

## The top trumps of time

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## **The top trumps of time: Factors motivating the resolution of temporal ambiguity\***

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### *Abstract*

*What factors motivate our understanding of metaphoric statements about time? English exhibits two deictic space-time metaphors: the Moving Ego metaphor conceptualises the ego as moving forward through time, while the Moving Time metaphor conceptualises time as moving forward towards the ego (Clark, 1973). In addition to earlier research investigating spatial influences on temporal reasoning (e.g., Boroditsky & Ramscar, 2002), recent lines of research have provided evidence that a complex of factors, such as personality differences, event valence, lifestyle, and emotional experiences, may also influence people's perspectives on the movement of events in time—providing new insights on metaphor and its ability to reflect thought and feeling (e.g., Duffy & Feist, 2014; Duffy, Feist & McCarthy, 2014; Margolies & Crawford, 2008; Richmond, Wilson & Zinken, 2012). Probing these findings further, two studies were conducted to investigate whether the interpretation of a temporally ambiguous question may arise from an interaction between the valence of the event and aspects of the personality (Experiment 1) and lifestyle (Experiment 2) of the comprehender. The findings we report on shed further light on the complex nature of temporal reasoning. While this involves conceptual metaphor, it also invokes more complex temporal frames of reference (t-FoRs) (Evans, 2013), which are only partially subserved by space-to-time conceptual metaphors.*

### *Keywords*

*Moving Time, Moving Ego, Metaphor, Ambiguity, Individual differences, Personality, Lifestyle, Valence, t-FoRs*

## **1. Introduction**

Across languages, there is a widespread tendency for time to be lexicalised in terms of space: moments can be conceptualised as points (*at* midnight; *on* Saturday); durations can be conveyed in terms of distances (a *long* wait; a *short* journey); and events can be moved (the wedding was *brought forward*; the interview was *pushed back*). The relationship between these two conceptual domains is not haphazard; rather, temporal relations are predicated on a

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subset of those used for the description of objects in space. In particular, the applicable subset of spatial relations is determined by conceptualising time as a one dimensional, unidirectional and dynamic entity. For this reason, the spatial terms that are used to talk about time are also one dimensional, unidirectional terms, such as *in front/behind* or *long/short*, as opposed to three dimensional, multidirectional terms, such as *shallow/deep* or *left/right* (Clark, 1973; Evans, 2004, 2013; Lakoff & Johnson, 1999; Traugott, 1978).

While English exhibits an array of space-time metaphors, particular attention has been given to two deictic space-time metaphors: in the Moving Ego metaphor, time is conceived as a background against which the active ego moves across (e.g., *We're approaching Christmas; We've passed the deadline*) and in the Moving Time metaphor, time is construed as a series of events that move from the future to the past, relative to a stationary observer (e.g., *Christmas is approaching; The deadline has passed*) (Clark, 1973; Lakoff & Johnson, 1999). In addition to the patterns observed in language, experimental research has also provided evidence which indicates that space and time are conceptually related on a deeper level. Specifically, in seminal research, Boroditsky and colleagues (Boroditsky, 2000; Boroditsky & Ramscar, 2002) conducted a series of studies to examine whether engaging in thought about spatial motion might also prime different conceptualisations of time. For instance, by using an ambiguous temporal task, namely *Next Wednesday's meeting has been moved forward two days. What day is the meeting now that it has been rescheduled?* (cf. McGlone & Harding, 1998), Boroditsky & Ramscar (2002) found that when participants were primed with a context involving self-motion, e.g., moving through space towards a stationary object (in line with the Moving Ego perspective), they were more likely to re-use this perspective for time and respond *Friday*, whereas when participants were primed with a scenario involving motion towards the self, e.g., imagining a moving object travelling through space towards them (in line with the Moving Time perspective), they were more likely to respond *Monday*. Taken together, these findings provide evidence of a conceptual relationship between space and time, such that different ways of reasoning about motion in space can yield different conceptualisations of time. Further experimental findings have given support to these findings, with demonstrations that non-deictic spatial schemas (Kranjec, 2006; Núñez, Motz & Teuscher, 2006), abstract motion schemas (Matlock, Holmes, Srinivasan & Ramscar, 2011), fictive motion schemas (Matlock, Ramscar & Boroditsky, 2005; Ramscar, Matlock & Dye, 2010) and gesture (Jamalian & Tversky, 2012) may similarly influence how people think about the movement of events in time.

### 1.1. Individual differences

While spatial schemas may exert an important influence on the structure and representation of time, arguably, a person's conceptualisation of time is not merely dependent on their experiences in space but rather, a complex of factors. Indeed, in addition to time, abstract domains, such as emotion, can also be understood in terms of motion in space, with certain emotions metaphorically eliciting particular types of movement, e.g., *jumping for joy; exploding in anger; scared stiff* (cf. Lakoff & Johnson, 1980). In view of this, recent lines of research have begun to examine other factors, such as personality differences, lifestyle, and emotional experiences, that may also play a role in shaping how people reason about events in time (Duffy & Feist, 2014; Duffy, Feist & McCarthy, 2014; Hauser, Carter & Meier, 2009; Richmond, Wilson & Zinken, 2012). For example, Hauser et al. (2009) investigated the link between the seemingly unrelated but similarly embodied abstract domains of anger and time. Emotion and cognition research suggests that anger, both as an emotion and as a personality trait, is spatially grounded in approach-related motivations, which drive the active self to

approach a goal or situation (Harmon-Jones, 2003). Similarly, in the Moving Ego metaphor, the self is represented as an active agent who moves forward through time, approaching events in the future. Thus, Hauser et al. (2009) hypothesised an embodied cognitive link between anger and the Moving Ego perspective, with the activation of one domain guiding the other through a shared approach-related spatial motivation. To test this hypothesis, participants completed a series of questionnaires for measuring trait anger (that is, anger as part of their personality) before responding to the Wednesday's meeting question. As predicted, the results revealed that participants who averaged higher trait anger were more likely to respond *Friday* (consistent with the Moving Ego perspective) than to respond *Monday* (consistent with the Moving Time perspective), thus providing initial evidence for a relationship between anger and metaphorical perspectives on time.

Building on these findings, in another study, Duffy & Feist (2014) investigated further the role that personality differences may play in influencing people's perspectives on the movement of events in time, focusing specifically on the personality dimension of extroversion-introversion. Personality research shows that extroverts tend to be characterised as assertive, energetic and gregarious, exhibiting a more active approach towards the social and material world (John, 1990; John & Srivastava, 1999; John, Naumann & Soto, 2008)—much in the way that in the Moving Ego metaphor, the self actively approaches events in the future. By contrast, introverts tend to be characterised as withdrawn, reserved, and retiring, exhibiting a more passive approach towards the social and material world—much in the way that in the Moving Time metaphor, the self passively observes the arrival of events. Furthermore, extroversion is represented by behavioural approach (e.g., Elliot & Thrash, 2002), much like anger, which Hauser et al. (2009) found to be associated with the Moving Ego perspective. As such, Duffy & Feist (2014) hypothesised that there would be differences in temporal reasoning between extroverts and introverts that parallel the spatially-based differences between approach and avoidance. To test this, participants completed a questionnaire for measuring extroversion-introversion (BFI; John, 1990) before responding to the Wednesday's meeting question. As anticipated, participants who adopted the Moving Ego perspective (answering *Friday*) exhibited higher degrees of extroversion in comparison to participants who adopted the Moving Time perspective (responding *Monday*). Taken together, these findings extend the range of individual differences that may influence temporal reasoning, indicating that people's metaphoric representations of time may be attributed to a combination of factors, rather than a single factor.

## 1.2. Event valence

While individual differences in personality may exert an influence on the resolution of a temporally ambiguous utterance, other lines of research in this area have demonstrated that the valence of the event (positive or negative) may also influence people's conceptualisations of time. Reasoning that, typically, positive affect is spatially represented by approach motivations and negative affect, by avoidance motivations (Cacioppo, Priester & Berntson, 1993; Chen & Bargh, 1999; Neumann, Forster & Strack, 2003),<sup>1</sup> Margolies & Crawford (2008) hypothesised that positively valenced events might influence the adoption of the Moving Ego perspective and negatively valenced events might influence the adoption of the Moving Time perspective. To test this, in one experiment, participants were asked to imagine an event in the future, scheduled for next Wednesday, for which they might feel either

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<sup>1</sup> An exception to this is the negative emotion and trait anger which, as discussed, is characterised by approach-related motivations (Harmon-Jones 2003; cf. Hauser et al. 2009).

enthusiasm (e.g., seeing a distant loved one) or dread (e.g., a stressful exam) before answering a number of task-related questions, such as: (i) *What day is the event now that it has been rescheduled?*; (ii) *How does this news change how you feel about the event?* (a. *Worse*; b. *Better*); and (iii) *Which statement best expresses how you feel?* (a. *I am approaching this event*; b. *The event is approaching me.*). Consistent with their predications, the results showed that participants in the enthusiasm (positive) condition were more likely to describe themselves as approaching the event (in line with the Moving Ego perspective), whereas participants in the dread (negative) condition were more likely to describe the event as approaching themselves (in line with the Moving Time perspective). In addition, participants in the enthusiasm condition were more likely to feel better about the rescheduling of the event to *Monday* than participants in the dread condition. However, the valence of the event did not significantly affect whether the participants responded *Monday* or *Friday*. Margolies & Crawford (2008) offer two possible explanations for this apparent inconsistency, the first being that while individuals may tend to imagine themselves moving towards positive events (Moving Ego), this effect is undermined by the tendency to want positive events to arrive sooner (Moving Time). Alternatively, the different nature of the two questions may be accountable: whereas the ‘approach question’ depicts a spatial scene and may involve a person’s underlying conceptions of space, McGlone & Harding’s (1998) ‘days question’ depicts a temporal scene and may involve a person’s underlying representations of time. Although related, the two scenes may remain, in essence, different (cf. Evans, 2013).

Probing further the interrelations between affect and metaphorical perspectives on time, recent research by Lee & Ji (2014) suggests that temporal reasoning is not only influenced by the feelings evoked by an event but also whether the focal event is situated in the past or future. On the assumption that people typically approach what they like and avoid what they dislike in space (Cacioppo et al., 1993; Chen & Bargh, 1999; Neumann et al., 2003), Lee & Ji (2014) hypothesised that similar tendencies might exist in time that enable people to dictate their psychological distance from different temporal events by minimising the distance from pleasant experiences and maximising the distance from unpleasant experiences. Across a series of experiments, they observed that, whereas the anticipation of pleasant events prompted use of the Moving Ego perspective, the anticipation of unpleasant events encouraged participants to adopt the Moving Time perspective—concordant with Margolies & Crawford’s (2008) findings. However, extending one step further, Lee & Ji (2014) observed a reverse tendency for events in the past. Specifically, whereas the recollection of unpleasant emotions prompted use of the Moving Ego perspective (i.e., actively moving away from the past and towards the future), the recollection of pleasant emotions encouraged participants to adopt the Moving Time perspective (i.e., remaining closer to the past and further away from the future). Taken together, Lee & Ji’s (2014) findings provide further evidence of the ways in which life experiences, emotions, and metaphorical perspectives on time are interrelated, demonstrating that how people reason about events in time is not only influenced by the feelings associated with an event but also whether the event is located in the past or the future.

The body of research reviewed thus extends the range of factors that may influence the ways in which people reason about events in time, providing new insights on metaphor and its ability to reflect thought and feeling. Extending this research further, we conducted two studies to investigate whether the interpretation of a temporally ambiguous question may arise from an interaction between the valence of the event and aspects of the personality (Experiment 1) or lifestyle (Experiment 2) of the comprehender. In sum, the findings we report on below shed further light on the complex nature of temporal reasoning. While this

involves conceptual metaphor, it also, as we propose later in the paper, invokes more complex temporal frames of reference (t-FoRs) (Evans, 2013), which are only partially subserved by space-to-time conceptual metaphors.

## 2. Event valence and personality

As discussed, recent research suggests that the valence of an event may influence how people reason about events in time, with the anticipation of positively valenced events encouraging use of the Moving Ego perspective (Lee & Ji, 2014; Margolies & Crawford, 2008). Moreover, as observed by Duffy & Feist (2014), a similar preference for adopting the Moving Ego perspective has been observed among people who exhibit high degrees of extroversion. In addition to this, research from the field of personality demonstrates that extroverts tend to actively seek positive encounters with others and are more likely to enjoy and participate in social activities, such as parties and sororities, or in physical activities, such as team sports (Ashton, Jackson, Paunonen, Helmes & Rothstein, 1995; Furnham, 1981; Emmons & Diener, 1986). By contrast, introverts tend to withdraw from social situations and are more likely to engage in solitary activities, such as reading a novel or gardening (Argyle & Lu, 1990). Tying these findings together, as positive affect and extroversion are represented by approach-related motivations and negative affective and introversion are represented by avoidance-related motivations (cf. Elliot & Thrash, 2002; Hauser et al., 2009; Margolies & Crawford, 2008), it raises the possibility that affect and extroversion-introversion may be connected to time via a shared spatial schema. Specifically, on the assumption that people are more likely to imagine themselves approaching a positive event (in line with the Moving Ego perspective) and to imagine a negative event approaching themselves (in line with the Moving Time perspective), we hypothesised that extroverts would be more likely to imagine themselves approaching a social event (viewing it positively) (cf. Lucas, Diener, Grob, Suh & Shao, 2000), which would lead to a higher likelihood of adopting the Moving Ego perspective. By contrast, introverts would be more likely to imagine a social event approaching themselves (viewing it negatively), which would lead to a higher likelihood of adopting the Moving Time perspective.

To this end, the aim of Experiment 1 is to probe the interaction between individual differences in extroversion-introversion, event valence and the interpretation of a temporally ambiguous question. Specifically, Experiment 1 investigates whether differences between the social-seeking behaviours of extroverts and the social-withdrawing behaviours of introverts would be reflected in the resolution of the ambiguous question: *Next Wednesday's **party** has been moved forward two days. What day has the event been rescheduled to?* In line with an active approach to positive encounters, we predict that people who adopt the Moving Ego perspective (answering *Friday*) will exhibit higher self-reported extroversion scores than participants who adopt the Moving Time perspective (answering *Monday*).

### 2.1. Experiment 1: Method

#### 2.1.1. Participants

40 full-time undergraduate students participated in this study, with an age range of 19 to 55 years and a mean age of 23 years. 18 participants were male and 22 were female. All participants were native speakers of English from the UK.

#### 2.1.2. Materials and procedure

A two-part questionnaire was distributed to a second year English literature class and a third year history class. To begin with, participants provided demographical information (age, gender, native language and nationality). For Part 1 of the questionnaire, extroversion was measured using the eight extroversion statements from the BFI (John, 1990), e.g., *I see myself as someone who is outgoing, sociable*, and a five-point Likert scale with “Very true” anchoring the left-hand side of the scale, “Neutral” in the middle and “Very untrue” anchoring the right-hand side of the scale. For Part 2 of the questionnaire, participants provided a response to the ambiguous temporal question: *Next Wednesday’s party has been moved forward two days. What day has the event been rescheduled to?*

### 2.1.3. Results and discussion

The average extroversion score for each participant was calculated by using the BFI Scoring Key (John & Srivastava, 1999). The scale ranged from 1–5, with 1 representing a low extroversion score and 5 representing a high extroversion score. Mean extroversion scores for each participant were calculated by adding the scores for each statement and dividing by the total number of statements, i.e., 8. Contrary to our prediction, the results showed no reliable difference in self-reported extroversion scores between participants adopting the Moving Ego perspective (responding *Friday*;  $M = 3.833$ ;  $SD = 1.033$ ) and those adopting the Moving Time perspective (responding *Monday*;  $M = 3.412$ ;  $SD = 0.876$ ),  $t(38) = 1.060$ ,  $p = 0.296$ ,  $d = 0.440$ . One possible explanation for this is that although extroverts might be more likely to imagine themselves approaching events (in line with the Moving Ego perspective), particularly social situations (Lucas et al., 2000), this effect is undermined by the tendency to want an enjoyable and sociable event, such as a party, to occur sooner (in line with the Moving Time perspective) (cf. Margolies & Crawford, 2008).

While no relationship was found between responses to the *Next Wednesday’s party* question and self-reported extroversion, an interesting finding to emerge from Experiment 1 is that 85.0% of the student population adopted the Moving Time perspective, moving *Next Wednesday’s party* forward to *Monday* in comparison to 39.4% of the student population sampled in Duffy & Feist (2014, Experiment 1), who moved *Next Wednesday’s meeting* forward to *Monday*. A post-hoc analysis reveals a reliable difference in response across the two groups:  $\chi^2_{1,73} = 16.401$ ;  $p < 0.0001$ ; Cramer’s  $V = 0.474$ , thus, further demonstrating that the type of event may influence people’s perspectives on the movement of events in time, with a population of students prioritising a party, moving it earlier in time (in line with the Moving Time perspective) and deferring a meeting, moving it later in time (in line with the Moving Ego perspective). Moreover, this difference re-emphasises the role that lifestyle plays in influencing people’s conceptualisations of time, suggesting that temporal language interpretation may arise from an interaction between the valence of an event and the life experiences of the comprehender (Lee & Ji, 2014; Margolies & Crawford, 2008). Probing this interaction further, Experiment 2 sought to investigate the effects of event valence on a cohort of students’ interpretations of an ambiguous temporal question using a focal event that features on all academic calendars: the assignment deadline.

### 3. Event valence and lifestyle

In recent years, there has been a growth in interest concerning the levels of stress experienced by students studying in higher education. Stress can be viewed as “an imbalance between perceived demands and perceived resources” (Matheny, Roque-Tovar & Curlette, 2008, p. 50; cf. Lazarus & Folkman, 1984). While research examining sources of stress among students

has shown that stress may be attributed to a range of factors, such as financial difficulties, health problems, and social strains, academic-related activities rank frequently as the most potent causes. More specifically, examinations and meeting deadlines for assignments have been reported as the two most common causes of academic stress (e.g., Abouserie, 1994; Kohn & Frazer, 1986). In addition to this, it has been reported that 75% to 80% of university students exhibit moderate levels of stress and 10% to 12% exhibit serious levels of stress (Abouserie, 1994; Pierceall & Keim, 2007).<sup>2</sup> A significant positive correlation has also been shown to emerge between stress and negative affect, as well as lack of perceived control (e.g., Abouserie, 1994; Clark & Watson, 1991; Watson, 1988). Indeed, according to Abouserie, “students who believe in their abilities and in their control of their situations are less stressed than those who believe that things happen by luck or outside agents” (1994, p. 329). On the assumption that assignment deadlines are one of the most frequent causes of stress among students, we hypothesised that students would feel negatively disposed towards the arrival of an assignment deadline, especially if it was rescheduled earlier in time. Furthermore, as stress is correlated with negative affect, as well as lack of perceived control—two factors that are demonstrably related to the Moving Time perspective (e.g., Margolies & Crawford, 2008; Richmond et al., 2012)—we also hypothesised that students would be more likely to imagine a stressful event, such as an assignment deadline, approaching themselves (in line with the Moving Time perspective) than to imagine themselves approaching it.

To this end, the aim of Experiment 2 is to examine further the ways in which the valence of an event, the life experiences of the comprehender, and metaphorical perspectives on time are interrelated by focusing specifically on the participant’s affective orientation towards the event. To do this, students were presented with the question *Next Wednesday’s **assignment deadline** has been moved forward has been moved forward two days. What day has the event been rescheduled to?* before being asked whether they perceived themselves as approaching the event or whether they imagined the event approaching themselves and also whether the rescheduling of the event made them feel better or worse (cf. Margolies & Crawford, 2008). In line with the findings that assignment deadlines are one of the most prominent causes of stress among students (Kohn & Frazer, 1986) and that people tend to feel worse about the rescheduling of a negative event when it is moved earlier in time (Margolies & Crawford, 2008), we predict that participants who report feeling worse about the rescheduling of the assignment deadline will be more likely to adopt the Moving Time perspective (indicated by *Monday* and *The event is approaching me* responses) compared to participants who adopt the Moving Ego perspective (indicated by *Friday* and *I’m approaching the event* responses). Furthermore, building on insights from earlier findings which demonstrate that people are more likely to imagine a negative future event approaching themselves (Lee & Ji, 2014; Margolies & Crawford, 2008), we predict that the Moving Time perspective will be more prominent than the Moving Ego perspective among the student population.

### 3.1. *Experiment 2: Method*

#### 3.1.1. *Participants*

39 full-time undergraduate students participated in this study, with an age range of 18 to 24 years and a mean age of 21 years. 13 participants were male and 26 were female. All participants were native speakers of English from the UK.

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<sup>2</sup> It should, however, be noted that in some situations stress can be beneficial. Indeed, distinctions have been made between eustress (positive stress) and distress (Brown and Ralph 1999; Bush et al. 1985).



### 3.1.2. Materials and procedure

A questionnaire was distributed to a third year English literature class. To begin with, participants provided demographical information (age, gender, native language and nationality). Next, adopting the methodology used by Margolies & Crawford (2008), participants read the ambiguous temporal statement below before answering three related questions:

*Next Wednesday's assessment deadline has been moved forward two days*

1. *What day has the event been re-scheduled to?*
2. *Which statement best expresses how you feel?*
  - a. *I am approaching this event*
  - b. *The event is approaching me*
3. *How does this news change how you feel about the event?*
  - a. *Worse*
  - b. *Better*

### 3.1.3. Results and discussion

For the purpose of this discussion, question one is referred to as the Days question and question two is referred to as the Approach question. In line with our predictions, the results showed that participants who felt better about the rescheduling of the event were more likely to adopt the Moving Ego perspective (indicated by *Friday* and *I am approaching the event* responses), whereas participants who felt worse about the rescheduling of the event were more likely to adopt the Moving Time perspective (indicated by *Monday* and *The event is approaching me* responses). Concretely, for the Days question, 85.2% of participants who felt worse about the rescheduling of the meeting responded *Monday* in comparison to 0% of participants who felt better about it. A chi-square test revealed a reliable difference in response:  $\chi^2_{1,39} = 21.231$ ;  $p < 0.0001$ ; Cramer's  $V = 0.768$ . Similarly, for the Approach question, 74.1% of participants who felt worse about the rescheduling of the meeting responded *The event is approaching me* in comparison to 11.1% of participants who felt better about it. Again, a chi-square test revealed a reliable difference in response:  $\chi^2_{1,39} = 11.010$ ;  $p < 0.001$ ; Cramer's  $V = 0.553$ . Participants were also highly consistent in their answers. Those who responded *Friday* also viewed themselves as approaching the event (84.7%), and those who responded *Monday* also viewed the event as approaching themselves (82.7%):  $\chi^2_{1,36} = 15.442$ ,  $p < 0.0001$ ; Cramer's  $V = 0.655$ . Furthermore, in line with our predictions, the student population demonstrated a preference for adopting the Moving Time perspective for the Days and the Approach questions, with (63.9%) participants responding *Monday* and (58.3%) of participants responding *The event is approaching me*.

Taken together, the results from Experiment 2 provide further evidence that temporal language interpretation may arise from an interaction between the valence of an event and the life experiences of the comprehender, which may, in turn, also influence the comprehender's affective orientation towards the event. Specifically, as predicted, participants who felt better about the rescheduling of the event were more likely to adopt the Moving Ego perspective (indicated by *Friday* and *I am approaching the event* responses), whereas participants who felt worse about the rescheduling of the event were more likely to adopt the Moving Time perspective (indicated by *Monday* and *The event is approaching me* responses). Furthermore, in line with earlier findings demonstrating that people are more likely to imagine a negative future event approaching themselves (Lee & Ji, 2014; Margolies & Crawford, 2008), the student population demonstrated a preference for disambiguating the *Next Wednesday's*

*assignment deadline* question in line with the Moving Time perspective, as evidenced by *Monday* and *The event is approaching me* responses.

#### 4. A temporal frames of reference (t-FoRs) account of the findings

A potentially intractable problem, in accounting for the experimental findings that we've reported on here, as well as the review of previous research, is this: on the one hand personality and lifestyle appear to influence a distinction between what we've characterised as an approach-based strategy—leading to privileging of the Moving Ego perspective in temporal reasoning; the human experiencer metaphorically 'moves' selecting *Friday*—versus a passive approach—leading to the Moving Time perspective being privileged; the subject is stationary, while time 'moves', leading to *Monday* being selected. Anger traits (cf. Hauser et al., 2009), introversion and extroversion (cf. Duffy & Feist, 2014), as well as lifestyle appear to be at play here.

One way of thinking about this concerns how much psychological control (cf. Lee & Ji, 2014) the subject believes he or she has in terms of influencing events that might affect them. In the case of Experiment 2, for instance, those who felt better about an imminent assignment in the temporal reasoning task might be hypothesised to feel a greater sense of control over their academic lives. Hence, they tend to privilege a more active approach, resulting in a Moving Ego pattern. In contrast, those who felt worse about the assignment, are hypothesised to feel less in control of their academic lives and, accordingly, adopt a more passive perspective: events happen to them. This results in privileging of the Moving Time perspective. But on the other hand, event valence—the extent to which subjects feel positively disposed towards an event is, we contend, not directly concerned with psychological control over our work lives. Rather, it concerns the degree to which a (social) event is highly anticipated or not. And here, the pattern reported in Experiment 1, is at odds with the pattern found on other personality and lifestyle measures (e.g., the findings we report in Experiment 2). The problem, then, is that event valence, which, on the face of it, might also be expected to lead to an approach-based conceptual strategy, results in an unexpected 'passive' strategy: *Monday* is selected in the temporal reasoning task—and this appears to outweigh other personality, lifestyle, and behavioural traits: event valence trumps other variables in terms of temporal reasoning. The question then, is, how to explain this apparently contradictory finding? And as we shall argue, in terms of event valence, subjects are not in fact employing a Moving Time/Moving Ego conceptual strategy.

In order to present our account, we need, first, to invoke an additional theoretical construct: that of temporal frames of reference (t-FoRs). This is required to supplement the conceptual metaphor perspective, in order to account for the apparent paradoxical findings. In the next section, we develop an account of t-FoRs. We subsequently apply this to the disjunction in temporal reasoning tasks outlined. We argue that the divergent reasoning strategies apparent in the two experiments we've reported on arise not from a straightforward application of Moving Ego and Moving conceptual metaphors. Rather, the situation is slightly more complex, and arises due to divergent applications of t-FoRs; this analysis, we suggest, provides an elegant account resolving the apparent paradox observed in the temporal reasoning tasks.

##### 4.1. *The nature of t-FoRs*

A frame of reference (FoR), in the domain of time (t-FoR), comprises three coordinates to

‘locate’ or fix a temporal entity with respect to another (Zinken, 2010). Early research focused on examining FoRs from the domain of space, investigating how they are recruited to structure temporal reference: the assumption being that FoRs from the domain of space are naturally mapped onto time. Two such taxonomies have been proposed (Bender, Bennardo & Beller, 2010; Tenbrink, 2011; see also Moore, 2011).

The potential drawback of this research was that it assumed, in key respects, the computational processes involved in temporal reference are essentially spatial. But based on a review of the phenomenological, neurological, and cognitive character of both time and space, Evans (2013) argued for an approach to t-FoRs that treats temporal reference in its own purely temporal terms: the essential insight is that computing ‘when’ an event occurs is quite different from computing ‘where’ it takes place, notwithstanding the re-use of aspects of spatial language and representations in facilitating temporal reference.

Evans (2013) adopted a likely core feature of temporal experience, by adducing and developing the notion of *transience*: a feature exhibited by time, but not space (see Galton, 2011). Evans (2013, p. 66) defines transience as “the subjectively felt *experience* of (temporal) passage”, where ‘passage’ refers to our subjective experience of time, rather than motion, i.e., physical passage. Subjective temporal passage arises from events of various sorts. These include when we engage in particular kinds of activities (e.g., a morning jog), when we perceive or experience an event (e.g., watching a movie), or experience, or are conscious of a specific state (e.g., fatigue, hunger, love, and so forth).

This notion of transience has recently been advanced by philosopher Anthony Galton (2011). For Galton, transience amounts to the hallmark of temporal experience, and hence part of its inalienable character. Tellingly, he observes that the conceptual metaphors that facilitate the recruitment of inferential structure from the domain of space to flesh out temporal representations in fact draw, in circular fashion, on temporal transience to do so:

All metaphors for temporal transience take some kind of change as their source, and hence themselves depend on temporal transience. We cannot describe this aspect of time without lapsing into circularity. Hence time, in its transient aspect, has a *sui generis* character that cannot be captured by metaphors that do not make use of the very notion to be described: time, as a fundamental and inalienable feature of our experience, will ultimately resist our attempts to explain it in terms of anything else. (2011, p. 695).

In addition, Evans (2013) argues that there are different types of transience. For present purposes, the two relevant transience types are *succession*, and *anisotropy*. Succession concerns the felt experience of the passage involving earlier and later experience types, which are sequenced with respect to each other. And anisotropy concerns the felt experience that the passage exhibits inherent asymmetry—a felt distinction between future, present and past. Table 1 summarises these transience types.

TRANSCIENCE TYPE	DESCRIPTION
<b>Succession</b>	the felt experience of the passage involving earlier and later experience types

<b>Anisotropy</b>	the felt experience that the passage exhibits inherent asymmetry—a felt distinction between future, present and past
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Table 1. Transience types

In turn, each of these two transience types give rise to two distinct t-FoRs (Evans, 2013). A t-FoR works by virtue of fixing one event, the target event (TE), with respect to a second event, a reference point (RP). Crucially, however, the RP is grounded in a specific transience type—the origo (O). And each distinct transience type leads to distinct temporal relations—future/present/past for anisotropy, and earlier/later for succession. In other words, the distinct character of a given t-FoR, and the type of temporal relations that emerge are contingent on the transience type that the t-FoR is grounded in.

The first t-FoR is the *deictic t-FoR* (Evans, 2013). In this t-FoR, the O constitutes the egocentric experience of now, anchoring the system to the phenomenologically real experience of anisotropy—the felt experience that the temporal passage exhibits inherent asymmetry: a felt distinction between future, present, and past. Indeed, it is this anchoring to our subjectively real experience of anisotropy that makes this t-FoR deictic. One consequence of this is that the temporal relation captured by this t-FoR is a past/future relation.

That said, the linguistic evidence shows that the deictic t-FoR also makes use of spatial information as a representational medium, in computing the temporal relation holding between the target event (TE) and the O. That is, events are related to a physical reference point (RP). More specifically, they are located with respect to the experiencer’s location in three dimensional space. Hence, the RP in a deictic t-FoR is the experiencer’s location, anchored by the experiencer’s awareness of now, the O, which is coincident with the experiencer’s precise location. Consider the following example:

- (1) We are moving closer to Christmas

In this example, the TE is Christmas, the event being fixed with respect to the experience of anisotropic transience. Yet, the way this is achieved is by relating the TE to a spatial RP (the experience, encoded by *we*). But as the experiencer is coincident with the egocentric experience of now, the relative motion of the experiencer with respect to Christmas provides a means of computing the relative point in time of the TE with respect to the O. And in this way, the TE is fixed with respect to anisotropic transience, giving rise to a future relation, in this example. Hence, spatial information provides a means of supporting temporal reference in the deictic t-FoR. We contend that the Moving Ego and Moving Time conceptual metaphors, which are also deictic in nature, also derive from the transience anisotropy, and are closely related to the deictic t-FoR.

The second t-FoR that we introduce here is the *sequential t-FoR*. In this type of t-FoR, the coordinate system is provided by a sequence of events. A given TE is fixed with respect to another event, the RP, with respect to which it is sequenced. A sequence of events is fixed with respect to an O, the first event, or a salient event, in the sequence, from which the RP takes its reference—note that the O can coincide with the RP. Accordingly, the O serves to anchor the RP to the transience type succession, from which the temporal relation earlier/later

arises.

As with the deictic t-FoR, the primary way in which English encodes the sequential t-FoR is via ascriptions of motion. However, the motion ascriptions are quite different from in the deictic t-FoR. Rather than relating to path-like motion on the sagittal axis, they concern expressions relating to sequential motion (see also Moore, 2006). Consider the following examples:

‘Earlier’

(2) Christmas comes before New Year’s Eve

‘Later’

(3) New Year’s Eve comes after Christmas

In these examples, there are two different TEs, Christmas, in (2), and New Year’s Eve in (3). These are the events which are being fixed with respect to the transience type of succession. The RPs, in these examples, are respectively New Year’s Eve in (2) and Christmas in (3). In these examples, the RPs are also the Os, the points that anchor the events to the transience type involved here. The consequence of the two events in each example, the TE and the RP/O, being related by virtue of sequential motion (*come before/after*) is the inference that there is a sequential temporal relation holding between the two events such that the TE, Christmas is earlier than the RP/O, New Year’s Eve in (2). In contrast, in (3), the TE, New Year’s Eve is later than the RP/O, Christmas.

In the sequential t-FoR, the RP and O do not have an egocentric basis, but inhere in the event sequence itself. As such, what makes examples such as (2) and (3) relate to the sequential t-FoR, rather than, for instance the deictic t-FoR, is that the earlier/later temporal relation that emerges does so as it is an inherent feature of the sequence of events, rather than when in time they are viewed. Consequently, the reference strategy adopted by this t-FoR is *allocentric*—what Moore has termed ‘perspective-neutral’ (Moore, 2011), as it involves reference between entities, in this case events, which are independent of the egocentric perspective of human experience of now.

#### 4.2. Accounting for the temporal reasoning tasks

We are now in a position to provide an account of the, on the face of it, paradoxical behaviour exhibited by subjects across Experiments 1 and 2. The ambiguous question in the experimental design requires subjects to fix a hypothetical TE in time, with respect to a temporal frame: days of the week.

One strategy for doing this, in light of the discussion in the preceding section, is to adopt an egocentric perceptive, and make use of the deictic t-FoR. In this strategy, the RP is the speaker’s experience of now, which given the days of the week frame is fixed at *Monday*. And as the experience of now is grounded in the transience type anisotropy, the temporal relations that emerge are future/past. The cognitive strategy involves calculating the ‘move forward’ expression, with respect to the ego’s RP, fixing the TE as either co-located with the ego’s RP—the Moving Time trajectory—or, alternatively, as being located in the future with respect to the RP, at *Friday*. And the two logical possibilities are influenced by personality, lifestyle, and behavioural traits in inter-subjectively reliable ways. The upshot is that in Experiment 2, deictic t-FoR is the reference strategy being employed.

In contrast, we hypothesise that the event-valence condition, in Experiment 1, is activating

the succession t-FoR, rather than the deictic t-FoR. In this task, event valence appears to trigger an earlier-later, rather than a future-past judgement. This appears to be a consequence of the positive affect that derives from a potentially exciting hypothetical event. Consequently, the sequential, rather than the deictic t-FoR appears to be invoked in this temporal reasoning task. In this strategy, the RP remains the speaker's experience of now. But according to the logic of the sequential t-FoR, this is conceptualised as forming a temporal sequence with the hypothetical social event and, consequently, the transience type in terms of which the RP is anchored is succession. The consequence is that a positively evaluated, and eagerly anticipated event is adjudged as occurring on *Monday*, earlier, in terms of the days of the week conceptual frame, than *Friday*. An interesting consequence of this analysis is the prediction that an event with negative valence would be 'moved forward' to *Friday*.

In sum, event valence appears to lead to a shift in arguably the default (experiencer-centred) deictic t-FoR when reasoning about rescheduling an event. While personality and other behavioural traits, including lifestyle, appear to take the deictic t-FoR as the default cognitive strategy in such experiments, event valence introduces a confound that privileges a different cognitive strategy: invoking the sequential t-FoR. Nevertheless, further research, and empirical investigation is clearly required to explore these issues further.

## 5. General discussion

### 5.1. Overview

Research investigating abstract thinking about time has been chiefly concerned with testing the effects of spatial priming on the interpretation of ambiguous temporal statements. However, more recently, research has also shed light on a number of additional factors, such as personality differences, lifestyle, and emotional experiences, that may also contribute to people's construals of time and their resolution of temporally ambiguous language (Duffy & Feist, 2014; Duffy et al., 2014; Hauser et al., 2009; Richmond et al., 2012). In addition, other lines of research have also uncovered at least one aspect of what is encoded that may influence temporal reasoning; namely, the valence of the event (Lee & Ji, 2014; Margolies & Crawford, 2008).

Building on earlier observations that individual differences in personality and lifestyle may influence people's perspectives on the movement of events in time, we conducted two studies to investigate a number of additional factors that may also play a role in influencing the resolution of temporally ambiguous language. Drawing on preliminary lines of research, which suggest that the valence of an event and specifically the comprehender's affective orientation towards the event may also influence people's conceptualisations of time, the studies aimed to investigate whether the interpretation of a temporally ambiguous utterance may arise from an interaction between the valence of the event and aspects of the personality (Experiment 1) and lifestyle (Experiment 2) of the comprehender.

To begin with, Experiment 1 sought to examine further the interaction between individual differences in personality and event valence on the interpretation of a temporally ambiguous question, focusing specifically on the personality dimension of extroversion-introversion. Specifically, the aim was to investigate whether differences between the social-seeking behaviours of extroverts and the social-withdrawing behaviours of introverts would be reflected in their resolution of the ambiguous *Next Wednesday's party* question. It was shown that, contrary to the prediction that extroverts would be more likely to imagine themselves

approaching a social event (viewing it positively) and introverts would be more likely to imagine a social event approaching themselves (viewing it negatively), there was no reliable difference in self-reported extroversion scores between participants adopting the Moving Ego perspective (responding *Friday*) and those adopting the Moving Time perspective (responding *Monday*); thus, suggesting that although extroverts might be more likely to imagine themselves approaching events (in line with the Moving Ego perspective), particularly social situations (Lucas et al., 2000), this effect is undermined by the tendency to want an enjoyable and sociable event, such as a party, to occur sooner (in line with the Moving Time perspective) (cf. Margolies & Crawford, 2008). As such, these findings give support to Hauser et al.'s (2009) suggestion that the ambiguous Days question (cf. McGlone & Harding, 1998) might only provide an accurate method for assessing people's conceptualisations of time when the event in question has a somewhat neutral meaning—at least for examining approach/avoidance-related processes.

Probing further the ways in which the valence of an event, the life experiences of the comprehender, and metaphorical perspectives on time are interrelated, Experiment 2 examined the effects of event valence on a cohort of students' interpretation of an ambiguous temporal question using a focal event that features on all academic calendars: the assignment deadline. To do this, students were presented with the *Next Wednesday's assignment deadline* question before being asked to rate whether the rescheduling of the event made them feel better or worse. In line with the findings that assignment deadlines are one of the most prominent causes of stress among students (Kohn & Frazer, 1986) and that people tend to feel worse about the rescheduling of a negative event when it is moved earlier in time (Margolies & Crawford, 2008), the results showed that participants who felt better about the rescheduling of the event were more likely to adopt the Moving Ego perspective (indicated by *Friday* and *I am approaching the event* responses), whereas participants who felt worse about the rescheduling of the event were more likely to adopt the Moving Time perspective (indicated by *Monday* and *The event is approaching me* responses). Furthermore, in line with earlier findings demonstrating that people are more likely to imagine a negative future event approaching themselves (Lee & Ji, 2014; Margolies & Crawford, 2008), the student population demonstrated a preference for disambiguating the *Next Wednesday's assignment deadline* question in line with the Moving Time perspective. In sum, the results from Experiment 2 provide additional evidence that the interpretation of an ambiguous temporal question may arise from an interaction between the valence of an event and the life experiences of the comprehender which may, in turn, also influence the comprehender's affective orientation towards the event.

## 5.2. Implications for the theoretical accounts of conceptual metaphor

The finding that temporal language interpretation may arise from an interaction between a range of factors, including the valence of an event and the lifestyle and personality of the comprehender raises the questions of whether other kinds of factors may exert significant influences on interpretation and also, crucially, whether some factors may play a more prominent role than others in shaping people's metaphoric representations of time. A number of research findings give weight to this possibility.

Firstly, the findings from Experiment 1, in which the anticipation of a party resulted in the adoption of the Moving Time perspective for both introverts and extroverts, indicates that the tendency for extroverts to imagine themselves approaching events (adopting the Moving Ego perspective), is overridden by an eagerly-anticipated event. In other words, the valence of the event can, at least in this context, 'trump' the personality-driven factors that lead to the

adoption of the Moving Ego perspective in the temporal reasoning task. Secondly, while cross-linguistic research in this area is comparatively scarce, preliminary research findings suggest that the language itself may play a role in the interpretive possibilities available to a comprehender (cf. Bender et al., 2005, 2010; Elvevåg et al., 2011; Lai & Boroditsky, 2013; Rothe-Wulf, Beller & Bender, 2015). In particular, while the ambiguity observed in English has been observed in some other languages, such as Dutch (Elvevåg, Helsen, De Hert, Sweers & Storms, 2011), cross-linguistic investigations of the Wednesday’s meeting question have shown that this is not the case for all languages. For instance, Bender et al. (2005) found that when the question is translated into German, using the term *vorverlegen* for ‘moved forward’, the vast majority of participants responded *Monday* (Bender et al., 2005), indicating that the German translation of the question is not truly ambiguous. More recently, in cross-linguistic research investigating individual differences in the interpretation of ambiguous temporal statements, Rothe-Wulf et al. (2015) found that, unlike speakers of English, when the Wednesday’s question—and related permutations—were translated into the respective languages, speakers of German and Swedish were not susceptible to spatial priming. That is, the language of communication can, in this context, override the effects of spatial priming on temporal reasoning.

Taken together, these findings suggest that people’s metaphoric representations of time may exhibit a cline in terms of the factors which may shape it and, within the context of this study, influence the interpretation of an ambiguous temporal question. The findings from Experiment 1 of this study suggest that event valence can trump personality and the findings from Rothe-Wulf et al. (2015) indicate that the language of communication can override spatial priming:

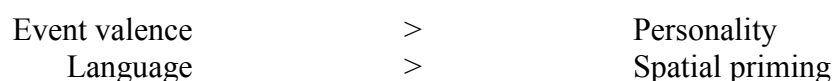


Figure 1. The top trumps of time

### 5.3. *Implications for theoretical accounts of temporal cognition*

Advances in the theoretical modelling of the linguistic representation of time, and temporal cognition have, increasingly, over the last decade or so, begun to move beyond conceptual metaphor. Temporal reasoning involves a sophisticated computational ability that, while invoking space-to-time mappings, also involves representations of time that appear to be grounded in non-spatial experience types, processed by brain regions specialised for temporal processing (see Evans, 2013 for discussion). And these representations, in conjunction with space-to-time conceptual metaphors, appear to subserve sophisticated t-FoRs, which play a decisive role in at least aspects of temporal reasoning. Indeed, we’ve argued that personality factors and event valence can influence which t-FoRs are invoked when reasoning about ambiguous behavioural tasks. Put another way, temporal reasoning is not merely a matter of having a set of conceptual metaphors, language users must also deploy t-FoRs. And this ability to reason, in the temporal domain, is informed and influenced by factors such as personality, as well as attitude towards a given event type.

## 6. Conclusion

Time is not a monolith, but rather a mosaic of construals with distinct properties and origins. (Núñez & Cooperrider, p. 2013: 220)



In sum, the findings from this paper provide further evidence that people's metaphoric representations of time are not only shaped by their experiences of motion in space but, rather, a complex of factors—some of which play a more prominent role than others. From the perspective of theory construction, our account of the experimental findings suggests that, at the very least, analyses of temporal reasoning must consider more than just space-to-time mappings—conceptual metaphors—in order to fully understand and account for the human ability to adduce temporal relationships, and make decisions in the context of temporal reasoning tasks. Our particular approach has been to invoke an approach to t-FoRs that views them as grounded, ultimately, in purely temporal terms. We operationalised this in terms of the construct of transience. Whether the particular account of t-FoRs we have invoked turns out to be correct or not, the more general point is that the notion of temporal reference seems to provide an elegant account of the experimental findings. This suggests that further research is warranted, both in terms of examining the non-spatial factors that influence temporal reasoning, as well as how such factors might be modelled in terms of the human capacity for computing temporal reference.

## References

- Abouserie, R. (1994). Sources and levels of stress in relation to locus of control and self esteem in university students. *Educational Psychology: An International Journal of Experimental Educational Psychology* 14(3), 323–330.
- Argyle, M. & Luo, L. (1990). The happiness of extraverts. *Personality and Individual Differences*, 11(10), 1011–1017.
- Ashton, M., Jackson, D., Paunonen, S., Helmes, E., & Rothstein, M. (1995). The criterion validity of broad factor scales versus specific facet scales. *Journal of Research in Personality*, 29, 432–442.
- Bender, A., Bennardo, G., & Beller S. (2005). Spatial frames of reference for temporal relations: A conceptual analysis in English, German, and Tongan. In Bara, B. Barsalou, L., & Bucciarelli, M. (eds.), *Proceedings of the 27th Annual Conference of the Cognitive Science Society*, 220–225. Mahwah: Lawrence Erlbaum Associates.
- Bender, A., Beller, S., & Bennardo, G. (2010). Temporal frames of reference: Conceptual analysis and empirical evidence from German, English, Mandarin Chinese, and Tongan. *Journal of Cognition and Culture*, 10, 283–307.
- Boroditsky, L. (2000). Metaphoric structuring: Understanding time through spatial metaphors. *Cognition*, 75(1), 1–28.
- Boroditsky, L. & Ramscar, M. (2002). The roles of body and mind in abstract thought. *Psychological Science*, 13(2), 185–188.
- Brown, M. & Ralph, S. (1999). Using the DYSA programme to reduce stress and anxiety in first year university students. *Pastoral Care*, 17(3), 8–13.
- Bush, H., Thompson, M., & Van Tuvergen, N. (1985). Personal assessment of stress factors for college students. *Journal of School Health*, 55(9), 370–375.
- Cacioppo, J., Priester, J., & Berntson, G. (1993). Rudimentary determinants of attitudes: II. Arm flexion and extension have differential effects on attitudes. *Journal of Personality and Social Psychology*, 65, 5–17.
- Chen, M. & Bargh, J. (1999). Consequences of automatic evaluation: Immediate behavioural predispositions to approach or avoid the stimulus. *Personality and Social Psychology Bulletin*, 25, 215–224.
- Clark, H. (1973). Space, time, semantics, and the child. In Moore, T. (ed.), *Cognitive Development and the Acquisition of Language*, 27–63. New York: Academic Press.
- Clark, L. & Watson, D. (1991). Tripartite model of anxiety and depression: Psychometric evidence and taxonomic implications. *Journal of Abnormal Psychology*, 100, 316–336.
- Duffy, S. & Feist, M. (2014). Individual differences in the interpretation of ambiguous statements about time. *Cognitive Linguistics*, 25(1), 29–54.
- Duffy, S., Feist, M., & McCarthy, S. (2014). Moving through time: The role of personality in three real life contexts. *Cognitive Science*, 38(8), 1662–1674.
- Elliot, A. & Thrash, T. (2002). Approach-avoidance motivation in personality: Approach and avoidance temperaments and goals. *Journal of Personality and Social Psychology*, 82, 804–818.
- Ellevåg, B., Helsen, K., De Hert, M., Sweers, K., & Storms, G. (2011). Metaphor interpretation and use: A window into semantics in schizophrenia. *Schizophrenia Research*, 133(1–3), 205–211.
- Emmons, R. & Diener, E. (1986). Influence of impulsivity and sociability on subjective well-being. *Journal of Personality and Social Psychology*, 50, 1211–1215.
- Evans, V. (2004). *The Structure of Time: Language, Meaning, and Temporal Cognition*. Amsterdam: John Benjamins.
- Evans, V. (2013). *Language and Time: A Cognitive Linguistics Approach*. Cambridge:

- Cambridge University Press.
- Furnham, A. (1981). Personality and activity preference. *British Journal of Social Psychology*, **20**, 57–68.
- Galton, A. (2011). Time flies but space doesn't: Limits to the spatialization of time. *Journal of Pragmatics*, **43**, 695–703.
- Harmon-Jones, E. (2003). Anger and the behavioral approach system. *Personality and Individual Differences*, **35**, 995–1005.
- Hauser, D., Carter, M., & Meier, B. (2009). Mellow Monday and furious Friday: The approach-related link between anger and time representation. *Cognition and Emotion*, **23**(6), 1166–1180.
- Jamalian, A. & Tversky, B. (2012). Gestures alter thinking about time. In Miyake, N., Peebles, D., & Cooper, R. (eds.), *Proceedings of the 34th Annual Conference of the Cognitive Science Society*, 503–508. Austin: Cognitive Science Society.
- John, O. (1990). The “Big Five” factor taxonomy: Dimensions of personality in the natural language and in questionnaires. In Pervin, L. (ed.), *Handbook of Personality: Theory and Research*, 66–100. New York: Guilford Press.
- John, O., Naumann, L., & Soto, C. (2008). Paradigm shift to the integrative Big-Five trait taxonomy: History, measurement and conceptual issues. In John, O., Robins, R., & Pervin, L. (eds.), *Handbook of Personality: Theory and Research*, 3<sup>rd</sup> edition, 114–158. New York: Guilford Press.
- John, O. & Srivastava, S. (1999). The Big Five trait taxonomy: History, measurement, and theoretical perspectives. In Pervin, L. & John, O. (eds.), *Handbook of Personality: Theory and Research*, 2<sup>nd</sup> edition, 102–138. New York: Guilford Press.
- Kohn, J. & Frazer, G. (1986). An academic stress scale: Identification and rated importance of academic stressors. *Psychological Reports*, **59**, 415–426.
- Kranjec, A. (2006). Extending spatial frames of reference to temporal concepts. In Forbus, K., Gentner, D., & Regier, T. (eds.), *Proceedings of the 28th Annual Conference of the Cognitive Science Society*, 447–452. Mahwah: Lawrence Erlbaum Associates.
- Lai, V. & Boroditsky, L. (2013). The immediate and chronic influence of spatio-temporal metaphors on the mental representations of time in English, Mandarin, and Mandarin-English speakers. *Frontiers in Psychology* 4, 142. doi: 10.3389/fpsyg.2013.00142.
- Lakoff, G. & Johnson, M. (1980). *Metaphors We Live By*. Chicago: University of Chicago Press.
- Lakoff, G. & Johnson, M. (1999). *Philosophy in the Flesh: The Embodied Mind and its Challenge to Western Thought*. New York: Basic Books.
- Lazarus, R. & Folkman, S. (1984). *Stress, Appraisal, and Coping*. New York: Springer-Verlag.
- Lee, A., & Ji, L. (2014). Moving away from a bad past and toward a good future: Feelings influence the metaphorical understanding of time. *Journal of Experimental Psychology: General*, **143**(1), 21–26.
- Lucas, R., Diener, A., Grob, A. Suh, E., & Shao, L. (2000). Cross-cultural evidence for the fundamental features of extraversion. *Journal of Personality and Social Psychology*, **79**(3), 452–468.
- Margolies, S. & Crawford, L. (2008). Event valance and spatial metaphors of time. *Cognition and Emotion*, **22**(7), 1401–1414.
- Matheny, K., Roque-Tovar, B., & Curlette, W. (2008). Perceived stress, coping resources, and life satisfaction among U. S. and Mexican college students: A cross-cultural study. *Anales de Psicología*, **24**, 49–57.
- Matlock, T., Ramscar, M., & Boroditsky, L. (2005). On the experiential link between spatial and temporal language. *Cognitive Science*, **29**, 655–664.

- Matlock, T., Holmes, K. Srinivasan, M., & Ramscar, M. (2011). Even abstract motion influences the understanding of time. *Metaphor and Symbol*, **26**, 260–271.
- McGlone, M. & Harding, J. (1998). Back (or forward?) to the future: The role of perspective in temporal language comprehension. *Journal of Experimental Psychology: Learning, Memory and Cognition*, **24**, 1211–1223.
- Moore, K. (2006). Space to time mappings and temporal concepts. *Cognitive Linguistics*, **17**(2), 199–244.
- Moore, K. (2011). Ego-perspective and field-based frames of reference: Temporal meanings of FRONT in Japanese, Wolof, and Aymara. *Journal of Pragmatics*, **43**(3), 759–776.
- Neumann, R., Forster, J., & Strack, F. (2003). Motor compatibility: The bidirectional link between behavior and evaluation. In Musch, J. & Klauer, K. (eds.), *The Psychology of Evaluation: Affective Processes in Cognition and Emotion*, 371–391. Mahwah: Lawrence Erlbaum Associates.
- Núñez, Rafael, Motz, B. & Teuscher, U. (2006). Time after time: The psychological reality of the Ego- and Time-Reference-Point distinction in metaphorical construals of time. *Metaphor and Symbol*, **21**, 133–146.
- Núñez, R. & Cooperrider, K. (2013). The tangle of space and time in human cognition. *Trends in Cognitive Science*, **17**(5), 220–229.
- Pierceall, E. & Keim, M. (2007). Stress and coping strategies among community college students. *Community College Journal of Research and Practice*, **31**, 703–712.
- Ramscar, M., Matlock, T. & Dye, M. (2010). Running down the clock: The role of expectation in our understanding of time and motion. *Language and Cognitive Processes*, **25**(5), 589–615.
- Richmond, J., Wilson, J., & Zinken, J. (2012). A feeling for the future: How does agency in time metaphors relate to feelings? *European Journal of Social Psychology*, **42**(7), 813–823.
- Rothe-Wulf, A., Beller, S., & Bender, A. (2015). Temporal frames of reference in three Germanic languages: Individual consistency, cultural consensus, and cross-linguistic variability. *Quarterly Journal of Experimental Psychology*, **68**(5), 917–939.
- Tenbrink, T. (2011). Reference frames of space and time in language. *Journal of Pragmatics*, **43**, 704–722.
- Traugott, E. (1978). On the expression of spatio-temporal relations in language. In Greenberg, J., Ferguson, C., & Moravcsik, E. (eds.), *Universals of Human Language, Vol. III: Word Structure*, 369–400. Stanford: Stanford University Press.
- Zinken, J. (2010). Temporal frames of reference. In Evans, V. & Chilton, P. (eds.), *Language, Cognition and Space: The State of the Art and New Directions*, 479–498. London: Equinox Publishing.