Validating 'belief in occurrence' for future autobiographical events

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Abstract

Belief in occurrence is theorized to play a central role in remembering autobiographical events. Ernst and D'Argembeau (2017) proposed that belief in occurrence also plays a key role in determining the "realness" of future events, or the subjective sense that imagined future events will genuinely occur. They reported data indicating that belief in occurrence for future events arises from the contextualization of imagined future events within autobiographical knowledge, and that such belief signals when simulated events are consistent with expectations and goals. The validity of their findings can be questioned due to the use of a single item to measure belief in occurrence. To further validate these propositions, we expanded an existing belief in occurrence scale to create parallel forms for measuring belief in occurrence for past and future events. In Study 1 (N = 470) participants rated three past or three future events (recent, distant, uncertain). Study 2 (N = 251) replicated Study 1 using French translations of the measures and a within-subjects design in which participants rated a past and a future event. Confirmatory structural modelling indicated that an eight-item belief in occurrence scale was a strong fit to the data, and that item loadings were invariant across event cues and temporal direction for belief in occurrence, spatial characteristic, and autonoetic awareness latent variables. These studies support the view that belief in occurrence appraisals for past and future events draw on overlapping processes. Relationships between the latent variables and other predictors of remembering / forecasting events are discussed.

Keywords: belief in occurrence, remembering, autobiographical memory, episodic future thinking

Author note

Many memory scientists agree that the retrieval of past events reflects constructive processes (Bartlett, 1932; Neisser, 1967; Schacter & Addis, 2007) and that the experience of remembering is informed by metacognitive appraisals (Cabeza & Moskovitch, 2013; Rubin, 2006). One important metacognitive appraisal is belief in occurrence, which is the appraisal that an event genuinely occurred to the self in the past (Scoboria et al., 2014). While research on belief in occurrence has typically focused on memory for past events, the current study extends this notion of belief to future events: the belief that an imagined event will genuinely occur to the self in the future. Although beliefs about past and future events differ in epistemic status (as the past has gone and the future has yet to happen; Perrin, 2016), future-oriented thoughts are associated, in varying degrees, with a subjective sense that imagined events will (or will not) materialize in the future (Ernst & D'Argembeau, 2017). The present study aims to develop a novel measure of this belief and to examine whether belief in occurrence for past and future events draw on overlapping processes.

Beliefs in occurrence for past events

Scoboria et al. (2014) defined recollection as the experience of mental simulation for an event accompanied by a sense of re-experiencing the past, and belief in occurrence as an attribution of an event to genuine occurrence, the self, and the past. Numerous researchers have observed that when events are recollected, they are also typically believed to have genuinely occurred (e.g., Brewer, 1996; James, 1890; Pillemer, 1998; Tulving, 1983). This is also the implicit assumption in most memory research. However, this is not always the case. For example, in a series of studies (among others, see Mazzoni, Scoboria & Harvey, 2010; Otgaar, Scoboria & Mazzoni, 2014) it has been documented that people might remember very well personal events, that, however, they no longer believe to have happened to them. These

'nonbelieved memories' (Mazzoni et al., 2010) have been found to be very similar to mental representations of past events that are still believed to have happened, as they evoke the same level of recollective experience (participants claim to be able to travel back in time, relive the event and re-experience the same emotions), even if they have decided, on the basis of external evidence, that the event had not happened to them.

The phenomenon of nonbelieved memories highlights that belief in the occurrence of past events is a metacognitive appraisal that needs to be distinguished from the appraisal of recollection. These two forms of appraisals arise from distinct underlying processes and can be experimentally dissociated (Scoboria, et al., 2014). Although belief in occurrence for past events is typically high, degrees of belief can vary substantially across memories and the strength of belief and strength of recollection are predicted by different covariates (e.g., belief in occurrence: event plausibility and social feedback; recollection: spatial/perceptual mental simulation and feelings of re-experiencing the past; Scoboria et al., 2014; Scoboria & Pascal, 2016; Scoboria, Talarico & Pascal, 2015).

Why is belief in occurrence important? For nonbelieved memories, even if the mental representation is very vivid and memory-like, what is missing, compared to believed memories, is the sense that the event in the mental representation belongs to one's personal past, is part of one's experiences. And the sense that a memory is part of one's genuine experience is after all the essence of memory.

In addition, several studies have found that it is the belief in occurrence, not the memory per se, that affects cognition and behavior. Typically, studies have shown that retrieving believed memories can have subsequent behavioral consequences. In other words, future behavior can be influenced by the retrieval of related autobiographical events (e.g., see Biondolillo & Pillemer,

2015, for effects on physical exercise; and Selimbegović, Régner, Huguet, & Chatard, 2016, for effects of recalling memories of success and failure on spatial and verbal ability). However, in these studies it was the belief that mattered, as behavior was changed independently of whether the events were objectively true or false. In addition, it has been shown that retrieving nonbelieved memories experimentally created in the lab makes people behave differently in cognitive tasks compared to when the same memories are believed in (Mazzoni, 2015). In other words, people tend to base their thinking and behavior on events that they believe to have occurred, regardless of whether the mental representation for the events is accompanied by recollection. Other examples show that falsely believing to have fallen ill on a specific food lead to changes in food preference and food avoidance (Bernstein & Loftus, 2009; Bernstein, Scoboria & Arnold, 2015; Scoboria, Mazzoni, Jarry & Bernstein, 2012). Thus, examining the role of belief in occurrence in memory is crucial to understand the effect of the memory on people's experience and behavior.

Beliefs in the occurrence of future events

Episodic future thinking—the ability to mentally simulate possible future events (Szpunar, 2010)—represents an interesting case for understanding the role of belief in occurrence for two reasons. One is the similarity between the cognitive and neural mechanisms involved in remembering past events and in envisioning future events (e.g., McDermott & Guilmore, 2015; Schacter, Benoit & Szpunar, 2017). There is substantial agreement that, similarly to past memories, the effective anticipation of future events is predicated on flexible cognitive systems that are capable of recombining information from prior experiences and other knowledge resulting in plausible and realistic mental simulations of future events (the constructive episodic simulation hypothesis; Schacter & Addis, 2007; Szpunar, 2010), and that

the recall of past events and imagining of future events draw on a common capacity for mental

simulation (Buckner & Caroll, 2007; Hassabis & Maguire, 2007; Suddendorf & Corballis, 2007).

The second is that an important component in imagining the future is the extent to which

envisioned events will be indeed part of a person's future (D'Argembeau, 2016). Similarly to

past memories, it is the degree to which a future event is believed to occur that makes the event

part of a person's future. Ernst and D'Argembeau (2017), for example, proposed that mental

simulations are associated, in varying degrees, with a subjective sense of belief that the imagined

event will occur in the future. They further proposed that, similar to belief in occurrence

appraisals for past events (Scoboria et al., 2014), belief in occurrence for future events reflects

metacognitive appraisals based on phenomenological experience, the information available at the

time(s) that future events are imagined, and other relevant knowledge.

The notion of belief in the occurrence of future events is intriguing. It presumes that the

type(s) of mental experience(s) associated with event occurrence can be associated with

simulations of events that are known to not yet have happened. Belief in occurrence is thought to

convey a sense of personal 'truth' or subjective veridicality to past events. As noted above,

Scoboria et al. (2014) defined belief in occurrence for past events as the attribution of an event to

self, past, and actual occurrence. The 'self' facet is presumably similar when imagining future

personal events. The temporal attribution is easily modified to 'future' or 'known to have not yet

have occurred'. This leaves the 'actual occurrence' component, which is necessarily

conceptually different for future events due to this knowledge that the event has yet to happen.

However, this does not preclude the possibility to attribute the experience of veridicality that

comes with belief in occurrence to mental representations of future events (see Arango-Muñoz &

Michaelian, 2014, and Moulin & Souchay, 2014, for further discussion of 'epistemic feelings'

that contribute to the experience of remembering). Feelings associated with events appearing

'genuine' or 'true' may be present when future events are contemplated.

Ernst and D'Argembeau (2017) reported data which extended the empirical distinction

between recollection and belief in occurrence to future event representations. In sum, they

provided the first evidence that people think of future events in terms of degrees of belief that

they will occur, and do use "belief in the possibility of occurrence" when appraising events that

might occur in the future. Based on their findings, Ernst and D'Argembeau proposed that belief

in future occurrence is related to the integration of future events within a broader

autobiographical context, and specifically to personal goals, the relationship of simulated future

events to other events in memory, knowledge of self and others, and the plausibility of potential

future events. They suggested that "belief in the occurrence of future events may mainly rely on

their personal plausibility and consistency with our knowledge and expectations about ourselves

and our life" (pp 1046-47). They reported quantitative (ratings of events) and qualitative data

(reports about justifications for belief in past and future events), which replicated previous

findings regarding the relationship between autobiographical belief and recollection for past

events (Scoboria et al., 2014; Scoboria & Pascal, 2016), and indicated similar relationships for

belief in occurrence and autonoetic awareness when people contemplate future events.

The present study

In order to shed further light on the notion of belief in future occurrence and to advance its

measurement, we aim to address a number of methodological limitations in Ernst and

D'Argembeau (2017). While a reasonable amount of work has been done on scale development

and establishing the validity of belief in occurrence for past events (e.g., Scoboria et al., 2004;

Scoboria et al., 2013; Scoboria & Pascal, 2016; Scoboria, Talarico & Pascal, 2015), Ernst and

D'Argembeau (2017) was the first systematic effort to examine belief in occurrence for future events (but see Scoboria & Wilson, 2011, for a discussion of belief in occurrence in the context of imagining future gambling wins for problem gamblers). Ernst and D'Argembeau (2017) used a single item to measure belief in occurrence for past and future events, with different item wording to reflect temporal direction (i.e., *While remembering/imagining this event, I feel that it actually occurred/will actually occur*). Given this use of a single item to measure belief in occurrence, little can be said about the reliability or validity of the future occurrence measure, or the comparative validity of the belief in occurrence for past and future events. Hence it remains empirically untested if measuring belief in occurrence for past and future events involves essentially the same underlying construct, or whether there are fundamental differences in the processes that influence ratings for each.

A second issue with the findings in Ernst and D'Argembeau (2017) is that they reported that event plausibility was related to belief in occurrence for future but not past events. Event plausibility is conceptually distinct from belief in occurrence, and reflects an appraisal of the possibility that an event could have occurred in the past (Scoboria et al., 2004); or in the case of future events, the possibility that an event could in principle occur in the future. Plausibility has been long identified as an important component of event memory (Scoboria et al., 2004). Plausibility is a contextual variable which reflects the integration of autobiographical knowledge, knowledge about an event, and knowledge of what can and cannot occur in the world (Blank, 2016). Plausibility can be measured at different levels of specificity. *General plausibility* is a judgment regarding the ontological status of events; it is the degree to which an individual believes that an event can occur to people in general. People also hold beliefs about the plausibility of an event for particular subgroups, which has been labelled 'cultural plausibility'

(Mazzoni, Loftus & Kirsch, 2001). *Personal plausibility* refers to an individual's judgment that an event can occur to the self (see Scoboria et al., 2004), and is the type of plausibility that has most frequently been measured in studies of autobiographical memory. It has been established that small changes in plausibility can potentiate the development of belief in the occurrence for false events (Mazzoni, Loftus & Kirsch, 2001). More generally, the level of plausibility constrains the degree to which an event is believed to have occurred (Scoboria et al., 2004), with the consequence that the belief rating for an event is typically lower than the plausibility rating for the same event (Scoboria, Mazzoni, Jarry & Shapero, 2012). However, appraisals of the plausibility of events are not fixed, and can increase or decrease when additional information about events is acquired (Mazzoni & Kirsch, 2001; Scoboria, Lynn, Hessen & Fisico, 2007; Scoboria, Mazzoni, Kirsch & Jimenez, 2006).

Because personal plausibility has been consistently related to belief in occurrence ratings for past events across numerous prior studies (e.g., McLelland, Devitt, Schacter & Addis, 2015; Scoboria et al., 2004; Scoboria et al., 2014; Scoboria & Pascal, 2016; Scoboria & Talarico, 2013), we wondered if in Ernst and D'Argembeau (2017) the relations between belief in occurrence and plausibility may have been influenced by skew in the distribution of belief in occurrence ratings given that average ratings approached the scale ceiling. Negative skew in belief ratings is often observed in studies that cue for strongly believed, vivid memories, hence ceiling effects for occurrence ratings may have influenced why plausibility was not related to belief in occurrence for past events in their data (Scoboria & Talarico, 2013). One method used to elicit events with 'weaker' associated autobiographical belief involves cueing for memories about which respondents are somehow "uncertain" (Scoboria, Talarico & Pascal, 2015). Most important for the current research, the measurement structure of scales of belief in occurrence

and recollection for past events have been found to be stable across different types of events and different cueing methods.

Given the results of the limited previous research examining belief in occurrence for future events, the primary goal of the present research was to examine commonalities and differences between the measurement of belief in occurrence for past and future events. We explored the extent to which belief in occurrence attributed to past and future event representations might be thought to reflect similar underlying processes. We replicated and extended Ernst and D'Argembeau (2017), by expanding the number of items used to measure belief in occurrence, by attending to the potential influence of ceiling effects in the rating of belief in occurrence when cueing events, and by validating English and French versions of the measure. To our knowledge, this is the first study to seek to validate a multiple-item belief in occurrence measure for future events.

Study 1

In Study 1 we expanded the conceptual breadth of an existing measure of belief in occurrence for past events (Scoboria et al., 2014), to create parallel forms for measuring belief in occurrence for past and future events. The past and future forms had similar item wordings with the exception of temporal reference. We addressed the issue of a "believed memory" bias when sampling events by cueing individuals to retrieve 'events' rather than 'memories' (Scoboria & Talarico, 2013), and by cueing for and assessing generalization across three different types of events (recent, distant, and uncertain). We included the 'uncertain' cue to increase variability in belief in occurrence ratings so that restricted range would be less likely to bias model solutions.

We used confirmatory factor analytic statistical techniques to estimate the fit of items to theorized latent constructs (belief in occurrence, and key aspects of recollection including spatial

characteristics and autonoetic awareness [feelings of reexperiencing/pre-experiencing associated with events]), and tested whether the resulting measures showed structural model equivalence (that loadings of items on latent variables was statistically the same across latent variables), supporting the view that belief in occurrence for past and future events involve overlapping processes. We then examined the relationship among these latent variables and other predictors known to be relevant to remembering the past / forecasting the future, to further examine the validity of the measures. We anticipated replicating Ernst and D'Argembeau (2017), in which personal plausibility, event importance, location, and sensory details correlated with belief in occurrence for future events.

Study 1 Method

Participants

664 MTurk workers completed the online survey, 330 in the past and 334 in the future event condition (randomly assigned). Each received $1.00 USD as a token of appreciation for completing the study. Workers were eligible if they had not completed a similar study with Scoboria's lab previously.

Responses to the cues were reviewed (see below for the criteria), and 233 participants in the past condition and 237 participants in the future condition provided usable responses to all three events. Demographic characteristics for the final sample were: Mean age = 36.71 (SD = 12.05), range 18 to 80; gender: 50.4% female, 45.2% male, 4.4% non-binary or not reported. Country of residence: 92.4% United States. Ethnicity: 6.2% Asian, 7.0% Black, 77.2% Caucasian, 5.5% Hispanic, 0.4% Native American, 3.7% mixed.

Measures

Events were rated on belief in occurrence (8 items), autonoetic awareness (4 items), spatial setting (4 items), and a number of single items: personal plausibility, visual detail, sensory detail, event importance and rehearsal. Past and future versions of each item were written that minimized wording differences. All items referred to 'events', and references to terms such as 'memory' and 'imagination' were minimized.

To create the pool of belief in occurrence items, the initial items were taken from Scoboria et al. (2014) and Ernst and D'Argembean (2017), and new items were written. We created parallel versions of each item for rating past and future events, and minimized differences in wording between the past and future versions. The remaining items were taken from prior work on autobiographical memory and future thinking, and were similarly worded to create closely parallel versions for rating past and future events. The complete list of items is provided in Appendix A. The items were presented in a random order following each event cue.

Procedure

Interested MTurk workers were randomly directed to one of two online surveys, one which cued participants to recall past events and the other to imagine future events (participants could only access one of the two surveys). Participants read general instructions about retrieving events, and then described, dated, and rated three past or three future events that were presented in a fixed order (due to limitations in the survey software): a recent event (in the past year / in the next year), an uncertain event, and a distant event (5-10 years ago / in 5-10 years). The verbatim event cues are provided in Appendix B.

Study 1 Results

Event screening. Two raters were trained to independently code the events. The goal of screening was to remove any reports that referred to extended events, lifetime periods, repeated

events, or that did not refer to events at all. These and all exclusion criteria were set in advance. The raters coded the narratives as Specific, Extended, Non-specific, Repeated, or Invalid, and agreed on classification for 94% of past and 98% of future cases. Disagreements were resolved via discussion. 71% of participants provided three 'specific' events and were included in the analyses; see Table 1 for the number of valid events per cue. Using participants with three complete events allowed us to statistically model the three events simultaneously. We note that analyzing the events separately and including all participants with a valid response for that event did not notably alter the findings reported below.

Primary Structural Equation Modelling Analyses

Confirmatory factor analysis (CFA) was used to test the latent structure of belief in occurrence, spatial, and autonoetic judgments for past and future events. CFA is a structural equation modeling (SEM) technique that requires one or more theoretical models be specified in advance of testing the fit of data to the model. Researchers define what factors will be present and onto which specific factor(s) indicators (items) will load. The data are then used to evaluate the extent to which the model explains covariance amongst the measured variables, resulting in an estimate of the degree to which the proposed theoretical model represents a good fit to the data.

For the primary model, model fit was tested simultaneously across the three events (recent, uncertain, distant) and two temporal directions (past, future). Items were loaded onto belief in occurrence (8 items), spatial (4 items), and autonoetic (4 items) latent variables for each event type and within each temporal direction, resulting in 18 latent variables in total (3 events

by 2 temporal directions x 3 LVs)[1]. Confirmatory Factor Analysis (CFAs) was performed in R

(R Development Core Team, 2008) using the Lavaan package, version .5-22 (Rosseel, 2012). No

problematic multivariate outliers were identified, and all cases were retained.

For past events, the initial model was a reasonably good fit to the data (robust CFI = .943;

robust RMSEA = .047 [.038,.055]; SRMR = .064). Examination of factor loadings (see Table 2)

indicated that all items loaded strongly and statistically significantly on their respective latent

variables. Examination of the modification indices indicated that residual error for one belief in

occurrence item (B7) tended to correlate with the residual errors for a number of the other belief

items. Removal of this item resulted in improved model fit (robust CFI = .953; robust RMSEA =

.033 [.029,.038]; SRMR = .063). For future events, the model with the 7-item belief scale was

also a reasonably good fit to the data (robust CFI = .937; robust RMSEA = .051 [.047,.055];

SRMR = .056). To assist with clarity of comprehension for the model, see Figure 1 for a

graphical representation of the resulting latent variables and correlations between LVs for one of

the event cues (Future Recent).

To address the question whether the belief in occurrence measure was equivalent for past

and future events, and whether the measure was equivalent across the three events, we fit a

model with the belief in occurrence latent variables for the three events adding a constraint of

group equivalence for loadings of indicators onto latent variables between past and future events,

and between the recent, distant, and uncertain cues. The loadings were statistically equivalent,

per the criteria described by Cheung and Rensvold (2002), who recommend a threshold of .01 or

below for change in the CFI fit index; ΔCFI was .003 for the current model. The complete model

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[1] We also attempted to fit a 'sensory' latent variable, using the visual and sensory items. This LV fit well for the three past events in Study 1, but rendered the model non-identifiable when the future events were included in the model. The model was also underidentified when this LV was included for Study 2. See the general discussion for more on mental simulation and the need for additional items when estimating this 'sensory' latent variable.

described above (including belief in occurrence, spatial, and autonoetic LVs) also indicated model equivalence (ΔCFI = .003). These models show that the indicators of belief in occurrence, spatial characteristics, and autonoetic awareness had statistically equivalent loadings on latent variables across the three event cues for both past and future events.

Relationships Between LVs and Single Item Covariates

Having established the latent structure of the belief in occurrence, autonoetic and spatial scales, we added the additional single items to the model (plausibility, rehearsal, visual, sensory, importance) to explore the relationships between the latent variables and these covariates. The single items were permitted to correlate in this model. Correlations between the latent variables are provided in Tables 3 and 4, and correlations between the single items covariates and latent variables are in Table 5.

Belief in occurrence for future events correlated positively with importance, plausibility, spatial, and autonoetic variables for all three events, and with visual detail for the recent event. Belief in occurrence for past events correlated positively with the plausibility and spatial variables for all three events, and with autonoetic awareness for the distant event. These findings generally replicate Ernst and D'Argembeau (2017).

Average item ratings

Mean ratings for the latent variables and the single items covariates are provided in Figure 2. The expected ceiling effect for belief in occurrence for past events was evident for the recent and distant event cues, and was not present for the uncertain event (also as expected). The item distribution was less of an issue for the future event cues, for which ratings did not approach the belief scale ceiling on average. We note that the robust estimation of model fit used for calculating model fit above corrects for this skewness in item distributions.

Belief in occurrence was rated lower on average for future events compared with past events. However, near future events tended to be rated high on belief in occurrence, raising the possibility that participants imagined and rated realistically anticipated near future events. All of the events were rated as fairly personally important, with the exception of 'past uncertain' events. Uncertain events were also characterized by lower ratings on predictors of recollection (i.e., spatial, visual, sensory details, autonoetic awareness). Future distant and future uncertain events showed a similar pattern of ratings. Overall, the pattern of differences between near and distant future events is consistent with previous findings (more sensory/contextual details and autonoetic awareness for near future events; see e.g., D'Argembeau & Van der Linden, 2004).[2]

Ratings of plausibility were generally high, and event importance was rated high for all events excepting past uncertain. Future events were rated high on average on the rehearsal scale, further indicating that many of the future events had been previously constructed and thought about. The issue of retrieval of previously constructed future scenes and construction of novel future events is considered further in the general discussion.

Study 1 Discussion

In Study 1, we developed an expanded seven-item measure of belief in occurrence with parallel forms for rating past and future autobiographical events. Structural modelling indicated a robust belief in occurrence latent variable, which generalized across three event cues and two temporal directions. In addition, we also report simultaneously measuring robust latent variables for other important aspects of remembering / forecasting: spatial detail and autonoetic awareness.

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[2] While we planned to collect data on the dating of events, due to a programming error, when asked to record temporal distance for future events, participants in the future event group were provided the same prompt as for the past event group "how long ago did this event occur". Many participants commented on being confused by the question, and the dating data provided for future events could not be used. The dates for past events were: Past Distant events, Average years = 14.98 (SD = 13.93), range 5 years to 56 years; Past Uncertain events, Average years = 7.39 (SD = 1.90 years), range 3 to 14 years; Past Recent events, Average days = 128 (SD = 105.53 days), range 1 to 365 days.

Consistent with Ernst and D'Argembeau (2017), event importance and personal plausibility correlated with belief in occurrence for future events, supporting the notion that belief in occurrence for future events is rooted in the fit of potential events with autobiographical knowledge and personal goals. Plausibility was more robustly related to belief in occurrence for past events than in Ernst and D'Argembeau (2017), which is more consistent with previous findings (Scoboria et al., 2004). Hence our study reinforces the importance of attending to the distribution of belief in occurrence ratings, as also done in Scoboria et al. (2014) and Scoboria, Talarico and Pascal (2015).

Past and future events were obtained using a between-subjects procedure. It is therefore necessary to examine the stability of the measure when participants report about both past and future events, to determine if the factor structure is stable when obtaining within-subjects measurement of past and future events (see Study 2).

Rehearsal ratings for future events were lower on average in Ernst and D'Argembeau (2017) than in the current study. The future events elicited in this study were rated fairly high on rehearsal, which, as previously noted, suggests that many of the future events may have previously been imagined/constructed and that participants may have retrieved memories of previously constructed future events (Jeunehomme & D'Argembeau, 2017; Szpunar, Addis, McLelland, & Schacter, 2013). Szpunar and Schacter (2013) found that repeated simulation of novel future events leads to future event representations becoming more detailed and perceived as more plausible. Hence the present study may have more to say about belief in occurrence for detailed and rehearsed future event representations. Future studies are needed in which the measure is applied to the development of belief in occurrence for novel future event simulations. It will be interesting to examine how belief in occurrence for future events develops over time,

which can potentially be accomplished with longitudinal use of the measure reported in this paper. The test-retest characteristics of the measure could also be assessed at such a time. The new measure could be used to observe patterns of change in belief in occurrence across repeated simulations of previously constructed and novel future events.

Consistent with previous research (Rubin, Schrauf & Greenberg, 2003; Rubin & Umanath, 2015; Scoboria et al., 2014; Scoboria, Pascal & Talarico, 2015), past distant and past recent events were characterized by regular rehearsal, strong mental simulation (visual, sensory, and spatial variables), autonoetic awareness, plausibility, and personal importance. In other words, these reports resembled other reports about vivid believed memories from the literature. Uncertain past events were rated as less frequently rehearsed, less personally important, and were associated with lower autonoetic awareness and lower mental simulation (visual, sensory, spatial).

Near future events were rated higher than distant future events for all items except importance, in line with previous findings (Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2004). Distant and uncertain future events did not differ notably. This suggests that there may be little difference between the distant future events and uncertain future events collected in this study, which makes sense given that distant future events may typically be experienced as inherently uncertain.

Study 2 Introduction

The purposes of Study 2 were to replicate Study 1 when collecting data using a within-subjects design in which participants reported and rated both a past and a future event, and to examine the generalizability of the measure when administered in French.

Study 2 Method

Participants

A total of 323 participants completed the study. Among these, 244 participants were recruited through the Prolific crowdsourcing platform, which is specifically tailored for research (https://www.prolific.ac/). Each Prolific participant received financial compensation of £2.50. The remaining 79 participants were recruited through forums or websites. Four participants were excluded due to the self-report of a current depression episode because depression can influence the phenomenological characteristics of memories and future thoughts (e.g., Anderson & Evans, 2015). The validity of responses was checked (see Results), leaving 251 participants who provided a specific event for both the past and the future cues. Demographic characteristics for the final sample were: Mean age = 29.99 (SD = 9.86), range 17 to 58; gender 66.1% female, 32.7% male, 1.2% not reported.

Measures

Events were rated using French translations of the items used in Study 1: belief in occurrence (8 items), autonoetic awareness (4 items), spatial setting (4 items), and the single items: personal plausibility, visual detail, sensory detail, event importance and rehearsal (see Appendix A). All items were independently translated by two English-French translators. The two translations were then compared and discrepancies were resolved by discussion.

Procedure

Participants were asked to produce two personal events, one for the past and one for the future (presented in a counterbalanced order). Instructions emphasized the importance of selecting specific and unique personal events, that is, events that are associated with a specific spatio-temporal context and lasting no more than a day. Participants read general instructions about event selection and then briefly described and rated a recent past event (something that occurred in the

past year) and an event that might happen in the near future (in the next year). The event cueing

procedure is detailed in Appendix C.

Study 2 Results

Event screening

Prior to data analysis, the specificity of events was checked using the following criteria

(Addis, Cheng, Roberts, & Schacter, 2011): an event was considered 'specific' if it referred to a

unique event occurring at a particular time and place, and lasting no longer than a day. Repeated,

extended or invalid events were considered 'non-specific'. Non-specific events were excluded,

leaving 273 past events and 258 future events. A random selection of 20% of transcripts was scored

by a second independent rater. The raters agreed on event specificity for 98% of past cases and

98% of future cases. Disagreements were resolved via discussion. Only participants who provided

a specific event for both the past and the future were included, leaving 251 participants (and thus

251 events per condition) for analysis.

As in Study 1, CFA was used to simultaneously test the latent structure of belief in

occurrence, spatial, and autonoetic judgments for the past and future events. Items were loaded

onto belief in occurrence (8 items), spatial (4 items), and autonoetic (4 items) latent variables for

each temporal direction, using the same approach and software as Study 1. No potentially

problematic multivariate outliers were identified and all cases were retained.

For past events, this model was a strong fit to the data (robust CFI = .991; robust RMSEA

= .017 [.001,.027]; SRMR = .064). Examination of factor loadings (see Table 6) indicated that

nearly all items loaded strongly and statistically significantly on their respective latent variables.

The loading for one belief in occurrence item was more modest at .40, but given that this item

performed well in Study 1 and the current loading was statistically meaningful, the item was

retained. Furthermore, the belief item removed in Study 1 performed well in Study 2, with little difference in model fit with the item included or excluded. Examination of modification indices did not reveal any problematic items, and all eight items were retained. For future events, the 8 item scale was a good fit to the data (robust CFI = .953; robust RMSEA = .021 [.00,.034]; SRMR = .047). The test of model equivalence indicated statically equivalent loadings of indicators on latent variables for the past and future events (ΔCFI = .001).

We added the single items covariates to the model (plausibility, rehearsal, visual, sensory, importance), which were permitted to correlate. Correlations between the latent variables are in Table 7, and correlations between the single items and latent variables are in Table 8. Consistent with Study 1, belief in occurrence for future events correlated positively with spatial characteristics, autonoetic awareness, plausibility, and importance, and did not correlate with the sensory or rehearsal items. Belief in occurrence for past events correlated positively with spatial characteristics, plausibility, visual detail, and importance; the sensory item did not correlate with past belief.

Mean ratings for latent variables and single items covariates are provided in Figure 3. The expected ceiling effect for belief in occurrence ratings was present, which is not surprising given that we did not cue multiple event types or attempt to elicit a broader range of responses on belief in occurrence in Study 2. We remind that the robust estimation of model fit corrects for skewness in item distributions.

Belief in occurrence for past events was rated higher on average than belief in occurrence for future events. Similar to Study 1, future events were rated above the mid-point on average on the rehearsal scale, indicating that many of the future events had been previously imagined and thought about. Both past and future events were rated as personally important, and high in

plausibility. Also as in Study 1, the pattern of differences between past and future events was consistent with prior findings (e.g., Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2004), with higher autonoetic, spatial, plausibility, sensory, and visual ratings on average for past events. The importance and rehearsal items did not differentiate past and future events.

Study 2 Discussion

Study 2 produced a robust replication of the measurement structure from Study 1 for belief in occurrence, spatial characteristic, and autonoetic awareness latent variables for both past and future events. All eight belief in occurrence items loaded well in Study 2, which may be related to the reduced complexity of the models (the absence of multiple events). This shows that the measurement structure for past and future events in Study 1 were not an artifact of the between subjects design or the specific cueing procedure – the measure performed similarly when people rated only past, only future, or both past and future events.

General discussion

The current findings are largely consistent with the results of Ernst and D'Argembeau (2017), and support the notion that future event representations are characterized by degrees of belief that future events will genuinely come to occur. The current relations between future belief in occurrence, event plausibility, event importance, and spatial characteristics support their argument that belief in occurrence for future events is rooted in autobiographical knowledge. In other words, belief in occurrence for future events is rooted in the degree to which potential events fit with understanding of one's self, expectations, goals and understanding of the world. This pattern of relations is similar, although not equivalent, for past events. Consistent with previous research, beliefs in past events are related to plausibility, spatial characteristics, and personal importance of events, suggesting that belief in occurrence for past and future events share substantially overlapping although not completely identical underlying processes.

These studies provide psychometrically improved measures for assessing belief in occurrence for past and future autobiographical events in English and French. The current research has emphasized internal consistency and construct representativeness. Future research is needed to establish additional psychometric properties of the measure, such as test-retest reliability and expanded convergent and divergent validity with other theoretically related and unrelated measures.

Challenges with distributions of belief in occurrence scores

Belief in occurrence is typically conceptualized as a continuous variable, which can take any value ranging from very weak to very strong. However, as reviewed above, obtaining a distribution of events that vary in belief in occurrence scores that includes not-strongly-believed event representations requires the use of event cues that either produce greater variation in responses, or cues that elicit events that are known to be characterized by lower belief in occurrence (e.g., nonbelieved memories, "uncertain" events, or events that happened to others, or other types of "not-believed-not-remembered" events; Scoboria et al., 2014; Scoboria, Talarico & Pascal, 2015).

Given the nature of this skew, we are not able to rule out that some of the relations estimated between belief in occurrence and other variables (particularly when single items are used) in the current studies are not partly attenuated (Kowalski, 1972). However, the body of evidence suggests that the item distributions obtained when measuring belief in occurrence does not present a major problem. Belief in occurrence measures tend to perform as expected when skew is accounted for by using robust model fit procedures during structural modelling (e.g., Scoboria et al., 2014; current studies) and when belief in occurrence is experimentally manipulated (e.g., Scoboria, Otgaar, & Mazzoni & 2018). We recommend that researchers

consider event cueing methods with care when working with memories in general, and in particular with belief in occurrence. The fact that the expanded scale hangs together well suggests that the various forms of variance that contribute to belief in occurrence as a construct are being captured by the current items.

Also important in examining the network of relations (Cronbach & Meehl, 1952) among the variables theorized to be relevant to understanding the experiences of autobiographical remembering and forecasting is considering whether all of the measures are of sufficient psychometric quality to reveal underlying relationships. In these studies, autonoetic awareness and spatial characteristics were modeled simultaneously with belief in occurrence, revealing consistent relationships across cueing procedures and temporal orientations. Given that the theory proposed by Ernst and D'Argembeau (2017) emphasizes that belief in occurrence when associated with future episodic thought is grounded in self-knowledge, event plausibility, and the personal importance of events, future research will also need to incorporate more robust (rather than single item) measures of these concepts. To our knowledge, no well-established multiple item scales exist (but see Berntsen & Rubin, 2006, for a measure of how central an event is to a person's identity and life story, and Svob, Brown et al., 2013, for a measure of the personal impact of events). A goal of future research might be to develop structural models of all relevant measurement components and to simultaneously test the fit of the scales. This is preferable to the approach often used in studies of event memory, where single items are included as covariates but are not formally incorporated in a more theoretically informed manner.

Understanding belief in occurrence appraisals for future events requires understanding how people come to view future events as having greater or lesser subjective sense of certainty of eventual occurrence. The data from Ernst and D'Argembeau (2017) points to several ways of

approaching this question that can be incorporated into measurement in future research. First, when justifying belief for future events some of their participants referred to 'commitment' to engaging in the event, such as intentions to attend scheduled events such as weddings (on average, this type of justification was provided for 13% of future events). Presumably this event will occur (due to knowledge that weddings once scheduled tend to happen), unless unanticipated (and perhaps implausible) intervening factors arise that result in the cancellation of the event or an inability to attend. Stronger belief in the occurrence should motivate efforts to ensure that the event comes to pass, and this has interesting implications for planning and updating of plans to anticipate factors that might facilitate or prevent the occurrence of events.

Furthermore, they found that participants frequently justified belief in future events in relation to personal goals (on average, this type of justification was provided for 41% of future events). The stronger the belief that a future event will occur, the more motivated a person may be to plan for and anticipate potential factors that might facilitate the occurrence of the event, and to anticipate factors that might prevent personally experiencing that event. Previous studies have shown that personal goals play an important role in guiding the construction of episodic future thoughts (D'Argembeau & Mathy, 2011) and in organizing imagined events in coherent themes and causal sequences (D'Argembeau & Demblon, 2012). Goals may also be closely related to belief in occurrence and this relation might be bidirectional: events that are related to goals may feel more "real" because one strives to achieve them (and thus one might have a sense of control over their occurrence) and, reciprocally, one might be more motivated to attain and plan for goal-related events because they feel more "real".

Conceptualizing belief in the past and in the future

In both studies, the structural modelling, in addition to revealing robust belief in occurrence components for past and future thinking, also indicated that the same variables were involved in predicting belief in occurrence in both temporal directions. The relations for past and future belief in occurrence were similar for three items: personal plausibility, spatial characteristics, and personal importance of events. This reveals how beliefs in both past and future events tap onto autobiographical knowledge and the appraisal of one's self, which include expectations, goals and most likely a more general understanding of the world. Past and future thinking might share substantially the same type of information, and at least partially overlapping processes (McDermott & Gilmore, 2015; Schacter et al., 2017; Suddendorf & Corballis, 2007). The integration of represented events with autobiographical knowledge is clearly a factor that could account (at least in part) for the commonality between past and future in terms of belief in occurrence. However, the overlap is not and cannot be complete as future thinking relies on mental simulation, imagination, and constructive processes to a greater extent than remembering.

In addition, the experience of envisioning future events is characterized by an unknowability and degree of uncertainty that typically does not apply to the experience of remembering the past. Ideas about 'veridicality' and 'accuracy' must be different between past and future events, as future events cannot be subjected to verification in the same manners that past events have the potential to be. Future simulation presumably also involves to a greater extent intentional cognitive appraisals of the relevance of future scenarios to the self and to personal goals. Future events might also be conceived as being of greater importance compared with past events (see also Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2006). Any type of past event can come to mind, from the most trivial to the most significant for the individual. Although importance of future events can vary substantially, in the current studies

people tended to report more significant future events, as indicated by event importance and rehearsal ratings.

Mental Simulation and Belief in Occurrence

There is good consensus in the literature around the notion of 'mental simulation' or what some term 'scene construction' as a core component of remembering and future thought[3] (Hassabis & Maguire, 2007; Schacter & Addis, 2007; Suddendorf & Corballis, 2007). Mental simulation refers to the capacity to form mental imagery of specific scenarios for a variety of purposes, such as imagining, remembering, or planning for the future. We note that we included items for 'visual' and 'sensory' detail in the current studies with mental simulation in mind. We did explore whether these two items might be included in the SEM models as a 'perceptual' factor that would contribute to a mental simulation construct. We found that including this two-item factor rendered the SEM model unidentifiable. However, ideally there would be three or more items for the scale, which is the most likely explanation for our inability to fit this additional latent variable within our models. Adding additional items related to mental simulation and perceptual features in future studies is likely to reveal this factor, given that similar scales have been developed (e.g., Sutin & Robins, 2007).

Notwithstanding this limitation in measuring a mental simulation construct, the present results clearly show that mental simulation and belief in occurrence are distinct aspects of episodic future thought. This finding is consistent with the view that the construction of specific event representations is an important but insufficient component of episodic future thinking: for an imagined event to be felt as truly belonging to one's personal future, it has to be meaningfully linked to autobiographical knowledge (D'Argembeau, 2016). The essence of episodic future

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[3] We do not imply equivalence between 'mental simulation' and 'scene construction', but to elaborate on the distinction would take the discussion in a direction not necessary for the paper.

thinking might thus lie at the conjunction of two components: mental simulation and the integration of imagined events in an autobiographical context. In other words, a key difference between episodic future thoughts and the imagination of fictitious, or atemporal scenes (de Vito et al., 2012) is that the former are meaningfully related to personal goals and/or general expectations about the self and one's life. The ensuing sense of "realness" when imagining events may in turn play an important role in goal pursuit, for example by increasing motivation and guiding actions toward desired future states (Baumeister et al., 2016).

Novel versus rehearsed Future Event Representations

As noted in both studies, rehearsal ratings were high for future events. This points to another challenge with eliciting and characterizing future event representations – the degree to which they have been previously constructed. There are relevant distinctions between novel, partial, well rehearsed, and even perhaps over-rehearsed images for future events (see Ingvar, 1985, for an early discussion of memory for the contents of future simulations or "memories of the future," and see Jeunehomme & D'Argembeau, 2017; Szpunar et al., 2013, for more recent findings). Another issue is the degree to which future event representations provided during studies such as these are formed spontaneously at the time of cueing, or whether they are retrieved more intentionally and planfully.

This issue is relevant when considering whether over-rehearsed future event representations might result in problems. Given notions that problem gamblers sometimes become convinced that they are "due a win" (Delfabbro, Lahn & Gabrosky, 2006) which contribute to a sense that a win in the future is inevitable, Scoboria and Wilson (2011) proposed that problem gambling behavior might be influenced by the development of vivid, believed false mental simulations for future gambling outcomes (which they speculated may even be

experienced as 'memories for future wins'). They found that a sample of problem gamblers rated belief in occurrence for future gambling wins as higher than future gambling losses, despite the fact that losses are the more likely outcome. Additionally, belief and memory for future wins correlated positively with frequency of gambling and positive gambling expectancies, whereas belief and memory for future losses correlated with negative outcome expectancies and problem gambling risk. Hence one question is whether overly rehearsed and overly believed future event representations might promote and reinforce psychopathology.

Future event representations play a role in a variety of mental health disorders (for a recent meta-analysis, see Hallford, Austin, Takano, & Raes, 2018). Many of the anxiety disorders are characterized by rumination about potential future events. Examples include visualization and anticipation of scenarios in which a panic attack might occur (panic disorder, simple phobias), or envisioning how others will engage in social shaming (social anxiety disorder) (see Milyoan, Bulley & Suddendorf, 2015; and see Hackmann & Holmes, 2004, for a discussion of intrusive prospective imagery across a variety of forms of psychopathology, Holmes & Mathews, 2010, for a review of mental imagery in emotional disorders, and Pearson, Naselaris, Holmes & Kosslyn, 2015, for a review of mental imagery that includes discussion of future prospection in clinical disorders). An interesting question for future research would be to assess whether belief in occurrence contributes to the individual's emotional responses when envisioning such future events.

Conclusion

In conclusion, the current studies advance conceptual understanding of the nature of belief in occurrence judgments for mental representations of past and future autobiographical events. The studies provide a psychometrically sound, conceptually broader measure of belief in

occurrence, which advances the validity of the concept (see Scoboria et al., 2014 for belief in occurrence applied to the past, and Ernst & D'Argembeau, 2017, for belief in occurrence for episodic future thought). Our results also suggest that the integration of events within autobiographical knowledge is an important factor for determining belief in occurrence for past and future events. An important avenue for future research would be to assess the predictive validity of our belief measure (Miloyan & MacFarlane, in press): although the future is fundamentally unknowable, people may have some ability to predict what will actually transpire, which may be reflected (at least in part) in their belief in future occurrence. This proposition could be tested by examining whether degrees of belief are related to the subsequent occurrence of imagined events.

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Table 1. Study 1, Participants with valid responses to each event cue.

	Total N	Recent	Uncertain	Distant	All three events valid
Past	330	282	287	296	233
Future	334	308	277	290	237

Table 2. Study 1, Loadings of indicators on latent variables.

Latent variable	Item	Past Events			Future Events		
		Uncertain	Distant	Recent	Uncertain	Distant	Recent
Belief in occurrence	b1	0.92	0.86	0.86	0.85	0.86	0.79
	b2	0.88	0.82	0.62	0.85	0.88	0.85
	b3	0.91	0.86	0.74	0.84	0.87	0.74
	b4	0.77	0.75	0.58	0.84	0.85	0.79
	b5	0.91	0.86	0.78	0.92	0.93	0.88
	b6	0.86	0.86	0.76	0.87	0.92	0.90
	b8	0.80	0.83	0.68	0.86	0.91	0.81
Spatial	sett	0.76	0.82	0.79	0.84	0.88	0.82
	spat	0.73	0.80	0.60	0.85	0.82	0.67
	loc1	0.87	0.90	0.80	0.91	0.95	0.91
	loc2	0.84	0.88	0.85	0.90	0.90	0.83
Autonoetic awareness	rel	0.83	0.87	0.76	0.83	0.84	0.65
	rxp	0.90	0.90	0.86	0.90	0.90	0.84
	mtt1	0.74	0.82	0.69	0.78	0.88	0.76
	mtt2	0.88	0.92	0.85	0.87	0.86	0.83

Table 3. Study 1, Correlations between LVs, Past events.

		Uncertain			Recent			Distant		
		Belief	Spatial	Auto	Belief	Spatial	Auto	Belief	Spatial	Auto
Uncertain	Belief	1	**0.24**	0.10	**0.35**	**0.23**	-0.11	**0.42**	0.01	-0.10
	Spatial		1	**0.67**	-0.01	0.02	0.02	0.08	**0.18**	0.11
	Auto			1	-0.15	-0.06	**0.33**	-0.10	**0.22**	**0.40**
Recent	Belief				1	**0.73**	0.16	**0.89**	**0.25**	0.07
	Spatial					1	**0.42**	**0.60**	**0.28**	0.14
	Auto						1	0.09	**0.26**	**0.58**
Distant	Belief							1	**0.37**	**0.16**
	Spatial								1	**0.77**
	Auto									1

Note: Statistically significant correlations are indicated in **bold** (p < .05). Auto – Autonoetic awareness. Belief – Belief in occurrence.

Table 4. Study 1, Correlations between LVs, Future events.

		Uncertain			Recent			Distant		
		Belief	Spatial	Auto	Belief	Spatial	Auto	Belief	Spatial	Auto
Uncertain	Belief	1	**0.29**	**0.46**	**0.16**	**0.20**	0.08	**0.23**	0.12	**0.17**
	Spatial		1	**0.81**	0.01	**0.18**	**0.21**	0.14	**0.38**	**0.29**
	Auto			1	0.02	**0.17**	**0.42**	**0.20**	**0.33**	**0.50**
Recent	Belief				1	**0.49**	**0.35**	**0.13**	-0.06	-0.05
	Spatial					1	**0.49**	**0.36**	**0.22**	**0.17**
	Auto						1	**0.50**	**0.27**	**0.49**
Distant	Belief							1	**0.36**	**0.50**
	Spatial								1	**0.82**
	Auto									1

Note: Statistically significant correlations are indicated in **bold** (p < .05).

Table 5. Study 1, Correlations between latent variable and single item predictors.

Variable	Event	Plausibility		Visual		Sensory		Importance		Rehearsal	
		Past	Future	Past	Future	Past	Future	Past	Future	Past	Future
Belief	Distant	**0.66**	**0.66**	0.04	0.06	0.16	0.14	0.06	**0.29**	0.04	0.05
	Recent	**0.46**	**0.60**	0.14	**0.16**	0.04	0.05	0.05	**0.17**	0.07	0.09
	Uncertain	**0.66**	**0.65**	0.14	0.08	0.08	0.06	0.12	**0.16**	0.01	0.11
Spatial	Distant	0.08	0.06	**0.62**	**0.75**	**0.42**	**0.42**	0.06	-0.09	**0.19**	**0.15**
	Recent	**0.34**	**0.16**	**0.36**	**0.63**	**0.31**	**0.32**	0.10	-0.08	**0.18**	0.08
	Uncertain	0.06	0.01	**0.68**	**0.77**	**0.46**	**0.44**	0.02	0.07	0.12	0.02
Autonoetic	Distant	-0.02	0.11	**0.52**	**0.64**	**0.45**	**0.45**	**0.24**	0.02	**0.24**	**0.20**
	Recent	-0.02	0.00	**0.40**	**0.60**	**0.41**	**0.43**	**0.25**	**0.14**	**0.18**	**0.14**
	Uncertain	-0.04	0.09	**0.61**	**0.65**	**0.49**	**0.50**	**0.24**	0.07	0.14	**0.14**

Note: Statistically significant correlations are indicated in **bold** ($p < .05$).

Table 6. Study 2, Loadings of indicators on latent variables.

Latent variable	Item	Past	Future
Belief in occurrence	b1	0.67	0.83
	b2	0.73	0.84
	b3	0.79	0.87
	b4	0.62	0.86
	b5	0.70	0.89
	b6	0.72	0.84
	b7	0.78	0.88
	b8	0.40	0.79
Spatial	spatial	0.60	0.74
	loc1	0.76	0.89
	loc2	0.84	0.94
	loc3	0.80	0.86
Autonoetic awareness	rel	0.77	0.87
	rxp	0.81	0.75
	mtt1	0.72	0.79
	mtt2	0.76	0.86

All loadings are statistically significant at $p < .001$.

Table 7. Study 2, correlations between LVs.

		Past			Future		
		Belief	Spatial	Auto	Belief	Spatial	Auto
Past	Belief	1	**.60**	**.23**	**.33**	.10	-.02
	Spatial		1	**.44**	**.34**	**.27**	**.16**
	Autonoetic			1	.10	**.35**	**.51**
Future	Belief				1	**.31**	**.31**
	Spatial					1	**.64**
	Autonoetic						1

Table 8. Study 2, Correlations between latent variable and single item predictors.

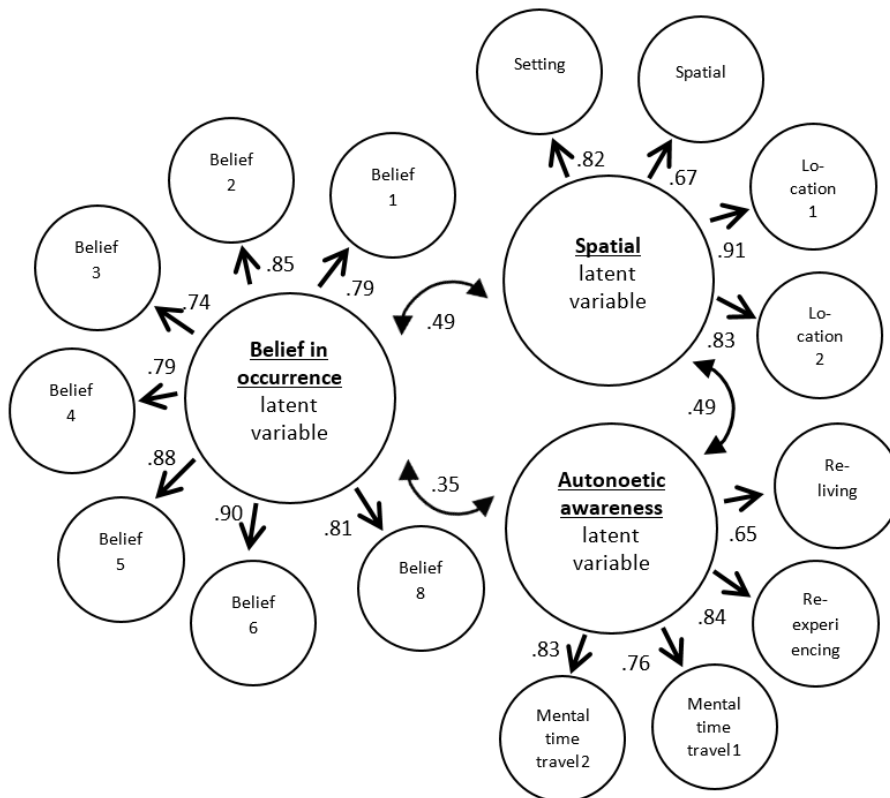| Latent variable		Plausibility	Visual	Sensory	Importance	Rehearsal
Past	Belief	**.56**	**.21**	.06	**.20**	-.04
	Spatial	**.34**	**.42**	**.25**	**.16**	.01
	Autonoetic	.03	**.32**	**.37**	**.20**	**.17**
Future	Belief	**.62**	.12	**.19**	**.28**	.09
	Spatial	.02	**.75**	**.27**	**.18**	.06
	Autonoetic	.01	**.48**	**.44**	**.30**	**.14**

Bold correlations are significant at p < .05.

Figure 1. Graphical depiction of the Future Recent event component of the model, including the belief in occurrence, spatial, and autonoetic awareness latent variables. The tables provide data on the identically and simultaneously modeled Past Distant, Past Recent, Past Uncertain, Future Distant, and Future Uncertain events. Straight lines indicate loadings of indicators on LVs, and curved lines correlations between LVs. All coefficients are statically significant.

Figure 2. Study 1, Average ratings for past and future events by event type.
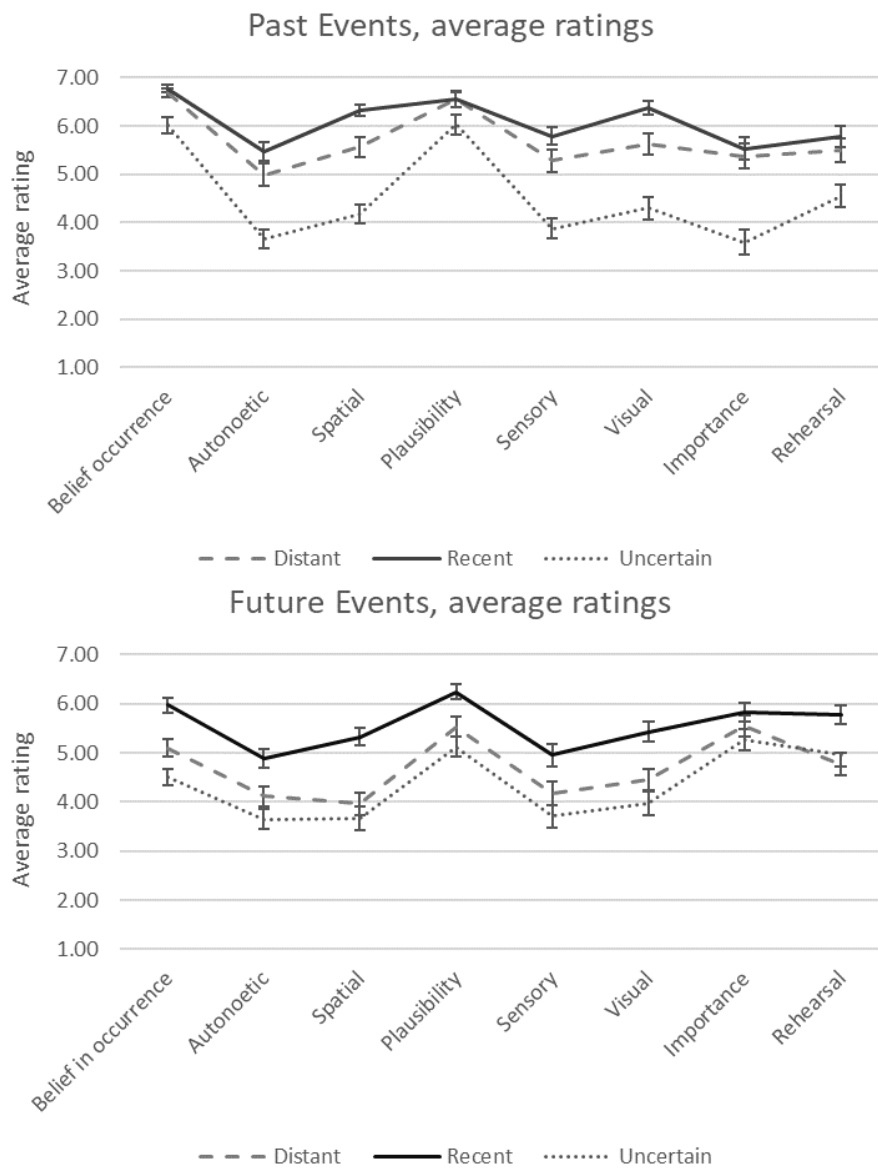
Error bars show 95% confidence intervals on the means.

Figure 3. Study 2, Average ratings for past and future events.
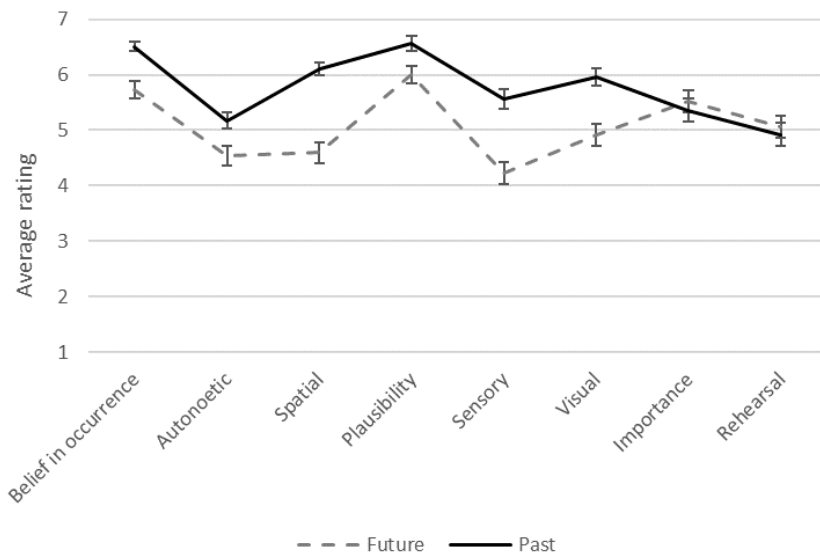
Error bars show 95% confidence intervals on the means.

Appendix A. Items used to rate events.

Construct	Study 1 Past Events	Study 1 Future Events	Source	Study 2, French versions
Belief in occurrence 1	How likely is it that you personally did in fact experience this event? 1 Definitely did not happen; 7 Definitely happened	How likely is it that you personally will in fact experience this event? 1 Definitely will not happen; 7 Definitely will happen	Scoboria et al. (2004)	Dans quelle mesure avez-vous réellement fait (ferez-vous réellement) l'expérience de cet événement ? (1 = il ne s'est certainement pas produit (il ne se produira certainement pas), 7= il s'est produit de manière certaine (il se produira de manière certaine)
Belief in occurrence 2	It is true that this event occurred to me. 1 Not at all true; 7 Extremely true	It is true that this event will occur to me. 1 Not at all true; 7 Extremely true	Scoboria et al (2014)	Cet événement m'est arrivé (va vraiment m'arriver) : (1=pas du tout vrai, 7=extrêmement vrai)
Belief in occurrence 3	How strong is your belief that this event actually occurred? 1 No belief, 7 Strong belief	How strong is your belief that this event will actually occur? 1 No belief, 7 Strong belief	Scoboria et al. (2014)	Quel est votre degré de conviction dans le fait que cet événement s'est réellement produit (va réellement se produire) ? (1=aucune conviction, 7=très forte conviction)
Belief in occurrence 4	While remembering this event, I feel that it actually occurred 1 not at all, 7 very strongly	While imagining this event, I feel that it will actually occur 1 not at all, 7 very strongly	Ernst & D'Argembeau (2017)	En me rappelant (en m'imaginant) cet événement, j'ai le sentiment qu'il a réellement eu lieu (va réellement avoir lieu) (1 = pas du tout, 7 = très fortement)
Belief in occurrence 5	I feel that this event really happened to me 1 No feeling; 7 strong feeling	I feel that this event will really happen to me 1 No feeling; 7 strong feeling	New item: emphasis on feeling of belief	J'ai le sentiment que cet événement m'est vraiment arrivé (va vraiment m'arriver) (1= pas du tout, 7 = énormément)
Belief in occurrence 6	Whether or not I can visualize this event clearly, I believe the event actually happened to me. 1 Not at all, 7 Very much	Whether or not I can visualize this event clearly, I believe the event will actually happen to me. 1 Not at all, 7 Very much	New item: emphasis on belief, regardless of clarity of mental simulation.	Que j'arrive ou non à visualiser clairement cet événement, j'ai la conviction qu'il m'est vraiment arrivé (va vraiment m'arriver) : (1 = pas du tout, 7 = énormément)
Belief in occurrence 7	I believe this event really occurred. 1 Definitely did not occur; 7 Definitely occurred	I believe this event will really occur. 1 Definitely will not occur; 7 Definitely will occur	New item	J'ai la conviction que cet événement s'est réellement produit (va réellement se produire) : (1= il ne s'est certainement pas produit (ne se produira certainement pas), 7 = il s'est produit de façon certaine (il se produira de façon certaine)

Belief in occurrence 8	I believe that this event actually occurred to me, even if the details that I remember is not completely accurate. 1 Not at all, 7 Very much	I believe that this event will actually occur to me, even if the details that I imagine will not be completely accurate. 1 Not at all, 7 Very much	New item; Emphasis on occurrence regardless of detail accuracy	J'ai la conviction que cet événement m'est vraiment arrivé (va vraiment m'arriver), même si les détails dont je me rappelle ne sont pas (que j'imagine ne seront pas) nécessairement tout à fait exacts. (1 = pas tout tout, 7 = énormément)
Personal plausibility	How plausible is it that you personally could have experienced this event? 1 Not at all plausible, 7 Extremely plausible	How plausible is it that you personally could experience this event? 1 Not at all plausible, 7 Extremely plausible	Scoboria et al. (2004)	Dans quelle mesure est-il plausible que vous, personnellement, ayez vécu (serez amené à vivre) cet événement ? (1 = pas du tout plausible, 7 = très plausible)
Visual	When I think about this event it involves visual details: 1 Not at all; 7 Very much	When I think about this event it involves visual details: 1 Not at all; 7 Very much	Numerous	En me rappelant de (en m'imaginant) cet événement, il inclut des détails visuels : (1 = pas du tout, 7 = énormément)
Spatial 1 (Sensory)	My representation of this event contains sensory details (I can see, hear or perceive what happened) 1 Not a lot; 7 A lot	My representation of this event contains sensory details (I can see, hear or perceive what will happen) 1 Not a lot; 7 A lot	Ernst & D'Argembeau (2017)	Ma représentation de cet événement comporte des détails sensoriels (je peux voir, entendre ou percevoir ce qui s'est passé (va se passer)) (1 = pas du tout, 7 = énormément)
Spatial 2 (Setting)	As I think about the event, I can visualize the setting where it occurred. 1 Vague; 7 Clear distinct	As I think about the event, I can visualize the setting where it will occur. 1 Vague; 7 Clear distinct	Numerous	Lorsque je pense à cet événement, je vois le lieu où il s'est produit (va se produire) : (1 = pas du tout, 7 = très clairement)
Spatial 3 (Location 1)	When I think about this event, the location where the event takes place is: 1 Vague; 7 Clear distinct	When I think about this event, the location where the event takes place is: 1 Vague; 7 Clear distinct	Numerous	En me rappelant de (en m'imaginant) cet événement, le lieu où il a eu lieu (va avoir lieu) est : (1 = vague, 7 = très clair)
Spatial 4 (Location 2)	As I think about this event, I can see the location/ setting where it took place 1 Not at all; 7 Extremely clear	As I think about this event, I can see the location/ setting where it will take place 1 Not at all, 7 Extremely clear	Ernst & D'Argembeau (2017)	En me rappelant de (en m'imaginant) cet événement, le cadre/l'environnement où il a eu lieu (va avoir lieu) est : (1 = vague, 7 = très clair)
Objects/ People	When I think about this event, the relative spatial arrangement of objects and people are: 1 Vague; 7 Clear/distinct	When I think about this event, the relative spatial arrangement of objects and people are: 1 Vague; 7 Clear distinct	Numerous	En me rappelant de cet événement, la configuration spatiale des objets ou des personnes présents est : (1 = vague, 7 = très claire)
Autonoetic 1 (Mental time travel 1)	As I think about the event, I feel that I travel back to the time when it happened, that I am a subject in it,	As I think about the event, I feel that I travel forward to the time when it will happen, that I am a	Numerous	En me rappelant de (en m'imaginant) cet événement, j'ai le sentiment de voyager dans le temps jusqu'au moment où cet événement s'est produit (se produira) et

	rather than an outside observer tied to the present: 1 Not at all; 7 Very much	subject in it, rather than an outside observer tied to the present: 1 Not at all; 7 Very much		d'en faire pleinement partie, plutôt que de l'observer de l'extérieur depuis le présent : (1 = pas du tout, 7 = très fortement)
Autonetic 2 (Mental time travel 2)	While thinking about this event, I feel that I travel back in time and that I am right at the moment when this event happened 1 Not at all; 7 Absolutely	While thinking about this event, I feel that I travel forward in time and that I am right at the moment when this event will happen 1 Not at all, 7 Absolutely	Ernst & D'Argembeau (2017)	En me rappelant de (en m'imaginant) cet événement, j'ai l'impression de retourner dans le passé (d'aller dans le futur) et de me retrouver (trouver) au moment où cet événement s'est produit (se produira) (1 = pas du tout, 7 = très fortement)
Autonoetic 3 (Reliving)	As I think about the event, I feel as though I am re-living the event: 1 Not at all; 7 Very much	As I think about the event, I feel as though I am pre-living the event: 1 Not at all; 7 Very much	Numerous	En me rappelant de (en m'imaginant) cet événement, j'ai comme le sentiment de revivre (vivre) cet événement : (1 = pas du tout, 7 = très fortement)
Autonoetic 4 (Re-experience-ing)	While thinking about this event, I feel that I am re-experiencing the situation, as if I was there 1 Not at all; 7 Very strongly	While thinking about this event, I feel that I am experiencing the situation, as if I was there 1 Not at all; 7 Very strongly	Ernst & D'Argembeau (2017)	En me rappelant (en m'imaginant) cet événement, j'ai le sentiment de revivre (vivre) l'événement comme si j'y étais (1 = pas du tout, 7 = très fortement)
Importance	This event is important to me (in relation to my goals, my values, and so on) 1 Not at all important; 7 Very important	This event is important to me (in relation to my goals, my values, and so on) 1 Not at all important; 7 Very important	Numerous	Cet événement est un moment important pour moi, par rapport à mes buts, mes valeurs, etc. (1 = pas du tout important, 7 = très important)
Rehearsal	I have thought or talked about this event before: 1 Not at all; 7 Very much	I have thought or talked about this event before: 1 Not at all; 7 Very much	Numerous	J'ai déjà pensé à ou parlé de cet événement avant de l'évoquer aujourd'hui (1 = jamais, 7 = très souvent)
Objective distance	How far in the past did this event occur? (Text box)	How far in the future will this event occur? (Text box)		*Not measured in Study 2.*

Appendix B

Study 1 – English, event cueing procedure

<u>Past events</u>
 "You will be asked to think of a number of EVENTS from your past. By ''Event'' we mean any story or scene that can occur at a particular time and in a specific place. Events usually last for minutes or hours and no more than a single day. A box will appear where you will type a short description of this event. All of the events should be different. Please do not record any proper names (for people or places) or other information that would let us know who you are – use an initial if necessary. We would like you to record the first event that comes to mind for each prompt. After each prompt you will be asked to make ratings about the event. The event may or may not have been significant to you. You also may or may not have thought much about the event since it happened, it does not matter. You may or may not have discussed this past event with other people. We are interested in any and all personally-experienced events that have happened in your past."

Past recent event: "Please select an event that you recall from <u>within the past year</u>. Please provide a brief description of the event in the box below. Do not include any personally identifying information in your description."

Past uncertain event: "Please think about a past event for which you are <u>uncertain about what you remember</u>. This might mean that you are not certain about all of the details that you recall, that something seems to be missing from what you remember, that something is just not quite right about the memory, or you may not be sure that the event occurred at all."

Past distant event: "Please select a different event, one that you recall from <u>five to ten years ago</u>. Please provide a brief description of the event in the box below. Do not include any personally identifying information in your description."

<u>Future events</u>
You will be asked to think of a number of <u>EVENTS</u> from your future. By ''Event'' we mean any story or scene that can occur at a particular time and in a specific place. Events usually last for minutes or hours and no more than a single day. A box will appear where you will type a short description of this event. All of the events should be different and unique (do not report routine or repeated events). Please do not record any proper names (for people or places) or other information that would let us know who you are – use an initial if necessary. We would like you to record the first event that comes to mind for each prompt. After each prompt you will be asked to make ratings about the event. The event may or may not be significant to you. You also may or may not have thought about this event happening in the future, it does not matter. You may or may not have discussed this future event with other people. We are interested in any and all personally-experienced events that may happen in your future.

Future recent event: Please imagine an event that might occur <u>within the next year</u>. Please provide a brief description of the event in the box below. Do not include any personally identifying information in your description.

Future uncertain event: Please think about a future event for which you are uncertain about what you imagine. This means you are not certain about all the details you think about, that something seems to be missing from this future scenario, that something is just not quite right about the scene, or you may not be sure that the event will occur at all.

Future distant event: Please imagine an event that might occur <u>in five to ten years time</u>. Please provide a brief description of the event in the box below. Do not include any personally identifying information in your description.

Appendix C

Study 2 – French, event cueing procedure

Past events
Nous vous demandons de penser à un événement personnel de votre passé, qui a eu lieu au cours des 12 derniers mois.

Il doit s'agir d'un événement passé spécifique, qui s'est produit à un moment et dans un endroit précis. Cet événement peut avoir duré quelques minutes ou quelques heures, mais s'est déroulé au maximum sur une journée. Par exemple, « *ma semaine de vacances à Paris* » n'est pas un événement précis. En revanche, « *la visite du Louvre* » est un moment spécifique.
Cet événement doit être unique et ne doit pas correspondre à quelque chose de routinier ou d'habituel pour vous. Par exemple, « *je vais à la piscine tous les mercredis* » est routinier. Par contre, « *le passage de mon brevet de natation* » est un moment unique.
Une fois cet événement passé sélectionné, veuillez en donner ci-dessous une brève description et répondre à une série de questions le concernant.
Note : certaines questions vous paraitront peut être plus ou moins semblables. Dans tous les cas, répondez de façon distincte à chaque question. Ce qui nous intéresse est votre réponse pour chaque question individuellement.

Décrivez brièvement cet événement passé spécifique et unique dans la zone ci-dessous.
Afin de garantir votre anonymat, mentionnez les personnes ou les lieux par des initiales si nécessaire et évitez l'évocation de tout élément qui pourrait permettre de vous identifier.

Future events
Nous vous demandons de penser à un événement personnel de votre futur, qui pourrait avoir lieu au cours des 12 prochains mois.
Il doit s'agir d'un événement futur spécifique, qui se produit à un moment et dans un endroit précis. Cet événement peut durer quelques minutes ou quelques heures, mais doit se dérouler au maximum sur une journée. Par exemple, « *ma semaine de vacances à Paris* » n'est pas un événement précis. En revanche, « *la visite du Louvre* » est un moment spécifique.
Cet événement doit être unique et ne doit pas correspondre à quelque chose de routinier ou d'habituel pour vous. Par exemple, « *je vais à la piscine tous les mercredis* » est routinier. Par contre, « *le passage de mon brevet de natation* » est un moment unique.
Une fois cet événement futur sélectionné, veuillez en donner ci-dessous une brève description et répondre à une série de questions le concernant.
Note : certaines questions vous paraitront peut être plus ou moins semblables. Dans tous les cas, répondez de façon distincte à chaque question. Ce qui nous intéresse est votre réponse pour chaque question individuellement.
Décrivez brièvement cet événement futur spécifique et unique dans la zone ci-dessous.

Afin de garantir votre anonymat, mentionnez les personnes ou les lieux par des initiales si nécessaire et évitez l'évocation de tout élément qui pourrait permettre de vous identifier.