Effects of past and future autobiographical thinking on the working self-concept

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Abstract

While the role of autobiographical memory in self-representation is well established, the identity function of future thinking has received much less attention. Yet, most people commonly imagine future events that convey meaningful information about the person they wish or expect to become. In three experiments, we assessed the extent to which thinking about such self-defining future events influences the current content of self-representation (i.e., the working self-concept). Participants were asked to think about either a past or future self-defining event, or a control topic, before describing aspects of their identity in the form of 'I am' statements (Experiments 1 and 3) or completing scales assessing self-related dimensions (Experiments 2 and 3). We found that thinking about a future self-defining event led participants to conceptualize themselves more in terms of their psychological traits, as did thinking about a past self-defining event. Furthermore, thinking about a future self-defining event increased the sense of present-future self-continuity, whereas thinking about a past self-defining event increased the sense of past-present self-continuity. These results suggest that self-representations are fuelled not only by autobiographical memories, but also by projections into the future.

Keywords: autobiographical memory; future thinking; self; identity

Having a sense of self—a representation of oneself as a unique individual with a personal history—is a central, perhaps distinctive, feature of human experience (Leary & Buttermore, 2003). This notion of self relies, in part, on mental representations of our personal characteristics and past experiences that are stored in long-term memory (Conway, 2005; Klein & Gangi, 2010; Neisser, 1988; Prebble et al., 2013). But our sense of self is not limited to the past; it also extends into the future. Our goals, expectations, hopes, and fears for the future are an important part of our identity that give direction and meaning to our lives (Markus & Nurius, 1986; McAdams, 2001). In recent years, considerable progress has been made in understanding the cognitive and neural mechanisms that allow us to think about the future (Addis, 2020; D'Argembeau, 2020; Schacter et al., 2017), yet the role of future thinking in shaping our self-conceptions has remained understudied. Here, we sought to examine this issue by assessing the extent to which thinking about personally important future events modulates the activation of information within the self-concept.

Memory and the self

Martin Conway's Self Memory System (SMS) is certainly one of the most influential conceptual frameworks that account for the memory basis of the self (Conway, 2005; Conway et al., 2004; Conway & Pleydell-Pearce, 2000). In this model, the self relies on a multi-layered representational structure that involves three main systems: the conceptual self (or self-concept), autobiographical knowledge, and episodic memory. The self-concept includes abstract (semantic) representations of one's personal characteristics (e.g., traits, abilities, and preferences), the autobiographical knowledge base provides information about the overall structure of one's life (organized in life periods and general events), and episodic memory keeps records of the details (sensory-perceptual, contextual, cognitive, and emotional) of specific experiences (Conway, 2009). Substantial evidence supports this tripartite distinction.

For example, neuropsychological studies have shown that these layers of self-representations can be selectively impaired (Grilli et al., 2018; Klein & Lax, 2010; Rathbone et al., 2009). Furthermore, neuroimaging studies have revealed that different types of autobiographical representations are associated with specific neural signatures within a widely distributed set of brain regions—corresponding to the default network (Cabeza & St Jacques, 2007; Kim, 2012; Svoboda et al., 2006). The retrieval of specific memories predominantly activates the medial temporal lobes and posterior cortical structures, whereas autobiographical knowledge and the self-concept mainly involve frontal and lateral temporal regions (for a meta-analysis, see Martinelli et al., 2013).

Although the self-concept, autobiographical knowledge base, and episodic memory involve distinct representational structures, the three systems interact closely. Indeed, specific autobiographical memories are conceived as transitory patterns of activation over the entire knowledge structure and thus not only contain episodic details (e.g., a mental image of my sister riding a bike near the beach), but also higher-order autobiographical knowledge that locates these details in the context of one's life (e.g., this happened during one of these weekends on the Belgian sea cost when we were children) (Conway, 2001; Conway & Pleydell-Pearce, 2000). Furthermore, autobiographical memories and the self-concept mutually influence each other: the self-concept modulates the formation of memories and, reciprocally, memories support the self-concept. As Conway put it, self-conceptions "are connected to autobiographical knowledge and the episodic memory system to activate specific instances that exemplify, contextualize, and ground their underlying themes or concepts" (Conway, 2005, p. 597).

The bi-directional relationship between the self-concept and autobiographical memories has notably been evidenced using the "*I AM* task" in which people are asked to provide a series of self-descriptions (Charlesworth et al., 2016; Rathbone et al., 2008, 2009).

In some studies, participants first had to generate self-images (e.g., I am confident), which were then used to cue autobiographical memories. Results showed that these memories clustered temporally around periods of identity formation (Rathbone et al., 2008). Conversely, Charlesworth et al. (2016) examined the extent to which recalling an autobiographical memory influenced the activation of self-conceptions. Participants wrote a description of an autobiographical memory or a control topic of no relevance to the self and then generated self-descriptions, each beginning with *I am*. Results showed that participants in the autobiographical memory condition generated proportionately more psychological (trait-like) descriptions, suggesting that autobiographical retrieval modulated access to information within the self-concept. These results show that self-conceptions are dynamic and somewhat malleable (DeSteno & Salovey, 1997). At any given moment, only a subset of self-conceptions is momentarily accessible, forming the working self-concept (Markus & Wurf, 1987). According to the SMS, the working self organizes the encoding and retrieval of autobiographical memories based on current goals and self-images and, conversely, the content of the working self constantly changes according to the information drawn from autobiographical memories (Conway, 2005).

Of course, not all autobiographical memories are equally important for the self-concept. A subset of autobiographical memories—referred to as *self-defining memories* (SDMs)—plays a particularly significant role in understanding who one is as a person (Singer et al., 2013; Singer & Moffitt, 1991). SDMs are vivid and frequently accessed memories that represent the dominant themes and concerns in a person's life, thereby grounding and exemplifying self-conceptions through personal experiences (Conway et al., 2004). SDMs are the building blocks of narrative identity—they form the stories we construct about ourselves to give unity and meaning to our lives (Singer et al., 2013). In keeping with the SMS framework, research has shown that the retrieval of SDMs leads to the activation of specific

information within the working self (Çili & Stopa, 2015). More generally, dimensions of SDMs have been related to adaptive and maladaptive personality traits, as well as various clinical disorders (Blagov et al., 2022; Wright et al., 2022).

Future thinking and the self

Our sense of self is not only based on mental representations of our personal past, but also on the imagination of what our personal future might be like. Markus and Nurius (1986) introduced the concept of *possible selves* to refer to representations of what we might become, would like to become, and are afraid of becoming in the future. Possible selves are closely related to personal goals and function as incentives for behaviour. For example, imagining a successful career organizes and energizes actions to achieve that future state.

Possible selves vary in their scope and degree of abstraction: some involve general representations of the self in the future (e.g., future traits, social roles, and occupations), while others include details that specify how and when a future self could be attained (Markus & Nurius, 1986; Oyserman & James, 2009). This latter type of possible selves could serve as the future counterpart of self-defining memories (i.e., mental representations of future events that relate to important goals and provide information for self-understanding), which D'Argembeau et al. (2012) have called *self-defining future projections* (SDFPs). SDFPs may provide an experiential understanding—through mental simulation—of what a future self would be like.

The role of future event representations in the sense of self has been much less studied than the role of memory for past events, yet there is evidence that future events are, on average, considered as more important to the self than past events (Addis et al., 2008; Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2006). Several studies have shown

that most people can readily imagine self-defining future events, that is, events that convey significant information about the person they wish or expect to become in the future . The characteristics of past and future self-defining events are correlated (D'Argembeau et al., 2012), and both types of events are often organized in coherent networks according to their themes and identity motives (Demblon & D'Argembeau, 2017). Other studies have shown that future self-conceptions are associated with representations of specific future events that temporally cluster around expected periods of identity development (Chessell et al., 2014; Rathbone et al., 2011), and that the activation of future self-conceptions affects the characteristics of related event representations (Hamilton & Cole, 2017).

The SMS framework has recently been extended to account for the role of future-oriented cognition in self-representation (Conway et al. 2019; see also D'Argembeau, 2020; D'Argembeau et al., 2012). According to this view, like past self-representations, imagined future selves are supported by three main representational systems: abstract self-conceptions, autobiographical knowledge, and episodic simulation. The self-concept includes semantic knowledge about personal goals and anticipated self-attributes, such as one's future traits (e.g., being self-assured), physical features (e.g., being in good shape), general abilities (e.g., speak well publicly), occupations (e.g., owner of a business), and social roles (e.g., being a parent). Autobiographical knowledge includes general representations of what one's future life might be like, which is organized in a series of anticipated life periods (e.g., "when I'll have moved to X", "when I'll own my own business") and general events (e.g., "going on vacation in Italy next summer", "meetings with my new colleagues"). Episodic memory contains a pool of experiential details that can be used not only to mentally reconstruct past events, but also to mentally simulate specific events that might happen in the future—a capacity that has been referred to as episodic future thinking (Atance & O'Neill, 2001; Schacter & Addis, 2007; Suddendorf & Corballis, 2007; Szpunar, 2010).

According to the SMS, these three representational systems closely interact. Autobiographical knowledge guides the construction and organization of episodic future thoughts (D'Argembeau & Demblon, 2012; D'Argembeau & Mathy, 2011), and self-conceptions are supported by the imagination of future events that exemplify, contextualize, and ground personal goals and self-attributes—such as SDFPs (D'Argembeau et al., 2012). For example, a person who sees herself as a mother in the future may nurture this self-image by picturing herself in the maternity ward, taking the children to school, playing with them in the garden, and so on. Supporting this role of future event representations in anchoring self-representation, neuroimaging studies have shown that, like autobiographical memory retrieval, episodic future thinking recruits a distributed set of brain regions (Benoit & Schacter, 2015), and that imagining personally significant future events activates regions underlying the self-concept, such as the medial prefrontal cortex (D'Argembeau et al., 2010).

The present research

Despite burgeoning research on the relationship between future thinking and the self, direct evidence for the role of future event representations in nourishing self-views is still scarce. To address this question, the present experiments investigated whether and how thinking about a personally important future event (a SDFP) modulates the content of the working self (i.e., the kind of self-conceptions that are active at a given moment), as has been demonstrated with memories for past events (Charlesworth et al., 2016; Çili & Stopa, 2015; Grace et al., 2021; Sedikides et al., 2015). With this in mind, we selected self-concept measures for which previous studies have shown consistent relationships with autobiographical memory. The "*I AM* task" is an open-ended measure of self-concept content that has been adapted from the twenty statements test (Kuhn & McPartland, 1954) and has been frequently used (in different variants) in relation to autobiographical memory (e.g., Addis & Tippett, 2004; Rathbone et al.,

2008). Here, we used the version developed by Charlesworth et al. (2016) to investigate how autobiographical memory retrieval influenced the activation of self-conceptions. More specifically, Experiment 1 examined whether thinking about a SDFP increases access to psychological self-conceptions to the same extent as thinking about a SDM.

Self-continuity is another important dimension of the self that has been frequently investigated in relation to autobiographical memory (e.g., Sedikides et al., 2015; van Tilburg et al., 2019; for review, see Sedikides et al., 2023). Thus, Experiment 2 assessed the effects of thinking about a future or past self-defining event on measures of self-continuity. In addition, we also explored whether thinking about past and future self-defining events affects other self-relevant dimensions, such as meaning in life and self-concept clarity, although these aspects have been less frequently assessed in relation to autobiographical thinking (but see Çili & Stopa, 2015; van Tilburg et al., 2019).

Together, Experiments 1 and 2 showed that both SDMs and SDFPs increased access to psychological self-conceptions and enhanced feelings of self-continuity. However, a limitation of these experiments was that the control condition differed from the self-defining conditions not only in terms of self-relevance but also in terms of temporal dimension. Experiments 3 thus aimed to replicate the effects of self-defining future projections using a better-matched control condition.

Experiment 1

The purpose of Experiment 1 was to replicate the results of Charlesworth et al. (2016) showing that thinking about a past autobiographical event increases access to psychological (trait-like) self-conceptions, and to further investigate whether a similar effect is observed when thinking about a future self-defining event.

Method

Participants. Participants were 198 young adults (154 women, 44 men; mean age = 22.46 years, *SD* = 3.66; average number of completed years of education = 15.44, *SD* = 2.18) who were recruited on social media. They were randomly assigned to the three group conditions (n = 66, 67, and 65, for the past self-defining, future self-defining, and control conditions, respectively). This sample size was determined a priori to have a statistical power of 80% to detect a significant difference between the self-defining and control conditions, with a medium effect size ($d = 0.5$) and an alpha of 0.05. Note that Charlesworth et al. (2016, Experiment 2) observed that autobiographical retrieval increased the proportion of psychological self-descriptions with an effect size of $d = 0.61$, so our sample size gave us over 90% power to replicate this effect. Seventy additional participants were tested but excluded (and replaced by other participants) because they failed to pass an instructional manipulation check (see below). All participants provided informed consent and this study was approved by the Ethics Committee of the Faculty of Psychology of the University of Liège (ref. 1819-14).

Materials and Procedure. The experiment was administered online using the experiment builder developed by the Faculty of Psychology of the University of Liège. Participants first provided their informed consent and were asked to complete the experiment in a silent environment, without interacting with other people, and in a single session (without doing other tasks like checking their phone, email, etc.). Depending on the condition, participants were then asked to think about a past or future self-defining event, or about the solar system (control condition). The instructions for the control condition (describing the solar system) were the same as Charlesworth et al. (2016). The instructions for self-defining events were

based on previous research on SDMs (Blagov & Singer, 2004; Singer & Moffitt, 1991) and SDFPs (D'Argembeau et al., 2012) and read as follows:

> *We are going to ask you to think of a past (future) personal event that defines you and that respects the following properties. This event must be about your personal past (future). It must be an event that helps you understand who you are as an individual and that you could tell someone so that they can get to know you better. This event has to do with an important theme or concern in your life. It can be a positive and/or negative event. It is an event that you have thought about frequently.*

When they had an event in mind, participants were asked to describe it with enough detail so that one would understand their experience during the event (i.e., where they were/will be, who they were/will be with, what happened/will happen, how they reacted/will react, and how others reacted/will react).

Immediately after writing their description, participants received the *I AM* task. The task was the same as used by Charlesworth et al. (2016, Experiment 2): participants were asked to list 10 stable and enduring aspects of their identity, in the form of statements that they felt were essential to defining who they are, which might include roles, personality traits or physical traits. They were told that each statement must begin with the phrase *I am*.

After the 10 self-descriptions had been provided, participants were presented with their 1st, 5th, and 10th descriptions, and were asked to rate each on three dimensions, using 7-point Likert scales. First, they rated the emotional valence of each self-description (from -3: very negative, to +3: very positive). Second, they rated the personal importance of this aspect of their identity (from 1: not at all important, to 7: very important). Third, they assessed the extent to which this aspect of their identity gives them a sense of personal continuity between the past, present, and future (from 1: not at all, to 7: a lot).

In the past and future self-defining conditions, participants were then asked to rate the characteristics of the self-defining event they selected. Their written description of the event was provided, and they were asked to bring the event again to mind and to rate its characteristics, using 7-point rating scales. The centrality of the event for identity was assessed with four items (Cronbach's alpha = 0.70): centrality in the life story, inclusion in identity, importance to goals and values, links to other autobiographical events (from 1: not at all, to 7: a lot). The level of psychological need satisfaction associated with the event was assessed using six items (Cronbach's alpha = 0.79) derived from previous research on the role of psychological need satisfaction in autobiographical memories and future thoughts: each of the three basic psychological needs from self-determination theory (i.e., autonomy, competence, and relatedness) was assessed by two items (from -3: strongly disagree, to +3: strongly agree) (Ernst et al., 2018; Philippe et al., 2012). Participants also rated the emotional valence of the event (from -3: very negative, to +3: very positive). Finally, they received an Instructional Manipulation Check (Oppenheimer et al., 2009) and provided demographic information. The instructions and materials that were used in this experiment are openly available in OSF at https://osf.io/pye9a/.

Data coding and statistical analyses. Self-descriptions provided in the *I AM* task were coded according to three categories (psychological, social, and physical), using the same criteria as Charlesworth et al. (2016). Statements were coded as psychological if they referred to a personality trait that required the participant to be introspective and were subjective in nature (e.g., helpful, perfectionist, loyal), as social if they described a social category that was objectively verifiable (e.g., student, musician, single), and as physical if they reflected apparent attributes (e.g., small, brunette, female). The entire set of descriptions was coded by C.G.J. (blinded to group condition) and a random selection of 40 participants (400 statements)

were scored by A.D. to assess the reliability of coding; the inter-rater agreement was excellent (ICC = 0.988, for the number of psychological self-descriptions provided by participants).

All statistical analyses were performed using R version 4.2.3 (R Core Team, 2021) and RStudio (RStudio Team, 2020). Our main aim was to investigate whether the thinking condition influenced the proportion of psychological self-descriptions provided in the *I AM* task. The proportion of psychological statements was computed for each participant and was analysed using a fractional logistic regression with the quasibinomial family, using the glm function in R (Clark, M., 2019). The thinking condition was dummy coded with the control condition as reference level. We used fractional logistic regression because common parametric tests like *t*-test and ANOVA are generally not recommended when the dependent variable is proportion data, because proportion data is by its nature bound at 0 and 1, and is often not normally distributed or homoscedastic (note, however, that similar results were obtained when the data were analysed using a robust ANOVA).

We also examined whether the emotional valence, importance, and sense of continuity associated with self-descriptions differed as a function of thinking conditions and order of descriptions (i.e., 1st vs. 5th vs. 10th self-description). Ratings for each dimension were analysed with an ordinal mixed-effects model (Bürkner & Vuorre, 2019), using the ordinal package in R (Christensen, 2019). For each model, the thinking condition (dummy coded, with the control condition as reference level), order of description (dummy coded, with the first statement as reference level), and their interaction were entered as fixed-effects predictors; the model also included a by-participant random intercept.

Finally, we compared the characteristics of the past and future self-defining events provided by the participants. The indices of the centrality of the event for identity and satisfaction of psychological needs were not normally distributed and thus were analysed using a robust variant of independent samples *t*-test (Yuen's test with 20% trimmed means)

(Field & Wilcox, 2017; Wilcox, 2012). For consistency, ratings of emotional valence were also analysed using a Yuen's test (but similar results were obtained with an ordinal regression).

An alpha level of .05 was used for all statistical analyses. All data and analysis code are available in OSF at https://osf.io/pye9a/. Note that preliminary analyses showed that there were no gender differences in the variables of interest, except for the proportion of psychological self-descriptions provided in the *I AM* task, which was slightly higher in men. However, when gender was introduced along with the thinking condition in the regression model, gender was no longer significant and did not interact with condition. Thus, we present results collapsed across gender for all analyses.

Results and discussion

Before assessing the effects of thinking conditions on self-descriptions, we examined the characteristics of past and future self-defining events. Consistent with previous research (Demblon & D'Argembeau, 2017), the centrality of events for identity was similar for the past (20% trimmed mean = 5.98, 95% CI [5.62, 6.28]) and future (20% trimmed mean = 5.98, 95% CI [5.66, 6.24]), $Y_t = 0.01$, $p = .997$, but future events were more positive (20% trimmed mean = 2.80, 95% CI [2.56, 2.98]) than past events (20% trimmed mean = 0.43, 95% CI [-0.48, 1.18]), $Y_t = 5.54$, $p < .001$. Levels of psychological need satisfaction were also higher for future (20% trimmed mean = 1.59, 95% CI [1.29, 1.84]) than past (20% trimmed mean = 0.53, 95% CI [0.06, 0.99]) events, $Y_t = 3.92$, $p < .001$. Both types of events mainly involved achievement and relationship themes, but past self-defining events also involved a substantial proportion of life-threatening events and comparatively fewer achievement-related events than future self-defining events (see Supplementary Materials).

The proportions of psychological self-descriptions provided by participants in the three conditions are shown on Figure 1A. A fractional logistic regression showed that psychological self-descriptions were more frequently reported in the past and future self-defining conditions than in the control condition (past: $b = 0.93$, $SE = 0.22$, $t = 4.27$, $p < .001$; future: $b = 0.77$, $SE = 0.21$, $t = 3.68$, $p < .001$). The difference between the past and future conditions was not statistically significant ($b = -0.17$, $SE = 0.24$, $t = 0.69$, $p = .49$).

Ratings of importance, continuity, and valence of self-descriptions are shown on Figure 1B-D, as a function of conditions and order of production. An ordinal regression showed that the 1st self-descriptions that were provided were rated as more important than the 5th and 10th self-descriptions, but there was no difference between conditions and no interaction between order and conditions (Table 1 and Figure 1B). The sense of continuity associated with self-descriptions also decreased with their order of production but there was a significant interaction showing that the decrease in continuity associated with the 10th self-description was less pronounced in the future than in the control condition (Table 1 and Figure 1C). For valence, the only significant difference was between the first and 10th descriptions, showing a reduction in positivity (Table 1 and Figure 1D).

In summary, Experiment 1 showed that thinking about a past or future self-defining event modulated the content of the working self-concept by increasing the activation of psychological (trait-like) self-descriptions. These findings replicate the observation of Charlesworth et al. (2016) for past events and further highlight that future events have a similar impact on self-conceptions. In line with Charlesworth et al., thinking about autobiographical events influenced the type of self-descriptions provided by participants, but not their rated importance or emotional valence. Interestingly, however, our results suggest that the sense of continuity associated with self-descriptions remained higher when participants thought about a self-defining future event. Self-continuity is an important

dimension of selfhood that influences decisions, motivation, and behaviour (Sedikides et al., 2023). Thus, in Experiment 2, we sought to further investigate the effects of past and future self-defining events on this aspect of self.

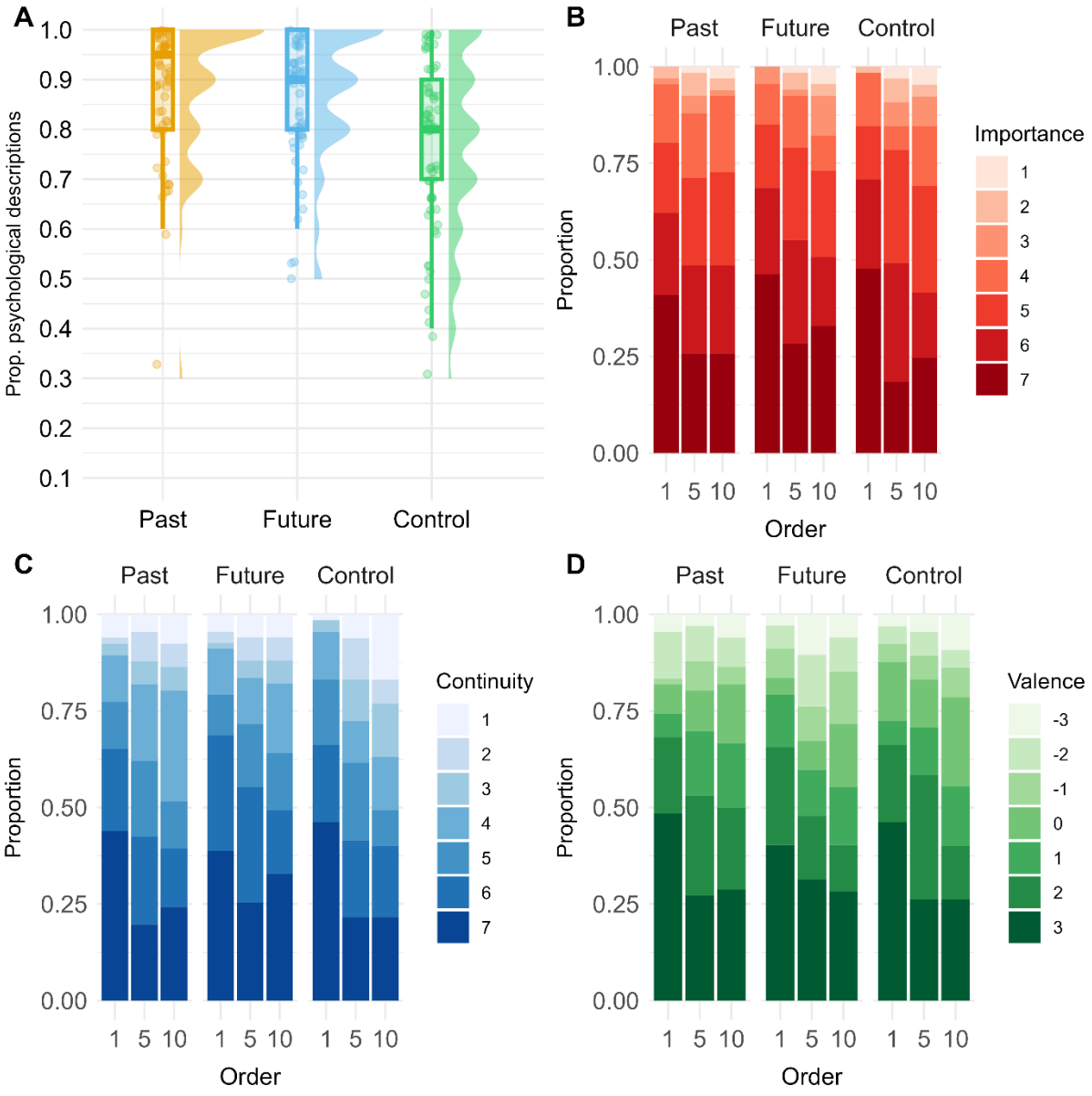

Figure 1. Characteristics of self-descriptions as a function of condition (past, future, control) in Experiment 1. (A) Proportions of psychological self-descriptions reported in the three conditions. (B) Distribution of importance ratings. (C) Distribution of continuity ratings. (D) Distribution of valence ratings.

Table 1. Results of the ordinal logistic regression examining the effects of condition and order on the characteristics of self-descriptions in Experiment 1

	Importance			Continuity			Valence		
	b (*SE*)	z	*p*	*b* (*SE*)	z	*p*	*b* (*SE*)	z	*p*
Past	-0.36 (0.35)	1.02	0.309	-0.20 (0.35)	0.56	.573	0.04 (0.35)	0.11	.914
Future	-0.06 (0.35)	0.17	0.862	-0.21 (0.35)	0.61	.539	-0.10 (0.34)	0.31	.756
Order-5	**-1.10 (0.33)**	**3.38**	**< .001**	**-1.25(0.33)**	**3.85**	**< .001**	-0.53 (0.32)	1.67	.095
Order-10	**-1.24 (0.33)**	**3.74**	**< .001**	**-1.64 (0.34)**	**4.85**	**< .001**	**-0.94 (0.32)**	**2.91**	**.004**
Past:Order-5	0.39 (0.46)	0.85	.344	0.28 (0.45)	0.62	.535	-0.13 (0.45)	0.29	.775
Future:Order-5	0.40 (0.46)	0.87	.383	0.65 (0.45)	1.45	.146	-0.29 (0.45)	0.63	.526
Past:Order-10	0.62 (0.46)	1.35	.176	0.54 (0.46)	1.17	.241	0.25 (0.46)	0.54	.590
Future:Order-10	0.39 (0.46)	0.85	.398	**1.01 (0.46)**	**2.20**	**.028**	0.09 (0.45)	0.20	.838

Note: The coefficients are log odds ratios. Significant effects ($p < .05$) are indicated in bold.

Experiment 2

Experiment 2 aimed to further investigate the effects of thinking about a past or future self-defining event on the sense of self-continuity, using a validated measure: the Self-Continuity Index (Sedikides et al., 2015). Previous studies have shown that recalling a nostalgic autobiographical event (a type of events that often encapsulates self-defining and consequential life experiences) increases past-present self-continuity (i.e., the sense of connection between one's personal past and present) (Sedikides et al., 2015; van Tilburg et al., 2019). Here, we sought to investigate whether thinking about an important future event induces a symmetrical effect on self-continuity, that is, a higher sense of connection between one's present and future. In addition, we explored whether thinking about past and future self-defining events affect other self-relevant dimensions, such as meaning in life (i.e., the perception of one's existence as purposeful and significant) (van Tilburg et al., 2019) and self-concept clarity (i.e., the extent to which beliefs about the self are clearly and confidently defined) (Çili & Stopa, 2015).

Method

Participants. Participants were 214 young adults (118 women, 96 men; mean age = 26.30 years, *SD* = 4.95; average number of completed years of education = 15.35, *SD* = 2.59) who were recruited on Prolific.ac (Palan & Schitter, 2018). They were randomly assigned to the three thinking conditions (n = 72, 69, and 73, for the past self-defining, future self-defining, and control conditions, respectively). This sample size was determined a priori to have a statistical power of 80% to detect a significant difference between the self-defining and control conditions, with a medium effect size (d = 0.5) and an alpha of 0.05. Forty-seven additional participants were tested but excluded (and replaced by other participants) because

they failed to pass an instructional manipulation check or because they did not report an adequate event. All participants provided informed consent and this study was approved by the Ethics Committee of the Faculty of Psychology of the University of Liège (ref. 1920-131).

Materials and Procedure. The experiment was administered online using the Gorilla experiment builder (gorilla.sc) (Anwyl-Irvine et al., 2020). The procedure was the same as in Experiment 1, except that participants completed a series of questionnaires instead of the *I AM* task after thinking about the self-defining event or the solar system.

First, participants completed an adaptation of the Self-Continuity Index (SCI) (Sedikides et al., 2015). The original version of the SCI comprises two factors: personal continuity, which refers to concrete perceptions of continuity between one's personal past and present (e.g., 'I feel connected with my past'), and temporal continuity, which refers to more abstract judgments regarding the relation between past and present (e.g., 'the past and present flow seamlessly together'). Here, we used the four items of the personal continuity factor, because they have been shown to be more strongly affected by autobiographical memory retrieval (Sedikides et al., 2015), and added two items that were adaptations of the two items assessing personal continuity with the past to assess personal continuity in the future (i.e., 'I feel connected with my future' and 'I feel connected with who I will be in the future'). Participants answered each item on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Next, participants completed the Meaning in Life Questionnaire (MLQ) (Steger et al., 2006). The MLQ is a 10-item questionnaire designed to measure two dimensions of meaning in life: Presence of Meaning (how much people feel their lives have meaning; e.g., 'My life has a clear sense of purpose'), and Search for Meaning (how much people strive to find

meaning and understanding in their lives; e.g., 'I am always looking to find my life's purpose'). Participants answered each item on a 7-point Likert scale ranging from 1 (absolutely untrue) to 7 (absolutely true).

Finally, participants completed the Self-Concept Clarity (SCC) scale (Campbell et al., 1996). The SCC is a 12-item questionnaire that assesses the extent to which self-beliefs are clearly and confidently defined, internally consistent, and stable (e.g., 'I have a clear sense of who I am and what I am'). Here, we used the state version of the SCC (Çili & Stopa, 2015) in which participants indicated the extent to which the statements applied to them "right now" on a scale from 1 (strongly disagree) to 5 (strongly agree).

After completing the questionnaires, participants in the self-defining conditions rated the characteristics of the event they had selected using the same rating scales as in Experiment 1. A similar instructional manipulation check was also used. The instructions and materials are openly available in OSF at https://osf.io/pye9a/.

Statistical analyses. The two factors of the MLQ and the SCC had a good internal consistency (Cronbach's alpha: MLQ-Presence = 0.78, MLQ-Search = 0.90, SCC = 0.90). Since we added two items to the SCI to assess continuity in the future, we first conducted an exploratory factor analysis of the six SCI items using maximum likelihood estimation. A parallel analysis suggested that three factors should be retained. Factor loadings after varimax rotation are shown in Table 2. Factor loadings indicated that the two items assessing future self-continuity loaded on the first factor and the two items assessing past self-continuity loaded on the second factor; item 4 loaded on the third factor and item 3 had low factor loadings. Informed by these findings, we created separate measures of personal continuity for the past (Spearman-Brown reliability coefficient = 0.80) and future (Spearman-Brown reliability coefficient = 0.86), and discarded items 3 and 4 of the scale.

Differences between the three conditions on each scale were assessed using robust statistical methods (Field & Wilcox, 2017; Wilcox, 2012). For self-continuity, we conducted 3 (condition: past, future, control) by 2 (type of self-continuity: past vs future) between-within robust ANOVA (using 20% trimmed means). Similarly, meaning in life was analysed using a 3 (condition) by 2 (type of meaning: Search vs Presence) between-within robust ANOVA. Finally, self-concept clarity (SCC) was analysed using a one-way (condition) robust ANOVA. Data and analysis code are available in OSF at https://osf.io/pye9a/. Note that preliminary analyses showed that there were no gender differences in the variables of interest, so we present results collapsed across gender.

Table 2. Factor loadings for the Self-Continuity Index in Experiment 2.

Items	Factor 1	Factor 2	Factor 3
1. Connected with my past	0.059	**0.716**	0.105
2. Connected with who I was in the past	0.145	**0.913**	0.016
3. There is continuity in my life	0.250	0.352	0.346
4. Important aspects of my personality remain the same across time	0.053	0.055	**0.995**
5. Connected with my future	**0.875**	0.101	0.109
3. Connected with who I will be in the future	**0.845**	0.137	0.051

Note: factor loadings > .40 are indicated in bold

Results and discussion

As in Experiment 1, the centrality of events for identity did not differ between the past (20% trimmed mean = 5.36, 95% CI [5.11, 5.61]) and future (20% trimmed mean = 5.65, 95% CI [5.36, 5.91]), $Y_t = 1.48$, $p = .142$, but future events were rated as more positive (20% trimmed mean = 2.58, 95% CI [2.28, 2.81]) than past events (20% trimmed mean = 0.86, 95% CI [0.11, 1.55]), $Y_t = 4.13$, $p < .001$. Levels of psychological need satisfaction were also higher for future (20% trimmed mean = 1.58, 95% CI [1.36, 1.76]) than past (20% trimmed mean = 0.56, 95% CI [0.13, 0.94]) events, $Y_t = 4.52$, $p < .001$. As in Experiment 1, both types of events mainly involved achievement and relationship themes, but past events also involved a substantial proportion of life-threatening events and comparatively fewer achievement-related events than future events (see Supplementary Materials).

Descriptive statistics (20% trimmed means with their 95% CI) for measures of self-continuity, meaning in life, and self-concept clarity are presented in Table 3 as a function of condition. For self-continuity (SCI), a 3 (condition) by 2 (type of self-continuity) robust ANOVA yielded a significant effect of condition, $F_t = 4.18$, $p = .018$, a significant effect of the type of continuity, $F_t = 9.92$, $p = .002$, and a significant interaction, $F_t = 3.36$, $p = .039$. Post-hoc tests showed that past self-continuity was significantly higher in the past self-defining condition than in the future self-defining and control conditions ($\hat{\psi} = 0.58$, $p = .004$, and $\hat{\psi} = 0.47$, $p = .022$, respectively); the difference between the future self-defining and control conditions was not significant ($\hat{\psi} = -0.11$, $p = .601$). Future self-continuity was higher in the future self-defining condition than in the control condition ($\hat{\psi} = 0.37$, $p = .032$). Future self-continuity was also slightly higher in the past self-defining condition than in the control condition, but the difference failed to reach statistical significance ($\hat{\psi} = 0.36$, $p = .056$). The difference between the past and future self-defining conditions was not significant ($\hat{\psi} = 0.01$, $p = .944$). For meaning in life (MLQ), the ANOVA showed that scores were significantly higher for the Search than the Presence scale, $F_t = 40.77$, $p < .001$, but there was no main

effect of condition, $F_t = 0.83$, $p = .440$, and no interaction, $F_t = 0.51$, $p = .603$. Finally, there were no significant differences between conditions for self-concept clarity (SCC), $F_t = 1.34$, $p = .268$.

Table 3. Descriptive statistics (20% trimmed means and their 95% CI) for measures of self-continuity, meaning in life, and self-concept clarity as a function of condition in Experiment 2

Scale	Past	Future	Control
SCI-Past	3.50 [3.24, 3.74]	2.92 [2.63, 3.20]	3.03 [2.73, 3.34]
SCI-Future	3.58 [3.31, 3.84]	3.59 [3.33, 3.81]	3.22 [2.98, 3.45]
MLQ-Presence	4.22 [3.86, 4.52]	4.36 [4.14, 4.58]	4.04 [3.74, 4.30]
MLQ-Search	5.10 [4.76, 5.38]	5.07 [4.74, 5.34]	5.05 [4.69, 5.35]
SCC	3.27 [3.06, 3.50]	3.03 [2.81, 3.25]	3.23 [3.01, 3.46]

Note: SCI-Past, SCI-Future, and SCC range from 1 to 5; MLQ-Presence and MLQ-Search range from 1 to 7.

In summary, the results of Experiment 2 replicated previous studies showing that thinking about an important past event increased past-present self-continuity (Sedikides et al., 2015; van Tilburg et al., 2019), and further showed that thinking about an important future event increased present-future self-continuity, compared to thinking about a non-personal topic. Note that the symmetry between past and future thinking was not perfect, as the past condition was not only associated with increased past-present self-continuity but also to a slight increase in present-future self-continuity, whereas the future condition was only associated with increased present-future self-continuity. Neither past nor future thinking influenced measures of meaning in life and self-concept clarity. Some previous studies found

that recalling a nostalgic event increased meaning in life (van Tilburg et al., 2019), and it could be that this increased sense of meaning is specifically related to nostalgic events rather than any kind of self-defining event (but see Waytz et al., 2015). Regarding self-concept clarity, previous results were inconsistent, with one study showing an effect of self-defining memories and another showing none (Çili & Stopa, 2015).

Experiment 3

Experiments 1 and 2 showed that thinking about a future self-defining event can modulate the content of the working self: it increased access to psychological self-conceptions and enhanced the sense of self-continuity between the present and future. However, a limitation of these experiments is that the control condition (i.e., describing the solar system) differed from the future self-defining condition not only in terms of its self-relevance but also in terms of the temporal dimension of associated thoughts (i.e., the self-defining condition had a future component that was absent in the control condition). Thus, in Experiment 3, we aimed to replicate the main results of Experiments 1 and 2 using a control task that differed from the future self-defining condition only in terms of self-relevance (i.e., imagining an ordinary future event). In addition, we sought to recruit a more age-diverse sample than in Experiments 1 and 2, which only included young adults.

Method

Participants. Participants were 128 adults (106 women, 21 men; 1 identified as 'other') aged between 18 and 74 years (mean age = 33.47 years, SD = 16.22; average number of completed years of education = 15.72, SD = 2.53) who were recruited on social media. They were randomly assigned to the two thinking conditions (n = 62 and 66, for the self-defining and

ordinary future conditions, respectively). This sample size was determined a priori to have a statistical power of 80% to detect a significant difference between the two conditions, with a medium effect size (d = 0.5) and an alpha of 0.05. Ninety-nine additional participants were tested but excluded (and replaced by other participants) because they failed to pass an instructional manipulation check. Although higher than in Experiments 1 and 2, this exclusion rate (44%) remains comparable to that reported in previous online studies (up to 46%) that used similar attention checks (see e.g., Oppenheimer et al., 2009; Sanson et al., 2018). All participants provided informed consent and this study was approved by the Ethics Committee of the Faculty of Psychology of the University of Liège (ref. 1920-131).

Materials and Procedure. The experiment was administered online using the experiment builder developed by the Faculty of Psychology of the University of Liège. Depending on the condition, participants were either asked to think about a self-defining future event or about an ordinary future event. The instructions for the self-defining future event were the same as in Experiments 1 and 2 and the instructions for the ordinary future event read as follows:

> *We are going to ask you to think of a future event that has the following properties. This event must be something trivial in your personal life. It must be an ordinary event for you and not something important. For example, you can imagine the next time you go shopping, or imagine you go for a walk next summer, or imagine tidying your house on your next day off, etc. Whatever future event you choose, what we are interested in is that you think of an event that is trivial and not important to you.*

In both the self-defining and ordinary event conditions, participants were asked to describe the selected event with enough detail so that one would understand their experience (where

they will be, who they will be with, what will happen, how they will react, and how others will react).

Next, participants received the same *I AM* task as in Experiment 1 (except that the 1st, 5th, and 10th self-descriptions were only rated for importance and valence) and completed the same past and future self-continuity scales (SCI-Past and SCI-Future) as in Experiment 2 (Spearman-Brown reliability coefficient = 0.70 and 0.81, for the SCI-Past and SCI-Future, respectively). In addition, we also included another self-continuity measure: the Future Self-Continuity Questionnaire (FSCQ) (Sokol & Serper, 2020). The FSCQ includes 10 items that assess different aspects (similarity, vividness, positivity) of personal continuity 10 years from now on 6-point Likert scales, with higher ratings representing higher levels of future self-continuity (e.g., 'How similar are you now to what you will be like 10 years from now?'; 'Do you like what you will be like 10 years from now?'). Scores of the individual FSCQ items were averaged to give the total FSCQ score (Cronbach's alpha = 0.80).

Participants rated the characteristics of the self-defining or ordinary future event they provided using the same rating scales as in Experiments 1 and 2. Finally, they completed the Rosenberg trait self-esteem scale (Rosenberg, 1965), a widely used scale that includes 10 items answered on a 4-point Likert-type scale (from strongly agree to strongly disagree). Scores of the individual items were averaged to give the total self-esteem score (Cronbach's alpha = 0.89). The instructions and materials are openly available in OSF at https://osf.io/pye9a/.

Data coding and statistical analyses. Self-descriptions provided in the *I AM* task were coded following the same criteria as in Experiment 1. The entire set of descriptions was coded by C.G.J. (blinded to group condition) and a random selection of 33 participants (330 statements) were scored by A.D. to assess the reliability of coding; the inter-rater agreement was excellent (ICC = 0.99, for the number of psychological descriptions provided by participants).

As in Experiment 1, the proportions of psychological statements were analysed using a fractional logistic regression and the importance and emotional valence of self-descriptions were analysed with ordinal regression models. As in Experiment 2, between-group differences on scales measuring self-continuity were assessed using robust statistical methods. The past and future SCI were analysed with a 2 (condition: self-defining vs ordinary future event) by 2 (type of self-continuity: past vs future) between-within robust ANOVA. For the FSCQ, group differences were analysed using a robust variant of independent samples *t*-test (Yuen's test). Similarly, differences in self-esteem and in the characteristics of future events (centrality for identity, need satisfaction, and valence) were assessed using Yuen's tests. Data and analysis code are available in OSF at https://osf.io/pye9a/. Note that preliminary analyses showed that there were no gender differences in the variables of interest, so we present results collapsed across gender. We also checked whether there were age differences in the effects reported, which was not the case.

Results

As expected, the centrality of events for identity was higher for self-defining (20% trimmed mean = 6.04, 95% CI [5.80, 6.28]) than ordinary future events (20% trimmed mean = 3.63, 95% CI [3.20, 4.08]), $Y_t = 9.72$, $p < .001$. Self-defining events (20% trimmed mean = 2.89, 95% CI [2.63, 3.00]) were also rated as more positive than ordinary events (20% trimmed mean = 1.30, 95% CI [0.85, 1.75]), $Y_t = 6.10$, $p < .001$. On the other hand, levels of psychological need satisfaction did not differ between the two types of events (self-defining: 20% trimmed mean = 1.53, 95% CI [1.24, 1.77]; ordinary: 20% trimmed mean = 1.20, 95% CI [0.90, 1.50]), $Y_t = 1.67$, $p = .099$.

The proportion of psychological self-descriptions provided by participants in the two conditions is shown on Figure 2A. A fractional logistic regression showed that psychological self-descriptions were more frequently reported in the self-defining future condition than in the ordinary future condition (b = 0.44, SE = 0.20, t = 2.27, p = .025).

Ratings of importance and valence of self-descriptions are shown on Figure 2B-C, as a function of condition and order of production. For importance, the ordinal regression showed a main effect of condition and a significant interaction between condition and order, indicating that the 1st self-descriptions were rated as more important in the self-defining future condition than in the ordinary future condition, but then decreased to a greater extent for the 5th and 10th self-descriptions to reach a similar level of importance (Table 4 and Figure 2B). For valence, the ordinal regression showed that the 1st self-descriptions were more positive in the self-defining future condition than the ordinary future condition; the effect of order and the interaction were not significant (Table 4 and Figure 2C).

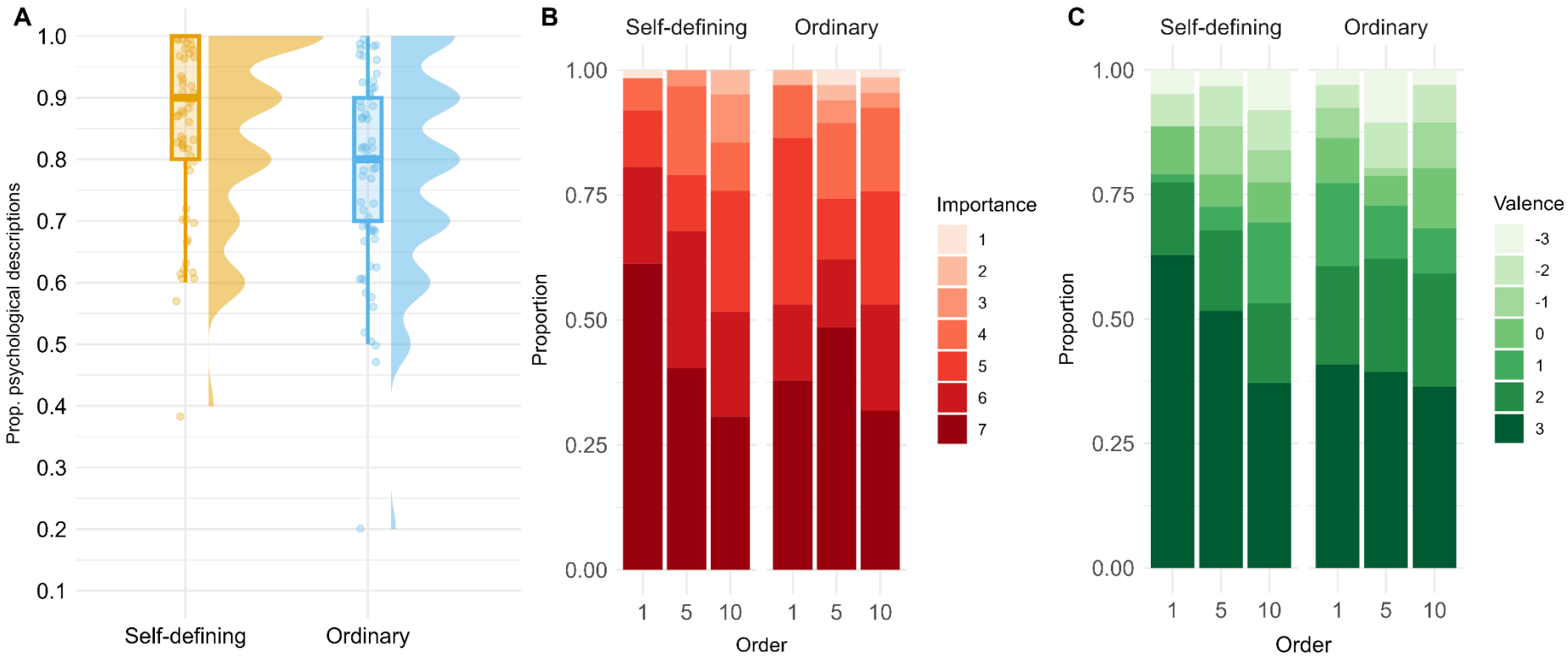

Figure 2. Characteristics of self-descriptions as a function of condition (self-defining vs ordinary) in Experiment 3. (A) Proportions of psychological self-descriptions reported in the two conditions. (B) Distribution of importance ratings. (C) Distribution of valence ratings.

Table 4. Results of the ordinal logistic regression examining the effects of condition and order on the characteristics of self-descriptions in Experiment 3

	Importance			Valence		
	b (*SE*)	z	*p*	*b* (*SE*)	z	*p*
Self-defining	**0.95 (0.33)**	**2.86**	**.0047**	**0.71 (0.34)**	**2.10**	**.035**
Order-5	0.16 (0.32)	0.50	.619	-0.17 (0.31)	0.53	.596
Order-10	-0.26 (0.31)	0.83	.405	-0.19 (0.31)	0.64	.525
Self-defining:Order-5	**-0.95 (0.47)**	**2.03**	**.042**	-0.32 (0.47)	0.68	.500
Self-defining:Order-10	**-1.04 (0.46)**	**2.26**	**.024**	-0.81 (0.46)	1.76	.078

Note: The coefficients are log odds ratios. Significant effects ($p < .05$) are indicated in bold.

Descriptive statistics (20% trimmed means with their 95%CI) for scales assessing self-continuity are presented in Table 5 as a function of condition. For the SCI, a 2 (condition) by 2 (type of self-continuity) robust ANOVA yielded a significant effect of condition, $F_t = 6.77$, $p = .011$, showing that self-continuity was higher in the self-defining future condition than in the ordinary future condition. There was also a significant effect of the type of continuity, $F_t = 12.50$, $p < .001$, indicating that self-continuity was higher in the future than in the past. The interaction was not significant, $F_t = 2.59$, $p = .11$. For the FSCQ, scores were significantly higher in the self-defining future condition than in the ordinary future condition, $Y_t = 2.32$, $p = .023$.

There was no difference between conditions regarding participants' trait self-esteem, $Y_t = 0.78$, $p = .438$. In line with previous studies (D'Argembeau et al., 2012), there was a significant correlation between individual differences in trait self-esteem and the valence of the reported self-defining future event, $r_s = 0.28$, $p = .029$. The correlation between self-esteem and the valence of the ordinary future event was also positive but did not reach statistical significance, $r_s = 0.14$, $p = .257$.

In summary, Experiment 3 replicated the main results of Experiments 1 and 2 with a better-matched control task and a more age-diverse sample. Thinking about a self-defining future event increased access to psychological self-descriptions and enhanced the sense of present-future self-continuity, compared to thinking about an ordinary future event. It should be noted, however, that explicitly asking participants to provide an unimportant event may not be the best procedure for eliciting mundane future events. Indeed, although ratings of event centrality for identity were higher for self-defining future events than ordinary future events, the latter were, on average, rated in the middle of the scale and therefore did not totally lack importance. Furthermore, levels of need satisfaction were comparable for the two kinds of events. Thus, in future studies, it would be useful to further explore the effectiveness of other

cueing methods in eliciting the imagination of mundane future events. In any case, the present results show that even with an imperfect control condition in terms of the personal importance of events, self-defining future events have a greater impact on the current self-concept.

Table 5. Descriptive statistics (20% trimmed means and their 95% CI) for self-continuity scales as a function of condition in Experiment 3

Scale	Self-defining	Ordinary
SCI-Past	2.96 [2.59, 3.30]	2.82 [2.51, 3.13]
SCI-Future	3.83 [3.55, 4.12]	3.15 [2.81, 3.49]
FSCQ	3.98 [3.79, 4.17]	3.68 [3.52, 3.84]
RSE	3.07 [2.87, 3.26]	2.97 [2.81, 3.13]

Note: SCI-Past and SCI-Future ranged from 1 to 5; FSCQ ranged from 1 to 6; RSE ranged from 1 to 4.

General discussion

While the role of autobiographical memory in the sense of self is well documented, the identity function of future thinking has received far less attention. Yet, most people commonly imagine future events that convey meaningful information about the person they wish or expect to become (D'Argembeau et al., 2012). In three experiments, we assessed the extent to which thinking about such self-defining future events influenced the current content of self-representation. We found that thinking about a self-defining future event led participants to conceptualize themselves more in terms of their psychological traits, as did thinking about a past self-defining event. Furthermore, thinking about a future self-defining event increased the sense of present-future self-continuity, whereas thinking about a past self-defining event

increased the sense of past-present self-continuity. Taken together, these results support the revised SMS, which assigns a role to future thinking in self-representation (Conway et al., 2019).

The idea that self-knowledge includes future selves is not new (Markus & Nurius, 1986) but a detailed account of the cognitive architecture underlying future-oriented self-representations has only been recently proposed, largely on the basis of Martin Conway's influential work on autobiographical memory (Conway, 2005; Conway et al., 2004; Conway & Pleydell-Pearce, 2000). According to the revised SMS (Conway et al., 2019; see also D'Argembeau, 2020; D'Argembeau et al., 2012), three main systems underlie future self-representations: the self-concept includes abstract representations of traits and other attributes of future selves, autobiographical knowledge organizes information about anticipated life periods and general events, and episodic memory provides the ingredients used to mentally simulate specific future events. These representational systems interact to support future thinking. For example, autobiographical knowledge guides the construction, organization, and temporal location of episodic simulations (Ben Malek et al., 2017; D'Argembeau & Demblon, 2012; D'Argembeau & Mathy, 2011). In addition, the SMS assumes that self-conceptions (i.e., personal characteristics and goals) influence the construction of future scenarios and, reciprocally, that imagined future events ground, exemplify, and contextualize self-views. The present results provide support for this view by showing that thinking about a future self-defining event modulates the type of information that is currently active in the self-concept. Furthermore, we replicated previous findings on the influence of past autobiographical thinking on self-representation (Charlesworth et al., 2016; Sedikides et al., 2015).

The self-concept is a dynamic memory structure composed of a collection of self-views that are differentially activated as a function of context, goals, and momentary experiences (DeSteno & Salovey, 1997; Markus & Wurf, 1987; McConnell, 2011). Thus, even

if the overall body of self-knowledge stored in long-term memory is relatively stable, different self-aspects are brought in the forefront depending on circumstances. For example, someone might view herself as “a scientist” when being at work and as “a mother” when being at home, with each of these self-aspects being associated with specific traits (e.g., rigorous vs. loving). Interestingly, the present results suggest that the subset of self-knowledge that is activated at a given moment (i.e., the content of the working self) can not only be modulated by the external environment (e.g., locations, objects, people), but also in response to internal representations of past or future events. Merely thinking about personally significant life events can bring specific facets of the self-concept to light.[1] This has potentially important consequences for motivation, decisions, and behaviour, given the assumed role of the working self in goal pursuit (Conway, 2005; Markus & Wurf, 1987). Indeed, there is evidence that the imagination of future events promotes farsighted decisions (Rösch et al., 2022), especially when these events are goal-related and self-relevant (Epstein et al., 2021; O’Donnell et al., 2017). The present finding that thinking about self-defining future events increases the sense of future self-continuity is particularly interesting in this respect, given the role of self-continuity in reducing delay discounting (Bartels & Rips, 2010; Ersner-Hershfield et al., 2009; McCue et al., 2019).

To what extent are these changes in self-conceptions following autobiographical thinking durable? Based on the view that the working self is dynamic (Markus & Wurf, 1987), we believe that the modulation of self-representation observed in the present experiments is temporary and that the activation of particular self-conceptions fluctuates continuously according to environmental contexts and internal states. However, it could be that reflecting

[1] What remains unclear from our data is the extent to which the thematic content of activated self-aspects reflects the content of previously recalled or imagined self-defining events, an issue discussed by Charlesworth et al. (2016). Examining the content overlap between self-defining events and subsequently activated self-concepts would be an interesting avenue for future research.

on self-defining future events sometimes produces enduring changes in the content of the self-concept (e.g., to update self-views according to expected events). In a similar vein, it has recently been shown that thinking about others can modify related self-knowledge for a prolonged period of time (Rubin-McGregor et al., 2022). Therefore, it would be interesting in future studies to investigate the effects of autobiographical thinking on self-conceptions after different delays to examine whether it can induce lasting changes in the content or structure of self-knowledge. In addition, it would be worth examining whether specific dimensions of self-defining memories and future thoughts—such as motivational and affective themes, autobiographical reasoning, and structural aspects (McLean et al., 2020)—have a more or less lasting impact on the content of self-representations. Answering these questions would lead to a better understanding of the role of autobiographical thinking in anchoring self-views that are coherent and consistent, but also flexible in the face of changing circumstances.

It is also worth noting that although we observed consistent effects of autobiographical thinking on the current content of self-conceptions, the effect sizes were moderate. This suggests that, despite contextual malleability, some core aspects of the self-concept remain relatively stable and are chronically accessible (Markus & Wurf, 1987). Previous research has shown that the self-concept includes both context-dependent self-views (e.g., “as a student, I am organized”) and more abstract, context-independent self-views (e.g., “I am an honest person”) (Schell et al., 1996). The latter type of self-representations might be more stable and thus less prone to modulation by past and future autobiographical thinking. Be that as it may, the size of effects observed in the present experiments should be put in perspective with the fact that the reflection manipulation we used was quite brief (involving only a few minutes of reflection); larger effects could occur with prolonged and repeated autobiographical thinking.

When comparing the characteristics of past and future self-defining events, we found that the two types of events were associated with similar importance for identity but that

future events were rated as more positive than past events. This difference in valence is consistent with previous studies on self-defining events (D'Argembeau et al., 2012; Demblon & D'Argembeau, 2017), and more generally with studies showing that the personal future is typically perceived as more positive than the personal past (e.g., Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2004; MacLeod, 2016; Salgado & Berntsen, 2020). Indeed, most people are overly optimistic regarding their future, which might increase their motivation to pursue future plans and foster mental health and well-being (MacLeod, 2016; Taylor & Brown, 1988). This positivity bias in future thinking may also serve a self-enhancement function (Salgado & Berntsen, 2020). For example, imagining having a successful career and fulfilling relationships can help promote a positive view of oneself and, conversely, a positive self-view can lead to more positive projections into the future. In line with this idea, we found that people who produced more positive self-defining future events had higher self-esteem (Experiment 3; see also D'Argembeau et al., 2012).

Although past and future self-defining events had a similar impact on the measures of self-representation used in the present experiments, potential differences in the effects of past and future thinking on the self would merit further investigation. For example, an important difference between past and future autobiographical thinking is that memories of past events are more constrained than future thoughts; although not necessarily accurate, memories are constrained by what actually happened in the past, whereas the content of future thoughts can be given more free reign (but note that the perceived truthfulness of such thoughts is still constrained by our goals and general expectations about the future) (Ernst & D'Argembeau, 2017). Thus, future thoughts may be more susceptible to biases than memories of past events (Rasmussen & Berntsen, 2013; Schacter et al., 2023), which could have important implications for self-representation. A related question that deserves further investigation concerns possible individual differences in the impact of past and future thinking on self-

conception. Given that the content of future thoughts is less constrained, there might be greater individual differences in the use of imagined future events for grounding the self. For example, dimensions of self-defining memories have been related to individual differences in personality traits (Blagov et al., 2022), and it could be that these relations are even stronger for self-defining future thoughts. In addition, previous research has shown that individual differences in visual imagery, emotion regulation, and time perspective are associated with the characteristics of episodic future thoughts (Arnold et al., 2011; D'Argembeau & Van der Linden, 2006), and it would be interesting to investigate whether these and other individual dimensions modulate the use and impact of future thinking on self-representation and, ultimately, on decisions and behaviour.

In conclusion, the present results show that the activation of past and future self-defining events can modulate how we perceive ourselves in the present and increase our sense of self-continuity. This impact of autobiographical thinking on the working self-concept lends support to the cognitive architecture of past and future self-representation proposed in the revised SMS. An important avenue for future research will be to examine how different representational substrates of the self—the conceptual self, autobiographical knowledge, episodic simulations—are harnessed in the service of adaptive decisions and actions.

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Disclosure statement

The authors report there are no competing interests to declare.

Data availability statement

The data that support the findings of this study are openly available in OSF at https://osf.io/pye9a/.

CRediT authorship contribution statement

Arnaud D'Argembeau: Conceptualization, Methodology, Data curation, Formal analysis, Funding acquisition, Visualization, Writing - original draft, Writing - review & editing.

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Supplementary Materials

Thematic content of events

To provide an idea of the thematic content of self-defining memories (SDMs) and self-defining future projections (SDFPs), both types of events were scored according to the Thorne and McLean (2001) manual. The narratives were classified into seven content categories: life-threatening events (death, serious illness, accident, sexual abuse, and so on), recreation/exploration (recreational activities or exploration, such as hobbies, parties, leisure activities, travelling, vacation, or peak experiences), relationship (events in which an interpersonal relationship is emphasized), achievement (events that emphasize attempts at mastery or accomplishment with regard to physical, material, social, or spiritual goals, regardless of the outcome), guilt/shame (events in which the issue of one's doing wrong or right is emphasized), drug/alcohol/tobacco use (events that center on the use of drug, alcohol, or tobacco for recreational, thrill, or possible suicidal purposes), and unclassifiable (events that do not fit well into any of the previous categories). Following Thorne and McLean (2001), each event was coded into only one category, which reflected the primary concern that was emphasized in the narrative; narratives that included multiple (but no primary) concerns were classified into the ''unclassifiable'' category. In addition, events were scored according to whether they involved cultural life scripts (i.e., culturally shared expectations about the order and timing of major life events in a prototypical life, such as graduation, marriage, and childbirth). Each event was coded according to whether or not it corresponded to one of the script categories provided by Berntsen and Rubin (2004).

The frequency of thematic content categories for SDMs and SDFPs in Experiments 1-3 are shown in Table S1. As can be seen, both types of events mainly involved achievement and relationship themes, but SDMs also involved a substantial proportion of life-threatening events and comparatively fewer achievement-related events than SDFPs. When comparing the frequency of different thematic contents in two experiments that included both SDMs and SDFPs (Experiments 1 and 2), we found that these differences in the content of SDMs and SDFPs were statistically significant (Experiment 1: $X^2(5, N = 133) = 26.3$, $p < .001$, Experiment 2: $X^2(6, N = 133) = 19.3$, $p = .004$).

In terms of the involvement of cultural life scripts, we found that the proportion of events that corresponded to life scripts was higher for SDFPs than SDMs in both Experiments 1 and 2 (Experiment 1: future events = 40%, past events = 21%, $X^2(1, N = 133) = 5.68$, $p = .017$; Experiment 2: future events = 45%, past events = 22%, $X^2(1, N = 141) = 8.17$, $p = .004$). In Experiment 3, the proportion of SDFPs that included a life script was similar as in Experiments 1 and 2 (45%). It should be noted, however, that most events that involved a life script were still imagined in an idiosyncratic way (i.e., included details that were unique to an individual's personal life; see Table S2 for some examples of reported events).

Table S1. Frequency of thematic content categories for self-defining memories (SDMs) and self-defining future projections (SDFPs) in Experiments 1-3 (percentages are shown in parentheses)

Content	SDM	SDFP
Experiment 1		
Life-threatening	20 (30%)	1 (1%)
Recreation/exploration	6 (9%)	10 (15%)
Relationship	19 (29%)	16 (24%)
Achievement	15 (23%)	28 (42%)
Guilt/shame	1 (1%)	0 (0%)
Drug/alcohol/tobacco	0 (0%)	0 (0%)
Unclassifiable	5 (8%)	12 (18%)
Experiment 2		
Life-threatening	10 (14%)	0 (0%)
Recreation/exploration	7 (10%)	6 (9%)
Relationship	23 (32%)	15 (22%)
Achievement	20 (28%)	38 (55%)
Guilt/shame	1 (1%)	0 (0%)
Drug/alcohol/tobacco	1 (1%)	0 (0%)
Unclassifiable	10 (14%)	10 (14%)
Experiment 3		
Life-threatening	-	0 (0%)
Recreation/exploration	-	9 (15%)
Relationship	-	15 (25%)
Achievement	-	24 (39%)
Guilt/shame	-	0 (0%)
Drug/alcohol/tobacco	-	0 (0%)
Unclassifiable	-	14 (22%)

Table S2. Examples of events provided in Experiments 1-3

Type of event	Examples
Experiment 1	
Self-defining memory	I was taking part in a competition with my high school class. At the beginning of the school year, I had to give an oral presentation with my team. The presentation was given in front of around 150 people. I was in total stress, trembling, at a loss for words, sweating... Once I arrived on stage with my team, and especially when I had to speak, I felt happy for a moment! To see these people listening to me, and to feel that the words I could say resonated with each and every one of them. At that very moment, my brain was turned off. As if I were an automaton. Then in the hours that followed, the days, the weeks, I held on to a moment of pure freedom, as if I'd just discovered what I was on this Earth for! Since that day, I've thought about it very often and I'm looking for that happiness again. [translated from French] The event that comes to mind is the departure of my ex-boyfriend. At that point we had been together for over a year and living together. He went abroad to live out his dream of living abroad and becoming a poker player, and I felt a huge emptiness and a sense of abandonment. I was very sad to let him go, but I wanted his happiness before my own, despite my fear of living alone while waiting to see him again. I had exams and couldn't follow him for the time being. This event took place at the station, when he got on a bus. In my opinion, this event helps me to understand my relationship with others, which is both altruistic and linked to a certain dependency. [translated from French]
Self-defining future projection	In the near future, I'd like to become a mother. I imagine that in 1.5 to 2 years, the father will be my current partner. I hope to still be living in Liège, but to have moved into a house. I think I'd be very happy but also very anxious about being a mother (would I be well enough?), about giving birth (I don't want to be in too much pain), about my mother-in-law (who's already nagging me to take care of and make important decisions for my future children and this is already a source of arguments) and about my partner. I think my partner will be really lost because he's really not used to looking after children. And my other relatives (my sister, my godmother, my grandparents, my friends) will be very happy. [translated from French] The event is my participation in the activities of the Belgian Red Cross as an official volunteer. It's an activity I'll be doing with my mom and little sister during the senior excursions organized for the commune's elderly by the

	regional Red Cross. We will take around a hundred elderly people on cruises around Germany, visiting abbeys or craft and/or original factories, to enable them to see more of the world, get out of their homes but also out of the commune they often know so well, and interact with younger people. For my part, I'll be delighted to be able to bring a little novelty to the daily lives of these people, most of whom live alone or in institutions, but I'll also be delighted to see them simply chatting to each other or enjoying the excursion on offer. As for the people around me, I imagine that almost all of them will feel a sense of joy at sharing this moment, and for the volunteers, a sense of accomplishment at having given their time for a good cause. There will certainly have an atmosphere of sharing with these people, who have a lot to tell of their past that the younger generation may not be aware of. In short, a more than positive atmosphere. This moment will help me to understand who I am as an individual, once I've taken time out of my free time to be of service to others, without being forced to do so, without being paid for it, even if I could have used it for something else. [translated from French]
Experiment 2	
Self-defining memory	I was on holiday in St Lucia, I was due to go on a tour that day of a nearby dormant volcano. Due to the weather conditions the tour guide had cancelled. As my family and I had already planned the day around that, we went alone. It was amazing seeing all of the scenery from such a high point. What made the trip was a near death experience, halfway up the volcano, due to the rain to terrain was slippery, I slipped and almost fell down the ledge, and it was only because my dad grabbed me that I didn't. It was a defining moment that made me appreciate exciting and dangerous experiences. In this particular event, I was in the airport about to board a flight to go on holiday with my family. When walking to the gate, a fellow passenger had just purchased something from a nearby shop. As he was walking, without noticing, he dropped a £50 note on the floor. Although I could have not done anything I decided that it was my responsibility to inform him so I picked up the note and handed it back to him. He was extremely grateful and told me that I was really kind and thoughtful because any other person in my situation might have just taken the money. Although this is a small thing I feel like it defines me as an individual as being selfless and caring about other people.
Self-defining future projection	I will be releasing my debut EP. This will be entirely self-recorded and it will be a proud work. It is a representation of my inner self. People will be able to listen to it on Spotify and I imagine I will get comments from people who do or don't like it.

	The event is a successful interview for my dream job. I will be in my house with my significant other when I get the call to say that I got the job. The phone will ring, I will answer it and my heart will be beating fast. The person on the phone takes a while to get to the point whereby they tell me that I got the job. I will be delighted and will jump into the air with excitement and happiness. My other half will do the same and smile at me and give me a big hug while I'm still on the phone, thanking the respondent for delivering the good news to me.
Experiment 3	
Self-defining future projection	I'm going to take part in a project organized by an association in a nature reserve. The aim is to raise visitors' awareness and/or interest in the subject of nature reserve management. As a member of the management committee, I've offered to help raise awareness. It's a task that's close to my heart, but also frightening, as I find it extremely difficult to express myself in public. I don't know how to react spontaneously when interacting with people I don't know. [translated from French] In the near future, I see myself in charge of a class (as I'm studying to become a primary school teacher) of around twenty pupils. I'll lead a science lesson in which the children have fun experimenting with water phenomena. They'll be happy and smiling because they're having fun. At the end of the lesson, however, they will have learned something useful and interesting. [translated from French]
Ordinary future event	I'll go to the library next Friday. I'll probably be alone. I don't know what I'll wear yet, but I hope it'll be cold so I can wear my favorite scarf. I'll take the bus with my headphones on as usual, but I don't know whether I'll stop at the terminus or a little before and walk, which would do me good. As usual, I have the choice of going to the one in town or the one in the European district. Then I'll take a seat, start by checking my phone a bit before starting to study and then I'll take my schedule and look at what I must do for Friday. I'll study maybe 1 hour at a time and then go for a break. I'll stay until 4:30 pm. When I've finished, I'll go to the bathroom to fix my outfit and put my headphones back on. To get home, I'll walk to the metro and take the bus back. [translated from French] Next Saturday, I'm going to listen to a podcast of a course. I'm going to settle down, alone, mid-morning at the dining room table, with my computer on my right and my course on my left. I'll listen to the podcast in 3 half-hour parts, highlighting the important things in the syllabus I have, with a yellow marker. I'll have my headphones on so as not to be disturbed by the noise my companion is making. Maybe he'll drop by to see what I'm doing in the room. [translated from French]

References

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