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Abstract

Research reveals that the ego- and time-moving representations, two divergent ways to talk and think about time, are psychologically meaningful: They are, for example, linked to agency. This research has, however, mainly been correlational in nature and only been conducted amongst English speakers, even though cross-linguistic differences are readily observed in research on time representation. The present research addresses these limitations. In the first study, we explore the causal relation amongst English speakers and show that feelings of personal agency lead to the adoption of the ego-moving representation. In the second and third study, we replicate the first study and conduct a correlational study amongst Dutch speakers. We find no proof for a similar relation between agency and time representation amongst Dutch speakers. In discussing the findings, the role language plays in shaping preferences is considered as well as the methodological issues that need to be addressed by future research.

Keywords

time representation, agency, ego-moving, time-moving, cross-linguistic differences

Dwelling on past events and anticipating hypothetical future events are prominent activities of the human mind (Spronken, Holland, Figner, & Dijksterhuis, 2016). When talking about such events to others, people heavily rely on spatial terms to

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get their message across: We say *a meeting was short*, that *a deadline is approaching*, that *we are ahead of our time*, and that *we are leaving bad days behind*, and *looking forward towards a bright future*. Research on understanding the representation of time has shown that this way of talking about time is reflective of the way time is cognitively represented (Boroditsky, 2001; Casasanto & Boroditsky, 2008; Casasanto, Fotakopoulou, & Boroditsky, 2010; Lai & Boroditsky, 2013). As time cannot be experienced directly through the senses, people rely on spatial metaphors to understand and talk about time (Lakoff & Johnson, 1980).

A considerable amount of research has focused on contrasting two spatial metaphors, two specific ways of representing time spatially: the ego- and the time-moving representation (Boroditsky & Ramscar, 2002; Duffy & Feist, 2014; Lakoff & Johnson, 1980; McGlone & Harding, 1998; McGlone & Pfiester, 2009; Richmond, Wilson, & Zinken, 2012). In the ego-moving representation, people see themselves moving through a temporal landscape, approaching future events whilst leaving past events behind. In contrast, in the time-moving representation, future temporal events approach and pass a stationary ego, as they change from events in the future to events in the past. Do these different ways of thinking and talking about time reveal anything about the way people feel and act towards the past and future events they so often think and talk about? The current research addresses this by investigating whether feelings of personal agency, the amount of control one perceives over life events, affects our representation of time. Specifically, we tested whether personal agency leads to the adoption of the ego-moving representation, where the person is the agentic entity moving towards future temporal events, and whether lack of personal agency leads to the adoption of the time-moving representation, where the person is stationary, being approached by future temporal events.

The idea that agency and time representation might be linked in such a way is corroborated by various studies. Indirect support for the link between agency and time representation, for example, comes from the work by McGlone and Pfiester (2009) and Ruscher (2011). Building on research linking agency to positive affect through an approach motivation (Higgins, 1997; Krieglmeyer, Deutsch, de Houwer, & de Raedt, 2010; Margolies & Crawford, 2008), they point out the inherent differences in the way that agency is assigned in ego- and time-moving expressions (McGlone & Pfiester, 2009; Ruscher, 2011). Agency is often inexplicitly communicated through certain linguistic constructions with greater agency assigned to grammatical subjects than to objects (Henley, Miller, & Beazley, 1995; McGlone & Pfiester, 2009; Ruscher, 2011; van Dijk, 1988; see also, Fausey & Boroditsky, 2010, 2011). In ego-moving expressions, the grammatical subject features the person (e.g., *We passed the deadline*) whilst in time-moving expressions the person is usually in the object role with the grammatical subject role featuring the temporal event (e.g., *The deadline passed us*).

McGlone and Pfiester (2009) analysed English corpora and found that when describing positive events, people more often employed ego-moving expressions than time-moving expressions; when describing negative events, people more often employed time-moving expressions than ego-moving expressions. In follow-up

studies, they found similar results when eliciting narratives about either positive or negative events from participants and when asking participants to indicate the affective orientation of someone described in a vignette using either ego- or time-moving expressions (McGlone & Pfiester, 2009). Ruscher's (2011) findings extend this by showing a relation between time representation and affective forecasting: Participants who read a vignette about a grieving mother after being primed with an ego-moving representation, estimated shorter grieving periods and provided agentic comments about a return to daily routines (as opposed to comments about the passive passage of negative affect), compared with participants who received a time-moving prime.

The link between the ego-moving representation and an approach motivation (and by extension thus agency) is further corroborated by findings of Hauser, Carter, and Meier (2009) who showed that anger, which is an approach emotion, is linked to an ego-moving representation. In addition, Duffy and Feist (2014) found that students, compared to professional administrators, were more likely to adopt an ego-moving representation. They explained their findings as being due to the different relation these two populations have with time: Where students are generally in control of structuring their time, administrators are controlled by time, in the sense that their days are more structured by external demands (Duffy & Feist, 2014).

More direct support for the hypothesized relation between agency and time representation is found in a recent study by Richmond et al. (2012). They report that happiness, higher levels of personal agency, and a future orientation were positively related to an ego-moving representation (Richmond et al., 2012). Depression, anxiety, lower levels of agency, a fatalistic and hedonistic time orientation, were, in turn, related to a time-moving representation (Richmond et al., 2012).

In the study most relevant to the current study, Richmond et al. (2012) measured personal agency using the Behavioral Identification Form (Vallacher & Wegner, 1989). The Behavioral Identification Form provides participants with 25 behaviours or actions (e.g., *taking a test*) and asks them to choose between two descriptions that identify the actions at different levels. One description focuses on the motives and meaning of the behaviour (e.g., *showing one's knowledge*) where the other description focuses on the details and methods (e.g., *answering questions*; Vallacher & Wegner, 1985, 1989). According to Vallacher and Wegner (1989; see also Richmond et al., 2012) agentic individuals incorporate the motives and meaning in their actions whereas those with lower levels of personal agency will focus on the details and methods. The results of the study showed that participants who adopted an ego-moving representation, as opposed to a time-moving representation, scored higher on the Behavior Identification Form (Richmond et al., 2012).

In the first study reported in the current research, we build on this correlational research and extend it by manipulating agency amongst participants to test whether feelings of personal agency lead to the adoption of an ego-moving representation as opposed to a time-moving representation. In doing so, we take a first step in investigating the possible causal mechanism underlying this relation.

Another aim of the current study was to extend prior research on agency and time representation by investigating the relation between the two amongst a non-English-speaking sample. Namely, all the above studies providing indirect and direct support for the relation between agency and time representation have exclusively been conducted amongst English-speaking participants. Yet a vast body of research shows that time representation is heavily influenced by linguistic and/or cultural factors (Bender, Beller, & Bennardo, 2010; Boroditsky, Fuhrman, & McCormick, 2011; Dahl, 1995; Fuhrman & Boroditsky, 2010; Lai & Boroditsky, 2013; Moore, 2011; Núñez & Sweetser, 2006; Rothe-Wulf, Beller, & Bender, 2015; see Bender & Beller, 2014, for a discussion). Specifically, in relation to the ego- and time-moving representation, researchers have found that speakers of other languages, like Malagasy, Mandarin, German, and Swedish, have a strong preference for one representation over the other: Malagasy, Mandarin, and German speakers all seem to prefer the time-moving representation while Swedish speakers seem to prefer the ego-moving representation (Bender et al., 2010; Dahl, 1995; Lai & Boroditsky, 2013; Rothe-Wulf et al., 2015). This strong preference for one representation over the other cannot be observed among English speakers: Studies generally report that about half of the English-speaking participants use an ego-moving representation whereas the other half uses a time-moving representation (Lai & Boroditsky, 2013; Richmond et al., 2012; Rothe-Wulf et al., 2015).

If language indeed plays such a vital role in shaping our time representation, the question of whether previous documented relations between time representation and psychological constructs such as agency amongst speakers of English generalize to other languages becomes pertinent. The second and third study reported in this research address this question by investigating the relation between agency and time representation amongst non-English-speaking participants. Study 2 replicates our first experimental study and manipulates agency between participants in a Dutch-speaking sample. Study 3 more closely follows Richmond et al.'s (2012) study design in taking a nonexperimental approach to investigate whether the adoption of either the ego- or time-moving representation is related to increased and decreased feelings of personal agency in speakers of Dutch, respectively.

Although research on time representation amongst Dutch speakers is almost nonexistent, Dutch speakers are well suited to examine the relation between agency and time representation on, as both representations can be employed to talk about temporal events: Like in English, in Dutch one can say that *the deadline is approaching* (*de deadline nadert*) or that *we are approaching the deadline* (*wij naderen de deadline*). Moreover, previous research has indicated that the ambiguous time question, a question used almost exclusively by researchers to gauge the ego-moving and time-moving representation, is ambiguous to speakers of Dutch (Elvevåg, Helsen, De Hert, Sweers, & Storms, 2011). This allows us to test the relation between agency and the ego- and time-moving representation amongst a different population using the same measures as used in prior studies with English-speaking participants.

Study 1

Study 1 manipulates feelings of personal agency between English-speaking participants to test the causal relation between agency and time representation. This study thus extends previous studies using a correlational approach, which, for example, used the Behavior Identification Form as proxy measures for agency (McGlone & Pfiester, 2009; Richmond et al., 2012). We follow previous studies in using time representation questions to gauge the ego- and time-moving representation (Lai & Boroditsky, 2013; Margolies & Crawford, 2008; McGlone & Harding, 1998; Richmond et al., 2012) and hypothesize that feelings of personal agency, compared to lack of personal agency, lead to the adoption of an ego-moving representation when answering these questions.

Method

Participants and Design. A total of 164 participants (74 males; 90 females) with an average age of 36.32 years (SD_{age} = 11.73), recruited via Amazon's Mechanical Turk, took part in the study. We only accepted "Turkers" who were located in the United States and with an 85% or higher approval rate to ensure high-quality participants in our sample. Most participants (75.6%) identified as having European American heritage. We only included the 159 participants (97%) who indicated English as their mother tongue for the analyses. One participant was removed from the analyses because he or she provided nonsensical answers, leaving us with a sample of 158 participants. On average, participants took about 20 minutes to complete the entire study and were given monetary compensation in exchange for their participation. They were randomly assigned to either the *high personal agency* or *low personal agency* condition.

Materials and Procedure. An explanation of the procedure was given before participants were asked to indicate their willingness to participate. To manipulate agency between participants we used Fisher and Johnston's (1996) autobiographical recall task. Participants in the *high personal agency* condition were asked to recall and describe three situations in which they were in control; participants in the *low personal agency* condition were asked to recall and describe three situations in which they had not been in control. This recall task was effectively used by Fisher and Johnston (1996) to manipulate perceived control and also by Ottley, Crouser, Ziemkiewicz, and Chang (2015) in their online study using participants recruited via Amazon's Mechanical Turk.

Directly after the agency manipulation we gauged time representation using two measures. The first measure consisted of two ambiguous time questions: *Next week Wednesday's meeting has been moved forward 2 days. What day is the meeting now that it has been rescheduled?* and *Tomorrow's 12:00 p.m. (noon) meeting has been moved forward 2 hours. What time is the meeting now that it has been rescheduled?* (Lai & Boroditsky, 2013; Margolies & Crawford, 2008; McGlone & Harding, 1998;

Richmond et al., 2012). If participants rely on an ego-moving time representation, see themselves as moving forward, moving a meeting forward would denote moving it to a later point in time, in the direction of the movement, thus from Wednesday to Friday or from 12:00 pm to 02:00 pm If, however, participants take a time-moving time representation, see temporal events as approaching them and sweeping past them, moving a meeting forward would denote moving to an earlier point in time, in the direction of the movement, thus, from Wednesday to Monday or from 12:00 pm to 10:00 am We randomized the order of the two ambiguous time questions.

The second measure consisted of a question that asked participants to choose between an ego-moving statement (*I am approaching the meeting)* and a time-moving statement (*The meeting is approaching me*; Hauser et al., 2009; Margolies & Crawford, 2008; Richmond et al., 2012). Participants were asked to pick the statement that best expressed how they felt. The order in which the two statements were presented was randomized across participants.

After the time representation measure, participants filled in questions unrelated to the purpose of this study. They filled in demographic information before being debriefed and thanked for their participation.[1]

Results

We first looked at the descriptions participants provided in response to Fisher and Johnston's (1996) autobiographical recall task. Within the *high personal agency* condition, participants typically provided a description of achieving a personal or professional goal through deliberate action on their part or of a period in their lives during which they had felt they were in control of the future. For example, in the *high personal agency* condition, one participant described achieving the weight loss that he or she desired: *When I lost 15 pounds using weight watchers. It is something that I really wanted to do and I achieved that goal.* Another participant described the period during which he or she was a quarterback:

> I felt in control when I was younger playing quarterback for my football team. I called the plays, I always had the ball, and I was the decision maker. Of course, all of the blame could be placed on me as well so it was a give and take situation. I liked his position and I cannot say any bad things about being a quarterback of a football team. I felt that I had a lot of control in these situations and I was proud of myself. When I did wrong I needed to own up to my misjudgments. When I did well people [praised] me.

In the *low personal agency* condition, participants typically provided a description of a situation in which some event outside of their control had happened and affected them in some way or a situation in which the outcome of something was outside of their control. For example, in the *low personal agency* condition, one participant described a situation in which their car broke down:

Table 1. Number of Ego- and Time-Moving Responses to the Ambiguous Time Questions in the High and Low Personal Agency Conditions.

	Ambiguous time questions	
Condition	Ego-moving	Time-moving
High personal agency	54	24
Low personal agency	35	34

> My car [would not] start and I had no idea how to get it started. I didn't think it was the battery because the battery hadn't been giving me trouble in the past. The car had plenty of gas in it as it had a full tank. I called my insurance agent to see if [they] could send someone out to fix the car but they could only send a tow truck. I called multiple friends and no one had a clue on why the car wouldn't start. A friend eventually came over and used jumper cables on it and it started it up just fine.

We then looked at the responses that participants gave to the time representation questions. With regard to the ambiguous time questions, 10 participants provided inconsistent answers (an ego-moving answer to one ambiguous time question and a time-moving answer to the other ambiguous time question) or incorrect answers (e.g., *Saturday*). As it was not clear which representation these 10 participants used, they were excluded from further analyses. One participant specifically commented on the ambiguous nature of the time questions and was also excluded from the analyses. Of the remaining 147 participants, the majority of participants (60.5%) provided an ego-moving consistent answer (*Friday* and *02:00 pm*) in response to both ambiguous time questions, whilst a minority (39.5%) provided a time-moving consistent answer (*Monday* and *10:00 am*). With regard to Margolies and Crawford's (2008) statement question, the majority of participants (62.6%) chose the ego-moving statement (*I am approaching the meeting*) whilst a minority (37.4%) chose the time-moving statement (*The meeting is approaching*). A chi-square analysis indicated that answers to the ambiguous time questions and Margolies and Crawford's (2008) statement question were not significantly related, $\chi^2(1, N = 147) = 1.324$, $p = .296$ (please note that for all analyses in this article, the chi-square value reported is the exact value and the associated p value reported is two-sided).

We examined the effect of agency on the two ambiguous time questions using a chi-square analysis. In line with our expectations, this chi-square analysis revealed that participants in the *high personal agency* condition, compared to participants in the *low personal agency* condition, were significantly more likely to provide an ego-moving consistent answer than a time-moving consistent answer, $\chi^2(1, N = 147) = 5.249$, $p = .028$ (see Table 1).

We then analysed the responses participants gave to Margolies and Crawford's (2008) statement question. A chi-square analysis revealed a nonsignificant effect of agency on the statement chosen: Participants in the *high personal agency* condition, compared to participants in the *low personal agency* condition, were not

Table 2. Number of Participants Who Chose the Ego- and Time-Moving Statements in the High and Low Personal Agency Conditions.

	Margolies and Crawford's statement question	
Condition	Ego-moving	Time-moving
High personal agency	51	27
Low personal agency	41	28

significantly more likely to choose the ego-moving statement (*I am approaching the meeting*) over the time-moving statement (*The meeting is approaching*), $\chi^2(1, N = 147) = 0.556, p = .497$ (see Table 2).

Following Dienes's (2014) recommendations, we performed Bayesian analyses in order to report Bayes factors. We tested the effect of agency on the ambiguous time question and Margolies and Crawford's (2008) statement question using the statistical software JASP. Bayesian contingency tables tests showed that in regard to the ambiguous time question, the BF_{10} was 2.69, indicating that the data we observed were 2.69 more likely under the alternative hypothesis than the null hypothesis; with regard to Margolies and Crawford's (2008) statement question, the BF_{01} was 3.62, indicating that the data we observed were 3.62 more likely under the null hypothesis than the alternative hypothesis.

Discussion

In Study 1, feelings of personal agency led to the adoption of an ego-moving representation as opposed to a time-moving representation, as measured by the ambiguous time question. Even though our Bayesian analyses indicate our data only provide "anecdotal" evidence in favor for an effect of agency on the ambiguous time questions (Jeffreys, 1961; Lee & Wagenmakers, 2014), it does corroborate previous correlational findings (McGlone & Pfiester, 2009; Richmond et al., 2012).

Interestingly, proof for such a relation was not found when measuring time representation with Margolies and Crawford's (2008) statement question. Richmond et al. (2012) did find that answers to Margolies and Crawford's (2008) statement question were related to agency, as measured by the Behavior Identification Form. A possible explanation for the discrepancy between the two measures and the way they relate to agency might be found when looking at Margolies and Crawford's (2008) own research and the research by Hauser et al. (2009). They found that their independent variables, event valence and anger, also affected the ambiguous time questions and the statement question differently (Hauser et al., 2009; Margolies & Crawford, 2008). In discussing their findings, both suggest that it might be due to the fact that having an enthusiasm- or anger-invoking event might counteract the tendency to move it towards a later point in time, as both are approach-related emotions. As alternative explanation, Margolies and Crawford (2008) also propose that the statement question might be conceptually distinct from the ambiguous time questions and instead might

tap into "one's conceptualization of an event in space, regardless of time" (Margolies & Crawford, 2008, p. 1405). As we used the original formulation of the ambiguous time questions and relied on a neutral event instead of a "valenced" event as was done by Hauser et al. (2009) and Margolies and Crawford (2008), our results—the fact that the two measures did not correlate significantly—support this later interpretation.

This is also, to some extent, supported by results of Richmond et al. (2012) who found that the relation between the two questions was just above significance level and found discrepancies between the two measures and how they were related to other constructs and effected by their emotion-inducing conditions. Moreover, the ambiguous time questions and Margolies and Crawford's (2008) statement question place very different demands on the participants: Where the ambiguous time questions asks them to provide an intuitive answer about an event being rescheduled to a certain day, Margolies and Crawford's (2008) statement question forces participants to make a very conscious decision between the ego- and time-moving representation. As participants are usually unaware of these two time representations, they might not feel strongly about either one. Future research should carefully consider this and determine the extent to which these two measures tap into the same construct and, in case they do tap into something slightly different, investigate the extent to which the construct gauged by Margolies and Crawford's (2008) statement question is related to agency (and other constructs).

Study 2

As language has been found to affect time representation (Bender et al., 2010; Dahl, 1995; Lai & Boroditsky, 2013; Rothe-Wulf et al., 2015), we wanted to see whether the relation found in Study 1 could also be observed amongst speakers of a different language. Ergo, we replicated Study 1 amongst Dutch participants. It should be pointed out here that we recruited participants from the Netherlands; the Dutch spoken by our participants is thus Netherlandic Dutch, which is different from, for example, the Dutch spoken in Belgium (Colleman, 2010; van Halteren & Oostdijk, 2018; Vandekerckhove, 2005; Yselinck & Colleman, 2016). Even though we have no evidence to suggest that time representation amongst Netherlandic Dutch participants is different from time representation amongst other Dutch-speaking participants (e.g., Belgian Dutch participants) the results and conclusions reported here are limited to Netherlandic Dutch (although see Loermans and Milfont, 2018, for time representation amongst English speakers from New Zealand that suggests that the distribution in responses might be somewhat different from the distribution typically observed amongst English speakers in the United States or the United Kingdom).

As mentioned before, a Dutch-speaking sample was used because previous research suggests that both the ego-moving and time-moving representation are used by Dutch speakers and that the ambiguous time question is in fact ambiguous to them as indicated by an occurrence of both ego-moving and time-moving responses (Elvevåg et al., 2011). Nonetheless, two pilot studies were conducted to further explore time representation and their measurement in Dutch participants. In a first pilot study, we

investigated the effect of spatial priming on time representation questions.[2] In the second pilot study, we investigated the effect of the language in which the time representation questions were formulated (Dutch vs. English) on the answers to the time representation questions.[3]

Method

Participants and Design. A total of 172 university students (48 males; 74 females) with an average age of 20.57 years (SD_{age} = 4.89) participated in this study, which was conducted in the behavioural lab of the *Vrije Universiteit Amsterdam*. The majority of participants (82.8%) identified as having Dutch heritage. Only the 99 participants (81.1%) who indicated Dutch as their (sole) mother tongue were retained for analyses. An additional two participants were excluded from the analyses, as they did not complete the autobiographical recall task used to induce either high or low personal agency. Participants, on average, took about 20 minutes to complete the entire study and were awarded partial course credits or monetary compensation in exchange for their participation. They were randomly assigned to either the *high personal agency* or *low personal agency* condition.

Materials and Procedure. The materials and procedure were identical to the materials and procedure of Study 1 with two exceptions: (a) all materials were translated to Dutch and (b) participants completed the study in the lab as opposed to completing it online. The Dutch formulation of the time representations questions can be found in the appendix.

Results

We then looked at the responses that participants gave to the time representation questions. In regard to the ambiguous time questions, six participants (6.2%) provided inconsistent answers (an ego-moving answer to one ambiguous time question and a time-moving answer to the other ambiguous time question) or incorrect answers (e.g., *Saturday*). As it is not clear which representation these six participants used, they were excluded from further analyses. One participant (1%) specifically commented on the ambiguous nature of the time questions and was also excluded from the analyses. A minority of participants (13.4%) provided an ego-moving consistent answer (*Friday* or *02:00 pm*) in response to both ambiguous time questions, whilst a majority (79.4%) provided a time-moving consistent answer (*Monday* or *10:00 am*). With regard to Margolies and Crawford's (2008) statement question, a slight minority (43.3%) chose the ego-moving statement (*I am approaching the meeting*), whilst a slight majority (56.7%) chose the time-moving statement (*The meeting is approaching*). A chi-square analysis revealed that answers to the ambiguous time questions and Margolies and Crawford's (2008) statement question were not significantly related, $\chi^2(1, N = 90) = 0.147$, $p = .770$.

Table 3. Number of Ego- and Time-Moving Responses to the Ambiguous Time Questions in the High and Low Personal Agency Conditions.

	Ambiguous time questions	
Condition	Ego-moving	Time-moving
High personal agency	4	46
Low personal agency	9	31

Table 4. Number of Participants Who Chose the Ego- and Time-Moving Statements in the High and Low Personal Agency Conditions.

	Margolies and Crawford's statement question	
Condition	Ego-moving	Time-moving
High personal agency	23	27
Low personal agency	16	24

We examined the effect of agency on the two ambiguous time questions using a chi-square analysis. This chi-square analysis revealed that participants in the *high personal agency* condition, compared to participants in the *low personal agency* condition, were more likely to provide a time-moving consistent answer than an ego-moving consistent answer, although this effect was just above conventional significance level, $\chi^2(1, N = 90) = 3.781$, $p = .071$ (see Table 3).

We then analysed the responses to Margolies and Crawford's (2008) statement question. A chi-square analysis revealed a nonsignificant effect of agency on the statement chosen: Participants in the *high personal agency* condition, compared to participants in the *low personal agency* condition, were not significantly more likely to choose the ego-moving statement (*I am approaching the meeting*) over the time-moving statement (*The meeting is approaching*), $\chi^2(1, N = 90) = 0.326$, $p = .670$ (see Table 4).

Again, we ran Bayesian analyses in order to report Bayes factors using the statistical software JASP. Bayesian contingency tables tests showed that in regard to the ambiguous time questions, the BF_{10} was 1.14, indicating that the data we observed were 1.14 more likely under the alternative hypothesis than the null hypothesis; in regard to Margolies and Crawford's (2008) statement question, the BF_{01} was 10.45, indicating that the data were 10.45 more likely under the null hypothesis than the alternative hypothesis.

Discussion

Study 2 showed that amongst Dutch participants, feelings of personal agency do not lead to the adoption of an ego-moving representation as opposed to a time-moving

representation when time representation is gauged by the ambiguous time question. Rather, the results showed a nonsignificant effect in the opposite direction suggesting that for Dutch participants, feelings of personal agency, may even lead to the adoption of a time-moving representation. The Bayes factor indicates, however, that we should be careful in favoring the interpretation that feelings of personal agency lead to the adoption of a time-moving representation amongst Dutch participants, seeing how our data are almost as likely under the null than the alternative hypothesis. In addition, we found no proof for a relation between agency and time representation when measuring time representation using Margolies and Crawford's (2008) statement question. Like in Study 1, we did not find that the two measures were significantly related in a Dutch sample either, again suggesting that these measures might tap into somewhat different constructs (Margolies & Crawford, 2008).

Our findings regarding the ambiguous time question stand in contrast to our own findings from Study 1 and previous correlational findings on the relation between agency and time representation (McGlone & Pfiester, 2009; Richmond et al., 2012). They thereby seem to suggest that the relation between agency and time representation might be linguistically or culturally idiosyncratic. When considering the possible reasons for this idiosyncrasy it is of interest to note that, when looking at the distribution of answers in response to the time questions, our data suggest a preference for the time-moving representation amongst (Netherlandic) Dutch-speaking participants. This preference is particularly pronounced when only taking into consideration the answers in response to the ambiguous time questions. Is it perhaps possible that the preference for one representation over the other within a speech community affects the way it relates to constructs like agency?

Based on the findings of the previous two studies this question cannot be answered. Although our finding regarding the (Netherlandic) Dutch preference for the time-moving representation obviously diverges from the findings of Elvevåg et al. (2011)—who observed a more equal distribution of ego-moving and time-moving answers in response to the ambiguous time question when using *verplaatst* as a translation of *moving*—their study involved a small, partially clinical, sample of (Belgian) Dutch-speaking participants. Moreover, in Study 2 and in Elvevåg et al.'s (2011) study a manipulation of some sort preceded the ambiguous time questions. In our study we manipulated agency before asking about time representation whereas Elvevåg et al. (2011) replicated McGlone and Harding's (1998) second study and presented participants with ambiguous time questions after being primed with either the ego-moving or time-moving representation through the presentation of unambiguous sentences. This makes it more difficult to make definitive claims about the Dutch preference for either one of the time representations at this point as gauged by the ambiguous time questions. We therefore decided to follow up with another study, amongst Dutch participants, wherein we simply measured agency and time representation, enabling us to examine the occurrence of time representation amongst Dutch participants as well as its relation to agency.

Study 3

In Study 3, we examined the relation between agency and time representation by more closely following Richmond et al.'s (2012) research design and taking advantage of the fact that individuals differ in terms of the degree that they think they control their own lives. Using a nonexperimental design does not only make our study more comparable to previous studies examining the relation between agency and time representation, it also provides a more unbiased indication of which time representation (Netherlandic) Dutch participants adopt when being asked an ambiguous time question.

Method

Participants. A total of 213 university students (95 males; 118 females) with an average age of 20.30 years (SD_{age} = 3.45) participated in this study conducted in the behavioural lab of the *Vrije Universiteit Amsterdam*. The majority of participants (77.8%) identified as having Dutch heritage only. Because of a technical error, participants' mother tongue was not recorded, we therefore decided to look to heritage as a proxy for mother tongue and only retain participants who identified as having Dutch heritage only (N = 164). Participants, on average, took about 21 minutes to complete the study and were awarded partial course credits or monetary compensation in exchange for their participation.

Materials and Procedure. On arrival in the lab, participants were given an explanation about the study before being asked to sign the informed consent form. Participants completed the entire study in a private cubicle on the computer. Our measures were included as part of a larger test battery.

To gauge agency, participants completed the Levenson's Locus of Control questionnaire (Levenson, 1972, 1973; Presson, Clark, & Benassi, 2001). This questionnaire taps into individual differences regarding the amount of control one perceives over one's own life, is widely used in research, and has been validated across several studies (Abdallah, 1989; Brosschot, Gebhardt, & Godaert, 1994; Kennedy, Lynch, & Schwab, 1998; Kourmousi, Xythali, & Koutras, 2015; Roddenberry & Kenk, 2007). The questionnaire consists of 24 items belonging to three subscales: *internal* (e.g., "I can pretty much determine what will happen in my life"), *powerful others* (e.g., "I feel like what happens in my life is mostly determined by other people"), and *chance* (e.g., "To a great extent my life is controlled by accidental happenings"). Items are rated on a 6-point Likert-type scale (1 = *completely disagree* and 6 = *completely agree*). We used the Dutch version translated and validated by Brosschot, Gebhardt, and Godaert (1994). Subscale scores were computed by averaging over items.

To gauge time representation, we used one of the ambiguous time questions also used in Studies 1 and 2: *Next week's Wednesday meeting was moved forward by two days. On which day is the meeting now?*

Table 5. *t*-Test Analyses of the Ambiguous Time Question and Levenson's Locus of Control Questionnaire.

	Ambiguous time question						
	Ego-moving		Time-moving				
Dimension	*M*	*SD*	*M*	*SD*	*t*	*p*	BF_{01}
Internal	4.53	.54	4.43	.48	−1.13[a]	.259	2.86
Powerful others	2.84	.68	2.91	.59	.574[a]	.567	4.40
Chance	2.94	.59	3.06	.61	1.07[a]	.286	3.05

Note. [a]Degrees of freedom (*df*) = 158.

Participants filled in demographic information before being debriefed and thanked for their participation.

Results

We first looked at the responses that participants gave to the ambiguous time question. A minority of participants (23.8%) provided an ego-moving consistent answer (*Friday*) in response to the ambiguous time question, whilst a majority (73.8%) provided a time-moving consistent answer (*Monday*). Four participants (2.4%) provided incorrect answers (e.g., *Saturday*) and were excluded from further analyses.

Following Richmond et al. (2012), we conducted a series of *t* tests to examine whether participant's answers to the ambiguous time question were related to agency as gauged by the Levenson's Locus of Control questionnaire. As can be observed in Table 5, participants with an ego-moving representation did not score significantly higher on the *internal* locus of control dimension, and not significantly lower on the *powerful others* and *chance* dimensions.

We ran the same *t* tests using the statistical software JASP in order to report Bayes factors. As can be observed in Table 5, all BF_{01} values indicate that the data we observed were more likely under the null hypothesis than the alternative hypothesis, although it should be noted that in regard to the *internal* locus of control dimension, the BF_{01} does not reach the threshold of 3 and our data thus only provide "anecdotal" evidence in support of the null hypothesis (Jeffreys, 1961; Lee & Wagenmakers, 2014).

In light of the increasing emphasis placed on replication efforts (Pashler & Harris, 2012; Pashler & Wagenmakers, 2012) and to add to the validity of our findings, we conducted a replication of this study with a few minor modifications. The results confirm the results obtained in Studies 2 and 3 in suggesting that amongst Dutch participants a high level of personal agency does not lead to the adoption of an ego-moving representation.[4]

Discussion

In Study 3, we found no proof that feelings of personal agency are related to the ego-moving representation amongst Dutch participants. This is in line with our findings from Study 2 but diverges from Richmond et al.'s (2012) findings obtained amongst English-speaking participants. In addition, the distribution of responses to the ambiguous time question in Study 3 mirrors the distribution of responses to the ambiguous time question in Study 2, and clearly suggests a (Netherlandic) Dutch preference for the time-moving representation. Such a clear preference for one representation over the other in non-English-speaking participants parallels other research (Bender et al., 2010; Dahl, 1995; Lai & Boroditsky, 2013; Rothe-Wulf et al., 2015). Of particular interest in this regard is the study by Rothe-Wulf et al. (2015) which compared speakers of Swedish, German, and English, all languages closely related to Dutch. They report a Swedish preference for the ego-moving representation and a German preference for the time-moving representation, as measured by the ambiguous time questions (Rothe-Wulf et al., 2015). English speakers, like in other studies, were not found to have a clear preference for either the ego- or time-moving representation (Rothe-Wulf et al., 2015). Given that Rothe-Wulf et al. (2015) convincingly argued that the verbs used are all equally "underspecified" (p. 935), it is highly unlikely that differences between English and other languages emerge out of the different meanings of the verb being used.[3] Rather it reveals the implicitly agreed-upon time representation adopted by the speakers of the language (Rothe-Wulf et al., 2015).

Similarly, our Dutch translation of the ambiguous time question does not render the question unambiguous, that is, direction is not specified in the *naar voren verplaatst* formulation. This is also supported by the fact a small proportion of participants did choose the ego-moving interpretation. The fact that opposite preferences are found in closely related languages such as Swedish and German (and Dutch) highlights that convention amongst speakers of the speech community in using a certain time representation is arbitrary—in the sense that it is not passed along jointly from the common ancestral language to these daughter languages (Rothe-Wulf et al., 2015)—but nevertheless a powerful driver in shaping time representation. Our findings extend this, as they suggest that convention amongst speakers may affect the way time representations are related to constructs such as agency, with relations between time representation and agency perhaps only being possible if convention provides the possibility of adopting either the ego-moving or time-moving representation. The data from our first pilot study also support this assertion as the data indicate that spatial primes do not affect responses to the ambiguous time questions as robustly as has been previously reported for English participants.[2]

General Discussion

The present research investigated the relation between agency and time representation amongst English and Dutch speakers. Specifically, in both groups of speakers we tested whether feelings of personal agency lead to the adoption of an

ego-moving representation, as opposed to a time-moving representation. Additionally, we investigated whether Dutch participants naturally adopting an ego-moving representation, as opposed to a time-moving representation, reported higher personal agency. Our results paint a heterogeneous picture: Where inducing feelings of personal agency does lead to the adoption of an ego-moving representation in English participants (Study 1), almost the opposite pattern was observed amongst speakers of Dutch (Study 2). Moreover, no proof for a correlational relation between the ego-moving representation and high personal agency could be found in speakers of Dutch (Study 3). Our findings contribute to the literature in two ways.

First, our research moves beyond previous correlational research on agency and time representation (McGlone & Pfiester, 2009; Richmond et al., 2012) by using an experimental design in which we manipulated agency between participants. Our findings from this experimental work provide a first insight into how agency and time representation might be causally related. Future research can build on this, for example, by investigating whether the reverse relation—so whether the adoption of an ego-moving/time-moving also increases/decreases feelings of personal agency—also holds. This is plausible considering that reciprocal relations have also been found between other psychological constructs such as anger and time representation (Hauser et al., 2009). Such a causal link between agency and time representation might be of interest to either advertisers or clinicians who may want to affect feelings of personal agency in people.

Second, by investigating the relation between agency and time representation in a Dutch population, by manipulating agency and measuring it directly, we accentuate the possible role language plays in shaping cognition, a contested notion investigated extensively (especially in research on time representation) by linguists and psychologists alike (Au, 1983; Boroditsky, 2001; Boroditsky et al., 2011; Casasanto, 2008; Fausey & Boroditsky, 2010, 2011; Fausey, Long, Inamori, & Boroditsky, 2010; Guiora, Beit-Hallahmi, Fried, & Yoder, 1982; January & Kako, 2007; Lai & Boroditsky, 2013; Majid, Bowerman, Kita, Haun, & Levinson, 2004). More specifically, the findings of Studies 2 and 3 seem to suggest that amongst Dutch speakers there is no relation between the ego-moving representation and personal agency, and conversely between the time-moving representation and lack of personal agency. The marginally significant finding in Study 2 even suggests a relation in the opposite direction.

This is consequential considering that the relation between agency and time representation in English speakers has been conjectured on inherent differences between the ego-moving and time-moving representation that hold true for Dutch speakers as well. Namely, in the ego-moving representations the ego is the moving, agentic entity, typically taking the subject role in linguistic constructions (e.g., *We approach the deadline/Wij naderen de deadline*), which gets assigned greater agency in both Dutch and English (Henley et al., 1995; McGlone & Pfiester, 2009; Ruscher, 2011; van Dijk, 1988; see also, Fausey & Boroditsky, 2010, 2011). Conversely, in the time-moving representation, the ego is the stationary nonagentic entity, typically being omitted or taking the object role in linguistic constructions (e.g., *The deadline is approaching [us]/De deadline nadert [ons]*).

Evidently, cultural and/or linguistic differences do not only directly influence the use of the ego-moving and time-moving representation to think and talk about time, as was shown in previous research (Bender et al., 2010; Dahl, 1995; Lai & Boroditsky, 2013; Rothe-Wulf et al., 2015) but affect the way these time representations are related to agency as well. Future research will need to determine whether this also extends to other psychological constructs implicated in time representation, such as valence, our emotional experience, and duration estimations (Boltz & Yum, 2010; Glicksohn & Ron-Avni, 1997; Hauser et al., 2009; McGlone & Pfiester, 2009; Richmond et al., 2012; Ruscher, 2011).

It should be noted that our study is not the first to implicate cultural and/or linguistic differences as (possible) explanation for our findings regarding time representation and some other variable. For example, Loermans and Milfont (2018) found that a previously reported relation between the ego-moving representation and a future temporal orientation (Richmond et al., 2012) could not be replicated amongst participants from New Zealand. Moreover, de la Fuente, Santiago, Roman, Dumitrache, and Casasanto (2014) showed that a culture's temporal orientation affects whether its constituents place the future to the front or to the back of ego. In their research, they followed up their cross-cultural comparison with an actual manipulation of temporal orientation allowing them to convincingly pinpoint differences related to temporal orientation as the cultural difference driving the time representation (de la Fuente et al., 2014). Similarly, a large body of research has implicated writing direction as the factor that determines whether time is construed as flowing from left-to-right or from right-to-left (Bergen & Chen Lau, 2012; Casasanto & Bottini, 2014; Fuhrman & Boroditsky, 2010; Tversky, Kugelmass, & Winter, 1991).

With the current data, we are not able to say anything conclusive about what linguistic and/or cultural differences might drive our observed differences in the way that agency and time representation are related in English and Dutch participants. Nevertheless, our data do suggest that (Netherlandic) Dutch participants might prefer a time-moving representation, whilst English participants have no strong preference for either. This makes convention/preference regarding the ego- or time-moving representation within a speech community a possible promising candidate for future research to investigate.

Regarding the observed frequencies of ego- and time-moving representations amongst Dutch participants, it should be noted that we found inconsistent results across the ambiguous time questions and Margolies and Crawford's (2008) statement question in Study 2. Whilst the ambiguous time question seemed to suggest a strong preference for the time-moving representation over the ego-moving representation, Margolies and Crawford's (2008) statement question seemed to suggest no such strong preference. Moreover, in both Studies 1 and 2 the two measures did not correlate. Although the absence of a correlation between the two measures amongst English participants goes against earlier findings by Richmond et al. (2012) who found a marginally significant relation between the Wednesday ambiguous time question and Margolies and Crawford's (2008) statement question, it favors Margolies and Crawford's (2008) interpretation that their statement question does not exactly gauge

the ego- and time-moving representation like the ambiguous questions do (but rather measures something slightly different).

In any case, research looking towards cultural and/or linguistic differences regarding use of the ego-moving and time-moving representation, as possible driver behind other effects, would benefit from combining the commonly employed ambiguous time questions with additional measures. Employing additional measures, like linguistic analyses of corpora, will provide more conclusive answers on the different conventions in adopting one or the other representation across different speech communities (see McGlone & Pfiester, 2009, for an example and Lai & Boroditsky, 2013, regarding preferences for the ego-moving and time-moving representation in Mandarin). Future research will hopefully also shed light on how these (unconscious) preferences for either the ego- or time-moving representation developed so differently in opposing directions in such closely related languages (see, Rothe-Wulf et al., 2015, for a comparison of English, Swedish, and German).

In conclusion, our study sheds light on the causal role agency plays in determining whether English speakers construe time using the ego-moving or time-moving representation. It also brings to the fore questions regarding the generalizability of this relation, as proof for this relation was not found amongst Dutch participants. In discussing these results, the role convention might play in favoring certain time representations over others, thereby not allowing them to be differentially linked to other constructs such as agency in ways that reveal the inherent differences between the ego- and time-moving representations, is considered. In doing so, we hope this research serves as a valuable impetus for future research examining cross-linguistic variation in time representation and broader issues regarding the interplay between language, cognition, emotions, and behaviour.

Appendix

Dutch Formulations of the Time Representation Questions

The time representation questions were translated to Dutch by the authors and are given below. We used *naar voren verplaatst* as a translation for *moved forward* in the ambiguous time questions (Questions 1 and 2) instead of, for example, *vervroegd* or *teruggeschoven*, not only because it is the most direct translation but also because Elvevåg, Helsen, De Hert, Sweers, and Storms (2011) found that this formulation "made" the question ambiguous in Dutch, as evidenced by both ego- and time-moving answers in response to the ambiguous time question using this formulation:

1. *De vergadering van morgen 12 uur is twee uur naar voren verplaatst. Hoe laat begint de vergadering nu?*

(Tomorrow's 12 'o clock meeting has been moved forward by two hours. What time will the meeting start now that it has been rescheduled?)

2. *De vergadering van volgende week woensdag is twee dagen naar voren verplaatst. Op welke dag vindt de vergadering nu plaats?*

(Next week Wednesday's meeting was moved forward by two days. What day is the meeting now that it has been rescheduled?)

3. *Welke uitdrukking beschrijft het beste hoe je je voelt?*
(a) Ik nader de vergadering.
(b) De vergadering nadert mij.

(Which statement best expresses how you feel? a) I approach the meeting. b) The meeting is approaching me.)

Authors' note

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Notes

1. Data associated with this article can be accessed at https://osf.io/u4w9t/
2. The first pilot study replicated the first study by Boroditsky and Ramscar (2002) amongst Dutch-speaking participants. Participants answered a time representation question after receiving either an ego-moving spatial prime or a time-moving spatial prime. A significant effect of the spatial prime in the expected direction was observed on two of the time representation questions. On request, the authors can provide the full details and more information on the results of this pilot study.
3. In the second pilot study, Dutch-native speakers answered one of the three time representation questions also used in Studies 1 and 2 in either Dutch or English (see Lai & Boroditsky, 2013, for a similar study using Mandarin–English bilinguals). A significant

effect of language was observed across the three questions. When asked in English, participants were more likely to provide an ego-moving consistent answer than when asked in Dutch. On request, the authors can provide the full details and more information on the results of this pilot study.

4. On request, the authors can provide the full details of the replication study.

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