.

Moral decisions

The aim of the analysis on the moral decisions was to evaluate whether the Foreign Language Effect could be replicated in a visual-world eye-tracking setting. Table 2 presents the mean percentage, SDs and frequencies of utilitarian decisions participants made in their native (Dutch) or their foreign language (English) for each dilemma type (personal vs. impersonal). In the native language, a higher percentage of utilitarian responses was made on average for the impersonal dilemmas ($M = 59\%$, $SD = 14$) than for the personal dilemmas ($M = 46\%$, $SD = 19$). In the foreign language, the percentage of utilitarian decisions was on average equal for both dilemmas ($M = 56$).

A 2 (Language: native vs. foreign, between-subjects) by 2 (Dilemma type: personal vs. impersonal, within-subjects) mixed ANOVA was conducted on the mean percentage of utilitarian decisions. The results demonstrated a significant main effect of dilemma type [$F_{(1,80)} = 7.69$, $p = 0.007$, $\eta^2 = 0.09$]. There was no significant main effect of language [$F_{(1,80)} = 1.52$, $p = 0.221$, $\eta^2 = 0.02$], but importantly, there was a significant interaction effect between dilemma type and language [$F_{(1,80)} = 7.14$, $p = 0.009$, $\eta^2 = 0.08$]. Following up on this interaction with pairwise comparisons (Bonferroni corrected) showed that participants' percentage of utilitarian decisions for personal dilemmas was higher when they were presented in their foreign language than in their native language ($p = 0.03$). This difference between languages was not found for the impersonal dilemmas ($p = 0.32$).

Eye-gaze data

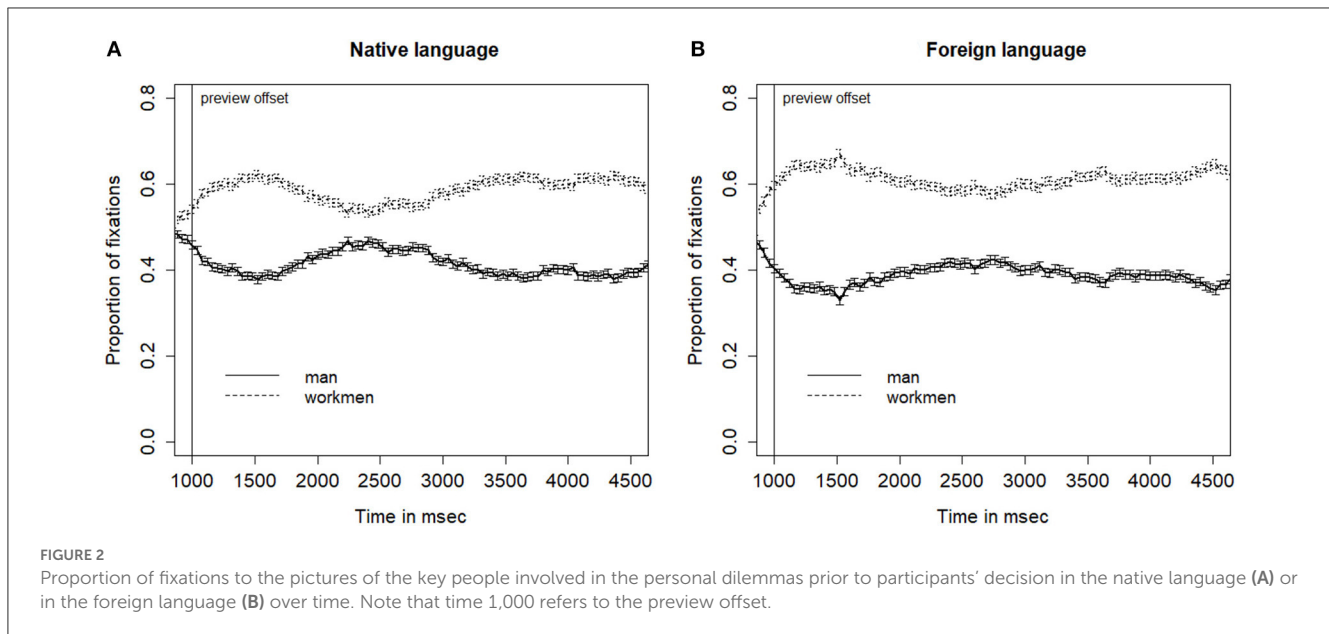
The aim of the analyses on the eye-gaze data was twofold. First, it was examined how participants' moral decision process unfolds prior to and after a decision in their native compared to their foreign language. Second, the eye gaze data were linked to whether participants made utilitarian or deontological decisions in their native or foreign language.

The eye gaze analysis included only the eye gaze during listening to the personal dilemmas because (1) the Foreign Language Effect has typically only been found on those type of dilemmas (e.g., Costa et al., 2014) which was also the case in the current study, and (2) the impersonal dilemmas did not always consist of key people which made it too difficult to create suitable pictures. For example, in the impersonal dilemma called Lost Wallet, the moral question was whether one would keep money found on the street in order to have more money for themselves. In this case, a picture of a wallet with and without money was shown.

The participants' dominant eye-gaze was tracked during the preview time, the posing of the moral question, and 1,500 ms after participants' decision. The analysis focused on two time windows. The first time window, *prior to* participants' decision, included eye gaze from preview offset until 3,500 ms into the moral question which was the duration of the shortest question after which participants could make a decision. The second time window, *after* participants' decision, included eye gaze from the offset of participants' decision (i.e., the button press) until 1,500 ms thereafter. Both time windows were offset by 200 ms to account for saccade latency (Salverda et al., 2014).

Logistic mixed effects models with fixation as binary dependent variable (0 = workmen vs. 1 = man) were conducted using the glmer function in the lme4 package (Bates et al., 2015). The visual display was divided into two regions of interest. More specifically, the picture displaying more people than the one it was paired with were coded as 0 (e.g., the workmen) and the picture displaying fewer people than the one it was paired with were coded as 1 (e.g., the man). The fixed effects included Language (native vs. foreign), Time (40 ms time bins, continuous), and their interaction. Language was contrast-coded with $-1/2$ for native (Dutch) and $+1/2$ for foreign (English), while Time was centered around zero (Baguley, 2012, p. 590–621) and divided by 1,000 in order to let the models converge. Participants and Items were included as random effects. Random slopes did not converge.

Figures 2–5 below demonstrate the proportion of fixations to the pictures of the key people involved in the personal dilemmas over time. For example, for the Footbridge dilemma, the man and the five workmen are the main characters that could either be sacrificed or not sacrificed. Depending on the type of decision, the pictures illustrate (1) the person/people that is/are sacrificed, and (2) the person/people that is/are not sacrificed. For example, in the case of a *utilitarian* decision on the Footbridge dilemma, the participant sacrifices man as a result of which the five workmen are not sacrificed. The reverse holds true for a *deontological* decision: the participant does not sacrifice the man and therefore the workmen are sacrificed. For illustration purposes, the labels “man” and “workmen” are used in the legends of Figures 2–5.



Eye gaze *prior* to participants' decision (first time window)

All decisions

Figure 2 demonstrates the proportion of fixations to the pictures of the key people involved in the personal dilemmas prior to participants' decision (i.e., first time window) in the native language (Figure 2A) or in the foreign language (Figure 2B) over time. There is a clear preference to look at the picture with more people (e.g., workmen) than fewer people on it (e.g., man) in both the native and the foreign language.

The analysis showed no effect of Language ($\beta = 0.005$, $se = 0.19$, z -value = 0.03, $p = 0.98$), but an effect of Time ($\beta = -0.02$, $se = 0.02$, z -value = -11.34 , $p < 0.001$, odds ratio = 0.98) and a significant interaction between Language and Time was found ($\beta = 0.03$, $se = 0.004$, z -value = 7.69, $p < 0.001$, odds ratio = 1.03). This pattern indicated that the odds of looking at the man significantly decreased more over time in the native language ($\beta = -0.04$, $se = 0.003$, z -value = -13.41 , $p < 0.001$, odds ratio = 0.96) than in the foreign language ($\beta = -0.008$, $se = 0.003$, z -value = -2.59 , $p < 0.01$, odds ratio = 0.99).

Utilitarian vs. deontological decisions

Figure 3 demonstrates the proportion of fixations to pictures of the key people involved in the personal dilemmas prior to participants' decision (i.e., first time window). The figure has been split by (1) the type of decision [i.e., utilitarian (Figures 3A, B) vs. deontological decision (Figures 3C, D)] and by (2) language [i.e., native (Figures 3A, C) vs. foreign language (Figures 3B, D)].

Figure 3 shows that prior to participants' utilitarian decision, they looked more at the people they did not sacrifice (e.g., workmen) than the person they sacrificed (e.g., man) across both languages. The reverse pattern is shown prior to participants' deontological decision: they looked more at the people they

sacrificed (e.g., workmen) than at the person not sacrificed (e.g., man). However, yet again, the preference to look at the picture with more people (e.g., workmen) than fewer people on it (e.g., man) is consistent across all conditions.

The analysis on the data prior to participants' utilitarian decision demonstrated a significant effect of Time ($\beta = -0.01$, $se = 0.003$, z -value = -4.26 , $p < 0.001$, odds ratio = 0.99), indicating that the odds of looking at the sacrificed man decreased over time. No effect of Language ($\beta = -0.06$, $se = 0.21$, z -value = -0.31 , $p = 0.76$) nor a significant interaction effect between Language and Time was found ($\beta = -0.003$, $se = 0.006$, z -value = -0.54 , $p = 0.59$).

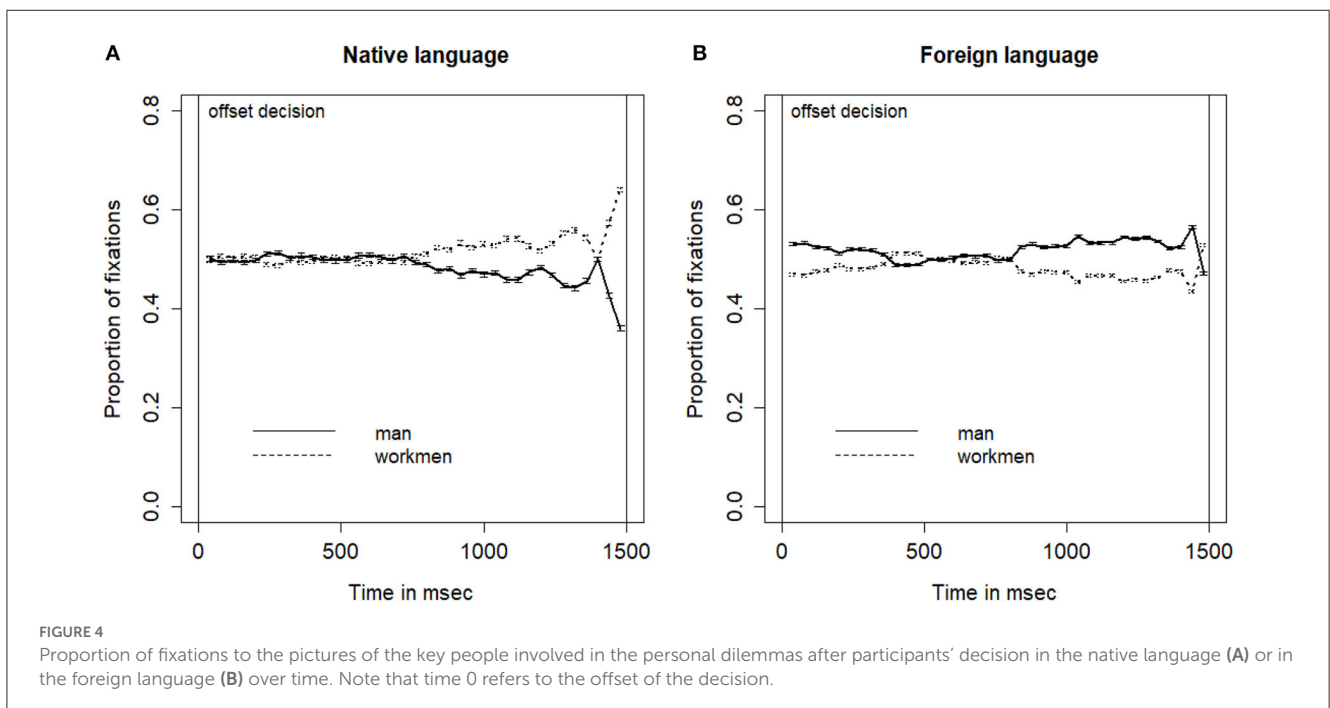
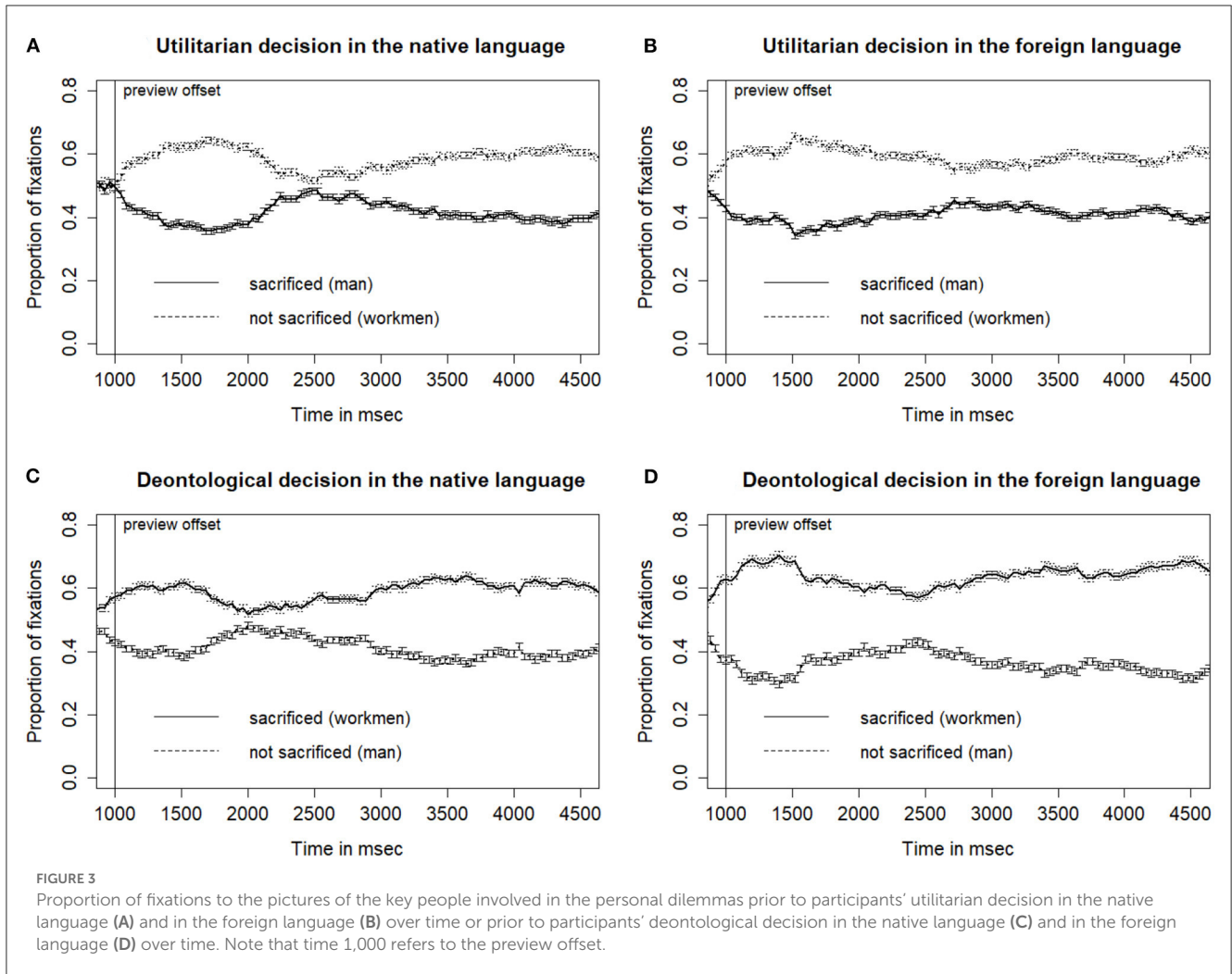
Similarly, the analysis on the data prior to participants' deontological decision showed an effect of Time ($\beta = -0.06$, $se = 0.01$, z -value = -4.62 , $p < 0.001$, odds ratio = 0.94), revealing that the odds of looking at the man, who was not sacrificed, decreased over time. Language ($\beta = -0.55$, $se = 0.31$, z -value = -1.76 , $p = 0.08$) and the interaction between Language and Time ($\beta = 0.05$, $se = 0.03$, z -value = 1.92, $p = 0.055$) were both not significant.

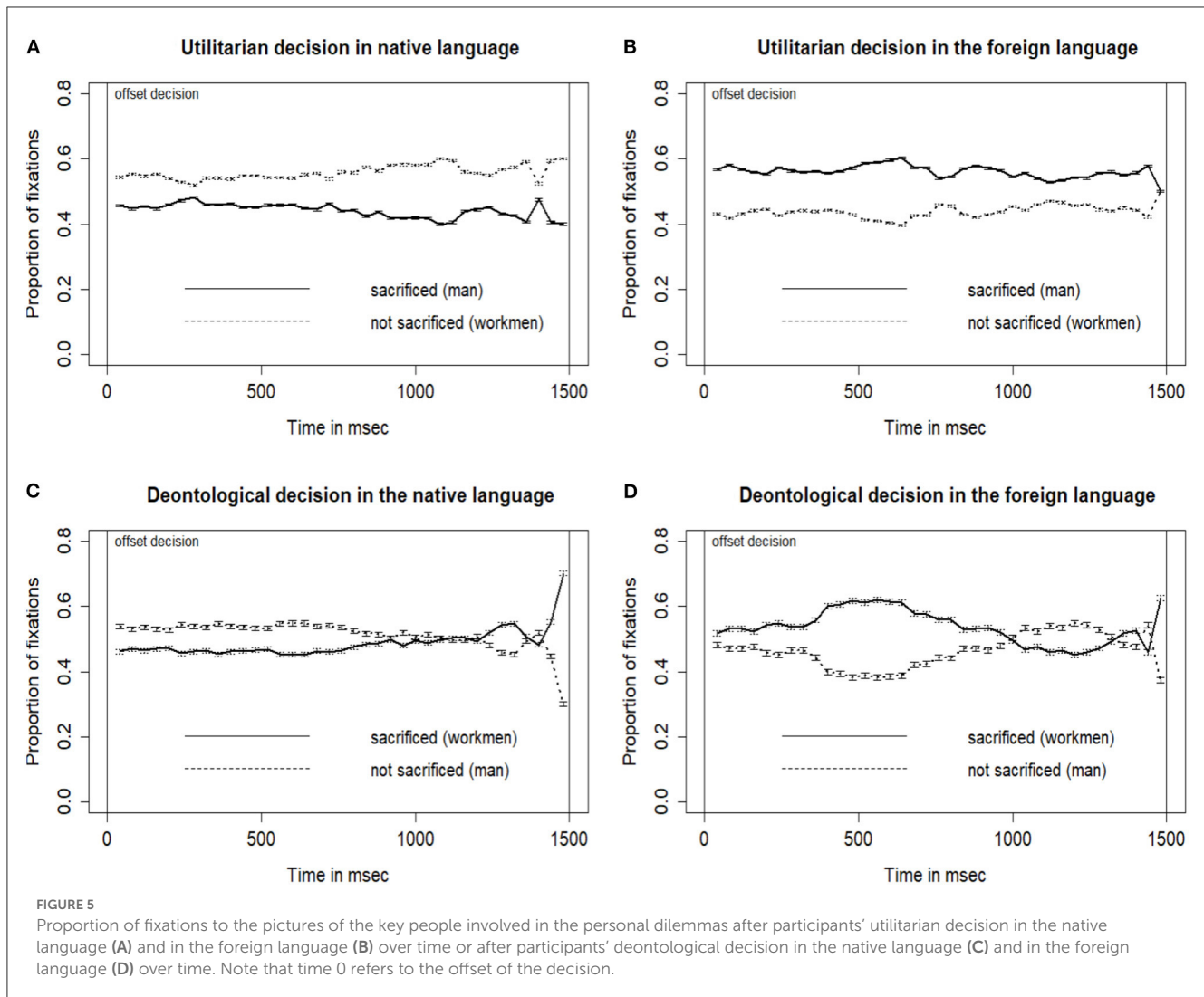
Eye gaze *after* participants' decision (second time window)

All decisions

Figure 4 demonstrates the proportion of fixations to the pictures of the key people involved in the personal dilemmas after participants made their decision (i.e., second time window) in the native language (Figure 4A) or the foreign language (Figure 4B) over time. Overall, it can be observed that, initially, participants' eye gaze look equally often at both pictures, but after around 800 ms, there is a preference to look more at the workmen in the native language but to look at the man in the foreign language.

The analysis showed no effects of Language ($\beta = 0.27$, $se = 0.34$, z -value = 0.80, $p = 0.43$) nor of Time ($\beta = -0.06$, $se = 0.06$, z -value





$= -1.25, p = 0.21$). Importantly, a significant interaction between Language and Time was found ($\beta = 0.30, se = 0.10, z\text{-value} = 3.10, p < 0.01, \text{odds ratio} = 1.35$). Unpacking this interaction revealed that the odds of looking at the man significantly decreased over time in the native language ($\beta = -0.21, se = 0.07, z\text{-value} = -2.96, p < 0.01, \text{odds ratio} = 0.81$), while the odds of looking at the man did not significantly increase over time in the foreign language ($\beta = 0.09, se = 0.06, z\text{-value} = 1.37, p = 0.17$).

Utilitarian vs. deontological decisions

Figure 5 demonstrates the proportion of fixations to pictures of the key people involved in the personal dilemmas after participants made their decision (i.e., second time window). The figure is split by (1) the type of decision [i.e., utilitarian (Figures 5A, B) or deontological decision (Figures 5C, D)] and by (2) language [i.e., native (Figures 5A, C) and foreign language (Figures 5B, D)].

It can be observed that after participants made a *utilitarian* decision, they looked more at the people they did not sacrifice (e.g., workmen) than the person they sacrificed (e.g., man) in the native language. This pattern was reversed in the foreign language: they looked more at the person they sacrificed (e.g., man) than

the people they did not sacrifice (e.g., workmen). In contrast, after participants made a *deontological* decision in the native language, they looked more at the person they did not sacrifice (e.g., man) than at the people they sacrificed (e.g., workmen). This pattern was again the reverse in the foreign language: they looked more at the people they sacrificed (e.g., workmen) than the person they did not sacrifice (e.g., man).

For the *utilitarian* decisions, the analysis showed no effects of Language ($\beta = 0.54, se = 0.52, z\text{-value} = 1.04, p = 0.30$), Time ($\beta = -0.14, se = 0.07, z\text{-value} = -1.96, p = 0.0504$) nor an interaction between Language and Time ($\beta = -0.10, se = 0.15, z\text{-value} = -0.65, p = 0.51$). For the *deontological* decisions, the analysis showed no effects of Language ($\beta = -0.03, se = 0.54, z\text{-value} = -0.05, p = 0.96$) or Time ($\beta = 0.11, se = 0.07, z\text{-value} = 1.55, p = 0.12$), but a significant interaction between Language and Time ($\beta = 0.79, se = 0.15, z\text{-value} = 5.39, p < 0.001, \text{odds ratio} = 1.08$). This indicated that the odds of looking at the man, who they decided to sacrifice, significantly decreased over time in the native language ($\beta = -0.28, se = 0.10, z\text{-value} = -2.83, p < 0.01, \text{odds ratio} = 0.76$), whereas the odds of looking at the sacrificed man significantly increased over time in the foreign language ($\beta = 0.51, se = 0.11, z\text{-value} = 4.70, p < 0.001, \text{odds ratio} = 1.67$).

General discussion

The current study had three main aims. The first aim was to examine whether the Foreign Language Effect, an increase in utilitarian decisions in the foreign as opposed to the native language, can be replicated in an eye-tracking set-up. The second aim was to investigate the time course of bilinguals' moral decisions by looking at their visual attention allocated to pictures related to moral dilemmas in their native or foreign language. The third aim was to link the bilinguals' eye gaze data to whether they made utilitarian or deontological decisions. To do this, Dutch-English bilinguals listened to personal and impersonal moral dilemmas in their native or their foreign language in a visual-world eye-tracking task. After each dilemma, they were presented with two pictures of the key people involved in dilemmas (e.g., the man and the five workmen in the Footbridge dilemma). Participants' decisions and their eye-gaze were measured to the key pictures prior to and after their decision.

There were three main findings. The first one is that bilinguals made more utilitarian decisions on the personal dilemmas in the foreign than the native language. This finding is as predicted and in line with previous work which has shown the Foreign Language effect in written form (e.g., Costa et al., 2014; Ciolletti et al., 2016) and in auditory form (Brouwer, 2020; Miozzo et al., 2020; Muda et al., 2020). Furthermore, as also expected, no Foreign Language effect was found for the impersonal dilemmas, which is consistent with the assumption that a foreign language might only increase utilitarianism if a dilemma is sufficiently emotionally aversive (Greene et al., 2001). In addition, this is the first study that showed the existence of the Foreign Language effect using the visual world eye-tracking paradigm, thereby generalizing the effect to other experimental settings.

The second main finding is that the eye gaze of bilinguals *prior* to their decision was directed more at the picture with multiple people displayed on it (e.g., workmen) than with fewer people on it (e.g., man), independent of language. This could be explained by an inherent initial preference to look more at complex and engaging pictures over simple and less interesting ones. By contrast, the eye gaze of bilinguals *after* their decision was dependent on language over time. More specifically, in the native language a preference to look at the workmen was found, while in the foreign language a preference to look at the man was observed. Together, these findings might reveal that initially the visual display with the two different types of pictures had an influence on the eye gaze pattern prior to bilinguals' decision. However, later in time, emotional and/or cognitive processes might be responsible for the eye gaze pattern after bilinguals' decision. More information on the possible mechanisms at work are explained below.

The third main finding is yet again that, *prior* to bilinguals' decision, they preferred to look at pictures with multiple people displayed on it (e.g., workmen) instead of with fewer people on it (e.g., man), independent of language and the type of decision. More importantly, *after* bilinguals' *deontological* decision (i.e., deciding not to push the man off the bridge, thereby not sacrificing him but sacrificing the five workmen), the eye gaze pattern was dependent on language over time. More specifically, in the native language, participants first looked primarily at the person they did not sacrifice (e.g., man) and this decreased over time, while in the

foreign language, they first looked primarily at the sacrificed people (e.g., workmen) and looks to the person they did not sacrifice (e.g., man) increased over time. Similarly, *after* bilinguals' *utilitarian* decision (i.e., deciding to push the man off the bridge, thereby sacrificing him), they looked more at the people they did not sacrifice (e.g., workmen) in their native language, while in their foreign language they looked more at the person they sacrificed (e.g., man). However, this pattern did not reach significance. Taken together, these results indicate that language played a role *after* the decision, but the type of decision did not. More specifically, in the native language, bilinguals looked more at the person/people they did *not* sacrifice, while in the foreign language, they looked more at the person/people they sacrificed.

The question arises to what extent the above findings are in line with the proposed hypotheses. The first hypothesis for the eye gaze data was based on Skulmowski et al. (2014) who found that participants look more at the sacrificed person/people *prior* to their decision in their native language. The current study was unable to replicate this pattern. A possible explanation for this difference might be that the current methodological set-up was quite different from Skulmowski et al. (2014). They presented different moral dilemmas in a virtual reality setting with avatars. In the present study, it could thus be the case that at an early stage in bilinguals' moral decision process, they are primarily cognitively and/or emotionally involved with the consequences of their (fictive) action or no-action by looking at pictures representing the maximal costs (i.e., five people at stake instead of one person). Another possible explanation is that the currently used visual display contained specific characteristics which could have elicited a preference to look at the more complex and interesting picture (e.g., workmen) at first. A conceivable solution to this could be to increase the preview time such that participants have more time to inspect both pictures and they become equally attractive.

The second hypothesis for the eye gaze data was based on Kastner (2010), who found that people look more at the saved person/people *after* their decision in the native language because they avoided looking at the person/people they sacrificed. This result was replicated in the current study. More specifically, bilinguals initially preferred to look at the saved person/people in their native language. This pattern was observed for both the utilitarian and deontological decisions. An additional novel finding of the current study is that the eye gaze pattern changed over time when bilinguals made deontological decisions in their native language. They first avoided looking at the people they sacrificed (e.g., workmen), but later in time, they started looking more at them. This could be interpreted in multiple ways. It could, for example, be a response of participants feeling guilty toward their victims. At the same time, it could also mean that participants were bored with the task and therefore switched their eye gaze to the other picture. And finally, as an anonymous reviewer pointed out, it could mean that in the native language, bilinguals are only interested in the person who they saved but they do not care much about the people they sacrificed.

The third, exploratory hypothesis for the eye gaze data, stated that the eye gaze patterns might be dependent on the language, native or foreign, in which the moral dilemma was presented. This hypothesis was confirmed when bilinguals had made *deontological* decisions. More specifically, in the native language, bilinguals first looked at the person they did not sacrifice (e.g., man), and later

in time they looked at the people they sacrificed (e.g., workmen). However, in the foreign language, bilinguals first looked at the people they sacrificed (e.g. workmen) and later in time they looked at the person they did not sacrifice (e.g., man).

How can these language-dependent gaze patterns be interpreted? In line with the Dual-Process account (e.g., [Greene and Haidt, 2002](#); [Kahneman, 2003](#)), there are two prominent explanations for the Foreign Language effect: a reduction in emotion or an increase in cognitive load in the foreign language. As no measures of emotionality and/or cognitive load were collected, I can only speculate to what extent they might have played a role here. What the previous literature has shown is that gaze direction is able to convey personal information, allowing one to follow people's focus of attention, infer intentions and detect mental states (e.g., [Frischen et al., 2007](#); [Colombatto et al., 2020](#)). More specifically, it has been found that information from prior interactions could influence later eye gaze behavior with the same person/people ([Dalmaso et al., 2006](#)), which is applicable to the current study. To illustrate, guilt, a negative experience-induced moral emotion that is related to understanding a victim's thoughts, feelings, and attitudes toward transgressors (e.g., [Yu et al., 2014](#)), might have arisen after bilinguals' moral decision due to feeling responsible for the action after deciding to (fictively) hurt one person or multiple people, and therefore violating moral principles ([Hoffman, 1982](#)). Prior work has shown that transgressors avoid gazing at the victim(s) to reduce the resulting negative emotions such as guilt ([Van Dillen et al., 2017](#); [Yu et al., 2017](#)). In particular, Yu and colleagues showed in an eye-tracking experiment that participants fixated less on a partner's eyes in a high-guilt condition in which the participants had caused the partner's pain than in a control condition. In the current study, the fact that bilinguals first avoided to look at the people they sacrificed in their native language might indicate that they felt guilty, and therefore focused attention on the person they did not sacrifice. However, in the foreign language, bilinguals did look at the people they sacrificed, which might indicate they experienced less guilt.

To test whether these explanations are correct, future research would need to, for example, measure how emotional people are and which emotions they experience prior to and after each moral decision by using physiological measures such as skin conductance. Alternatively, it would be interesting to increase the cognitive load in the native language by, for example, adding another cognitively taxing task. If the eye gaze pattern in the native language will then pattern more similarly to the foreign language, it reveals that cognitive load plays an important role.

In conclusion, this is the first demonstration of the Foreign Language effect on moral decision making in a visual-world eye-tracking paradigm. In addition, the time course of moral decision making was revealed to be dependent on language. Bilinguals preferred looking at the person they did not sacrifice in their native language, but in the foreign language, they preferred looking at the people they sacrificed. A speculative explanation for this eye gaze pattern is that bilinguals might have experienced guilt in the native language, and therefore focused attention on the person they did not sacrifice, while in the foreign language they might have experienced less guilt because they paid attention to the people they sacrificed. More research is needed to follow-up on this study and

understand the influence of factors such as emotion reduction and cognitive load.

Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: osf.io/wdtca.

Ethics statement

This study involving human participants was reviewed and approved by the Independent Ethics Committee of the Radboud University. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individuals for the publication of any potentially identifiable data included in this article.

Author contributions

SB conceptualized and designed the work, performed the analyses, interpreted the data, and wrote the full manuscript.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

SB declared that they were an editorial board member of *Frontiers*, at the time of submission. This had no impact on the peer review process and the final decision.

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References

- Alter, A. L., Oppenheimer, D. M., Epley, N., and Eyre, R. N. (2007). Overcoming intuition: Metacognitive difficulty activates analytic reasoning. *J. Exper. Psychol.* 136, 569–576. doi: 10.1037/0096-3445.136.4.569
- Andrade, G. (2021). Arabic speakers offer more utilitarian responses when thinking about the Trolley dilemma in English. *Curr. Psychol.* 42, 6933–6935. doi: 10.1007/s12144-021-01976-1
- Baguley, T. S. (2012). *Serious Stats: A Guide to Advanced Statistics for the Behavioral Sciences*. New York: Palgrave Macmillan. doi: 10.1007/978-0-230-36355-7
- Bates, D., Mächler, M., Bolker, B., and Walker, S. (2015). Fitting linear mixed-effects models using lme4. *J. Stat. Softw.* 67, 1–48. doi: 10.18637/jss.v067.i01
- Bialek, M., and De Neys, W. (2016). Conflict detection during moral decision making: evidence for deontic reasoners' utilitarian sensitivity. *J. Cogn. Psychol.* 28, 631–639. doi: 10.1080/20445911.2016.1156118
- Brouwer, S. (2019). The auditory foreign-language effect of moral decision making in highly proficient bilinguals. *J. Multil. Multic. Dev.* 40, 865–878. doi: 10.1080/01434632.2019.1585863
- Brouwer, S. (2020). The interplay between emotion and modality in the Foreign-Language effect on moral decision making. *Bilingualism*. 24, 223–230. doi: 10.1017/S136672892000022X
- Cavar, F., and Tytus, A. E. (2018). Moral judgement and foreign language effect: When the foreign language becomes the second language. *J. Multil. Multic. Dev.* 39, 17–28. doi: 10.1080/01434632.2017.1304397
- Chan, Y. L., Gu, X., Ng, J. C. K., and Tse, C. S. (2016). Effects of dilemma type, language, and emotion arousal on utilitarian vs deontological choice to moral dilemmas in Chinese–English bilinguals. *Asian J. Soc. Psychol.* 19, 55–65. doi: 10.1111/ajsp.12123
- Cipolletti, H., McFarlane, S., and Weissglass, C. (2016). The moral foreign-language effect. *Philos. Psychol.* 29, 23–40. doi: 10.1080/09515089.2014.993063
- Circi, R., Gatti, D., Russo, V., and Vecchi, T. (2021). The foreign language effect on decision-making: A meta-analysis. *Psychon. Bull. Rev.* 28, 1131–1141. doi: 10.3758/s13423-020-01871-z
- Colombatto, C., Chen, Y.-C., and Scholl, B. J. (2020). Gaze deflection reveals how gaze cueing is tuned to extract the mind behind the eyes. *Proc. Nat. Acad. Sci.* 117, 19825–19829. doi: 10.1073/pnas.2010841117
- Cooper, R. M. (1974). The control of eye fixation by the meaning of spoken language: A new methodology for the real-time investigation of speech perception, memory, and language processing. *Cogn. Psychol.* 6, 84–107.
- Costa, A., Foucart, A., Hayakawa, S., Aparici, M., Apesteguia, J., Heafner, J., et al. (2014). Your morals depend on language. *PLoS ONE* 9, e94842. doi: 10.1371/journal.pone.0094842
- Dalmaso, M., Edwards, S. G., and Bayliss, A. P. (2006). Re-encountering individuals who previously engaged in joint gaze modulates subsequent gaze cueing. *J. Exper. Psychol.* 42, 271–284. doi: 10.1037/xlm0000159
- Del Maschio, N., Crespi, F., Peressotti, F., Abutalebi, J., and Sulpizio, S. (2022). Decision-making depends on language: A meta-analysis of the Foreign Language Effect. *Bilingualism*. 25, 617–630. doi: 10.1017/S1366728921001012
- Dewaele, J. M. (2004). The emotional force of swearwords and taboo words in the speech of multilinguals. *J. Multiling. Multic. Dev.* 25, 204–222. doi: 10.1080/01434630408666529
- Dylman, A. S., and Champoux-Larsson, M. F. (2020). It's (not) all Greek to me: Boundaries of the foreign language effect. *Cognition* 196, 104148. doi: 10.1016/j.cognition.2019.104148
- Foot, P. (1967). The problem of abortion and the doctrine of double effect. *Oxford Rev.* 5, 5–15.
- Frischen, A., Smilek, D., Eastwood, J. D., and Tipper, S. P. (2007). Inhibition of return in response to gaze cues: The roles of time course and fixation cue. *Visual Cogn.* 15, 881–895. doi: 10.1080/1350628060112493
- Gan, T., Lu, X., Li, W., Gui, D., Tang, H., Mai, X., et al. (2016). Temporal dynamics of the integration of intention and outcome in harmful and helpful moral judgment. *Front. Psychol.* 6, 2022. doi: 10.3389/fpsyg.2015.02022
- Geipel, J., Hadjichristidis, C., and Surian, L. (2015). The foreign language effect on moral judgment: The role of emotions and norms. *PLoS ONE* 10, e0131529. doi: 10.1371/journal.pone.0131529
- Greene, J., and Haidt, J. (2002). How (and where) does moral judgment work? *Trends Cogn. Sci.* 6, 517–523. doi: 10.1016/S1364-6613(02)02011-9
- Greene, J., Morelli, S., Lowenberg, K., Nystrom, L., and Cohen, J. D. (2008). Cognitive load selectively interferes with utilitarian moral judgment. *Cognition* 107, 1144–1154. doi: 10.1016/j.cognition.2007.11.004
- Greene, J. D. (2008). "The secret Joke of Kant's Soul," in *Moral Psychology*, ed. W. Sinnott-Armstrong (Cambridge, Massachusetts; London, England: MIT Press) 35–80.
- Greene, J. D., Cushman, F. A., Stewart, L. E., Lowenberg, K., Nystrom, L. E., and Cohen, J. D. (2009). Pushing moral buttons: The interaction between personal force and intention in moral judgment. *Cognition* 111, 364–371. doi: 10.1016/j.cognition.2009.02.001
- Greene, J. D., Sommerville, R. B., Nystrom, L. E., Darley, J. M., and Cohen, J. D. (2001). An fMRI investigation of emotional engagement in moral judgment. *Science* 293, 2105–2108. doi: 10.1126/science.1062872
- Harris, C. L., Ayçiçeği, A., and Gleason, J. B. (2003). Taboo words and reprimands elicit greater autonomic reactivity in a first language than in a second language. *Appl. Psycholing.* 24, 561–579. doi: 10.1017/S0142716403000286
- Hayakawa, S., Tannenbaum, D., Costa, A., Corey, J. D., and Keysar, B. (2017). Thinking more or feeling less? Explaining the foreign-language effect on moral judgment. *Psychol. Sci.* 28, 1387–1397. doi: 10.1177/0956797617720944
- Hoffman, M. L. (1982). Affect and moral development. *New Direct. Child Adolesc. Dev.* 1982, 83–103. doi: 10.1002/cd.23219821605
- Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *Am. Psychol.* 58, 697–720. doi: 10.1037/0003-066X.58.9.697
- Kastner, R. M. (2010). Moral judgments and visual attention: An eye-tracking investigation. *Chrestomathy: Ann. Rev. Undergrad. Res.* 9, 114–128. Available online at: <https://chrestomathy.cofc.edu/documents/vol9/kastner.pdf>
- Keysar, B., Hayakawa, S. L., and An, S. G. (2012). The foreign-language effect: Thinking in a foreign tongue reduces decision biases. *Psychol. Sci.* 23, 661–668. doi: 10.1177/0956797611432178
- Kirova, A., Tang, Y., and Conway, P. (2023). Are people really less moral in their foreign language? Proficiency and comprehension matter for the moral foreign language effect in Russian speakers. *PLoS ONE* 18, e0287789. doi: 10.1371/journal.pone.0287789
- Koop, G. J. (2013). The assessment of the temporal dynamics of moral decisions. *Judgment Dec. Mak.* 8, 527–539. doi: 10.1017/S1930297500003636
- Kyriakou, A., Foucart, A., and Mavrou, I. (2022). Moral judgements in a foreign language: Expressing emotions and justifying decisions. *Int. J. Biling.* 34, 193. doi: 10.1177/13670069221134193
- Kyriakou, A., and Mavrou, I. (2023). "Eres muy emocional? I don't think so. How does language determine our emotional responses to everyday moral dilemmas?" in *Emotion and Identity in Second Language Learning*, eds. A., Blanco Canales, and S., Martin Leralta (Bern, Switzerland: Peter Lang) 297–321.
- Kyriakou, A., and Mavrou, I. (in press). What language does your heart speak? The influence of foreign language on moral judgments and emotions related to unrealistic and realistic moral dilemmas. *Cogn. Emot.*
- Lemhöfer, K., and Broersma, M. (2012). Introducing LexTALE: a quick and valid Lexical Test for Advanced Learners of English. *Behav. Res. Methods* 44, 325–343. doi: 10.3758/s13428-011-0146-0
- Miozzo, M., Navarrete, E., Ongis, M., Mello, E., Giroto, V., and Peressotti, F. (2020). Foreign language effect in decision-making: How foreign is it? *Cognition* 199, 104245. doi: 10.1016/j.cognition.2020.104245
- Muda, R., Pieńkosz, D., Francis, K. B., and Bialek, M. (2020). The moral foreign language effect is stable across presentation modalities. *Quart. J. Exper. Psychol.* 73, 1930–1938. doi: 10.1177/1747021820935072
- Oppenheimer, D. M. (2008). The secret life of fluency. *Trends Cogn. Sci.* 12, 237–241. doi: 10.1016/j.tics.2008.02.014
- Pavlenko, A. (2012). Affective processing in bilingual speakers: Disembodied cognition? *Int. J. Psychol.* 47, 405–428. doi: 10.1080/00207594.2012.743665
- R Core Team. (2023). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. Available online at: <http://www.R-project.org/>
- Salverda, A. P., Kleinschmidt, D., and Tanenhaus, M. K. (2014). Immediate effects of anticipatory coarticulation in spoken-word recognition. *J. Memory Lang.* 71, 145–163. doi: 10.1016/j.jml.2013.11.002
- Sarlo, M., Lotto, L., Manfrinati, A., Rumiati, R., Gallicchio, G., and Palomba, D. (2012). Temporal dynamics of cognitive-emotional interplay in moral decision-making. *J. Cogn. Neurosci.* 24, 1018–1029. doi: 10.1162/jocn_a_00146
- Segalowitz, N. (2010). *The Cognitive Bases of Second Language Fluency*. Routledge: New York, NY, USA. doi: 10.4324/9780203851357
- Skulmowski, A., Bung, A., Kaspar, K., and Pipa, G. (2014). Forced-choice decision-making in modified trolley dilemma situations: a virtual reality and eye tracking study. *Front. Behav. Neurosci.* 8, 426. doi: 10.3389/fnbeh.2014.00426
- Stankovic, M., Biedermann, B., and Hamamura, T. (2022). Not all bilinguals are the same: A meta-analysis of the moral foreign language effect. *Brain Lang.* 227, 105082. doi: 10.1016/j.bandl.2022.105082

- Tanenhaus, M. K., Spivey-Knowlton, M. J., Eberhard, K. M., and Sedivy, J. C. (1995). Integration of visual and linguistic information in spoken language comprehension. *Science* 268, 1632–1634. doi: 10.1126/science.7777863
- Van Dillen, L. F., Enter, D., Peters, L. P. M., van Dijk, W. W., and Rotteveel, M. (2017). Moral fixations: The role of moral integrity and social anxiety in the selective avoidance of social threat. *Biol. Psychol.* 122, 51–58. doi: 10.1016/j.biopsycho.2016.01.016
- Wickham, H. (2016). *ggplot2: Elegant Graphics for Data Analysis*. New York: Springer-Verlag. doi: 10.1007/978-3-319-24277-4
- Wolff, A., Yao, L., Gomez-Pilar, J., Shoaron, M., Jiang, N., and Northoff, G. (2019). Neural variability quenching during decision-making: neural individuality and its prestimulus complexity. *NeuroImage* 192, 1–14. doi: 10.1016/j.neuroimage.2019.02.070
- Wong, G., and Ng, B. C. (2018). Moral judgement in early bilinguals: language dominance influences responses to moral dilemmas. *Front. Psychol.* 9, 1070. doi: 10.3389/fpsyg.2018.01070
- Yu, H., Duan, Y., and Zhou, X. (2017). Guilt in the eyes: Eye movement and physiological evidence for guilt-induced social avoidance. *J. Exper. Soc. Psychol.* 71, 128–137. doi: 10.1016/j.jesp.2017.03.007
- Yu, H., Hu, J., Hu, L., and Zhou, X. (2014). The voice of conscience: Neural bases of interpersonal guilt and compensation. *Soc. Cogn. Affect. Neurosci.* 9, 1150–1158. doi: 10.1093/scan/nst090