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**Everyday Thoughts in Time:
Experience Sampling Studies of Mental Time Travel**

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Abstract

Time is among the most important yet mysterious aspects of experience. We investigated everyday mental time travel, especially into the future. Two community samples, contacted at random points for three (Study 1; 6,686 reports) and 14 days (Study 2; 2,361 reports), reported on their most recent thought. Both studies found that thoughts about the present were frequent, thoughts about the future also were common, whereas thoughts about the past were rare. Thoughts about the present were on average highly happy and pleasant but low in meaningfulness. Pragmatic prospection (thoughts preparing for action) was evident in thoughts about planning and goals. Thoughts with no time aspect were lower in sociality and experiential richness. Thoughts about the past were relatively unpleasant and involuntary. Subjective experiences of thinking about past and future often were similar — while both differed from present focus, consistent with views that memory and prospection use similar mental structures.

The psychological importance of time can scarcely be overstated. Aside from pronouns, *time* is the single most commonly used noun in the English language (Burdick, 2017). Some of the most radically groundbreaking works of the 20th century focused on time, in disciplines as diverse as theoretical physics (relativity theory, Einstein, 1915), literature (e.g., Proust, 1913), and phenomenological philosophy (e.g., Heidegger, 1927).

We report two studies designed to illuminate the nature and quality of everyday conscious thoughts, particularly thoughts in relation to time (past, present, and/or future). We investigated these questions using experience sampling, in which people respond to questions at various times during the day (through an application on their smart phones), offering insight into the qualities of everyday life. We sought to understand the relative frequency of thoughts about future, the present, and the past; their motivational links; and the subjective experiences and social contexts accompanying thoughts in time.

Mental Time Travel and the Primacy of Propection

The present investigation was particularly interested in conscious thoughts about the future, or what Gilbert and Wilson (2006) dubbed *propection*. Seligman and colleagues (Seligman et al., 2013, 2016) have argued that psychological theory has underappreciated future-oriented thinking, as indicated by psychology's traditional focus on the causal power of past events (e.g., reinforcement history, Oedipus complex), as well as extensive cognitive studies of memory processes.

Emphasis has recently shifted toward increased emphasis on future cognitions. The discovery that the same brain sites that are used for thinking about the past are also used for prospective thinking caused some to reflect that perhaps thinking about the future is the more important, more adaptive, and otherwise primary function of these brain areas (Schacter et al., 2012). Episodic memory appears to be uniquely human (Tulving, 2005), and it may have developed less as a way to replay past events than to enable simulations of the future (Baumeister & Masicampo, 2010). In other words, the uniquely human ability to travel mentally away from the present moment, and thus even to think and reason about time (see Hoerl & McCormack, in press) may be primarily designed for traveling forward into the future.

To be sure, some highly creative research has examined future thinking, such as work by Gilbert and Wilson (2006) on predicting future emotional states, and more recently Tetlock's quest to identify and understand superforecasters, people who make unusually accurate predictions (Tetlock & Gardner, 2015; see also Tetlock, Mellers, Rohrbaugh, & Chen, 2014). Nevertheless, psychologists have studied thoughts about the past more than the future — whereas people's actual conscious thoughts might show the reverse emphasis. It is arguably more adaptive to think about the future than the past.

If propection is adaptive, why do other animals not do it? Animals remember lessons from the past, but Suddendorf and Corballis (1997) concluded that hardly any animals can think more than a few minutes into the future (see also Roberts, 2002). Moreover, nonhuman animals' memory for past events may be confined to movements

and lessons about contingencies, unlike the human mental ability to vividly re-create prior experiences. The advanced powers of the human brain, notably the neocortex, may be necessary for prospection. Even episodic memory (replaying experiences, rather than just having learned from reinforcing/punishing experiences) may be beyond what animals can do. The ability to engage in complex prospective thinking may be one of the key reasons that human culture has advanced so far beyond other animal societies. Suddendorf and Corballis proposed that the prospective capacities of the human mind are essentially linked to other special human mental powers, such as advanced theory of mind. Thus, future thinking may be a core ingredient of human thought.

Experience sampling permits only study of conscious thoughts, insofar as unconscious ones cannot be reported. Yet there is reason to theorize that thinking about the future may be specific to consciousness. The link to advanced human cognition (Suddendorf & Corballis, 1997) suggests that thinking about the future involves advanced mental capabilities, such as constructing sequences. Baumeister and Masicampo (2010) argued that the advanced (human) form of conscious thought is for simulating realities and possibilities, particularly in the context of social interaction, and so consciousness may be particularly vital for evaluating alternative scenarios of future outcomes.

Methods for studying everyday thinking have improved over time, but the primacy of prospection has been a recurrent theme. Cameron (1972) had to be content with knocking on doors and asking people what they had been thinking about just now. Twice as many thoughts were about future than past. Anderson and McDaniel (2019) likewise found that thoughts about the future were (over) twice as common as thoughts about the past. Smallwood, Nind, and O'Connor (2009) found that people's minds wandered more into the future than the past, except when the current task consumed their attention. Further work by Smallwood, Ruby, and Singer (2013) found that the more people mind-wandered, presumably into the future, the better they performed on a delay of gratification measure linked to maximize benefits. That important finding indicates that thinking about the future can be adaptive insofar as it increases long-term benefits.

Why Think about the Future?

William James (1890) famously asserted that thinking is always ultimately for doing, and this insight has been widely confirmed and extended in many contexts (e.g., Fiske, 1993). Our emphasis on the adaptive value of prospection emphasizes its particular utility for preparing action. James's assertion is thus the foundation of theorizing about *pragmatic* prospection, which assumes that the purpose of thinking about the future is to prepare for future actions, including decision making and performance demands (Baumeister, Vohs, & Oettingen, 2016). Whereas much research on prospective thinking involves making predictions, and predictions are undeniably important, pragmatic prospection theory calls for a change in emphasis. Rather than predicting how things will turn out, the goal of prospection is to anticipate situations in which multiple outcomes are possible in order to steer events toward the more desirable outcomes. In this view, the future is not a single, predetermined pathway that can potentially be predicted, but rather a "matrix of maybe," that is, a cluster of possibilities

and contingencies, only some of which will be realized (Baumeister, Maranges, & Sjøstad, 2018).

The pragmatic thrust of prospective thoughts has been suggested by previous work in various ways. Studies of prospective memory (e.g., reminding oneself of what needs to be done) suggest it constitutes about half of thoughts about the future (Anderson & McDaniel, 2019), and increases with age, possibly because older people need to rehearse such reminders so as not to forget important obligations (Gardner & Ascoli, 2015). Even when people are simply engaged in mind-wandering, thoughts about the future surpass other thoughts in terms of pragmatism. They are disproportionately focused on anticipating and planning future events involving oneself (Stawarczyk et al., 2011). Future-oriented mind-wandering thoughts are more likely than other thoughts to reflect structured sequences of thoughts (as in making plans and reasoning) and to be realistic and concrete (Stawarczyk et al., 2014), all of which is consistent with pragmatic emphasis on what oneself should and will do.

Pragmatic utility can be asserted for thoughts about past and present as well as future, and the current investigation made it possible to test James's formulation in these contexts also. Thinking about the past may facilitate learning for the future. As already noted, animals have procedural memory, but episodic replay may be more uniquely human — possibly to enable counterfactual replays, which simulate past events differently from how they happened. Such powers of alternative simulation may greatly facilitate prospection, because the future does not yet exist to be perceived and therefore must be mentally constructed. Schacter and Addis (2007; see also Szpunar, 2010) concluded that the same brain sites used for replaying past events are used for simulating future events, raising the question of whether these brain sites evolved because of improved retrospection or improved prospection.

Thinking about the present can of course also be highly pragmatic, insofar as people focus on the task at hand. Mind-wandering research suggests that the human mind wanders naturally into past and future and requires diligent effort to stay focused on the present, especially for performing mundane tasks (e.g., Smallwood & Schooler, 2006; Smallwood, Nind, & O'Connor, 2009). Our Study 1 asked participants to report whether their thoughts were under their conscious control. One might think that focusing on the present would not require control, given that presumably most animals normally and naturally think only about the present. Following from mind-wandering findings, staying focused on the present may often require conscious, effortful control, whereas thoughts about future and past may intrude unbidden into the stream of consciousness.

The pragmatic approach to prospection suggests that certain kinds of thoughts will predominate in prospection: specifically, ones that help prepare for action, such as choosing and deciding among options, reflecting on intentions and obligations, and thinking what to say. Other, less pragmatic thoughts (e.g., worrying or predicting one's future emotions) should be less common. Above all, planning should be an important part of prospection.

Planning is essentially pragmatic, because it specifies how to act so as to reach goals. It can specify what choices to make and what difficult performances require preparation. (Planning is generally assumed to be a conscious process also, presumably because it requires the mental simulation of sequential steps based on causal understanding and links the present to the future; see Baumeister & Masicampo,

2010; Baumeister, Masicampo, & Vohs, 2011). Planning is a form of prospection based on recognizing there are multiple possible outcomes contingent on one's actions and choices. We included measures of how often prospection involves planning and how planning compares with other forms of prospection (e.g., predicting, worrying, wondering what will happen). Insofar as the self evolved so as to maximize its body's long-term welfare, in part by integrating actions across time, it would improve outcomes by pondering decisions in advance so as to be able to be prepared to make the optimal ones when the time arises. Planning is thus essentially an adaptive process of preparing future behavioral decisions well in advance, and we expected it to be a common feature in conscious thoughts involving the future. (To be sure, planning can be used for maladaptive purposes, such as when planning a crime or suicide.)

Understanding prospection as pragmatic gives rise to several other predictions. First, prospective thoughts will link to motivations, which by definition aim at future outcomes (e.g., goals). Second, the goal pursuit aspect should increase arousal, to make more energy available. (In contrast, the past does not directly call for action, insofar as it cannot be changed, and so arousal should be relatively low. The present could be either high or low in arousal.)

Third, there should be disproportionate emphasis on the near future rather than the distant future, because the near future must be dealt with imminently whereas the distant future does not. Some evidence for this was provided by D'Argenbeau, Renaud, and van den Linden (2011), albeit with a very small sample. In their diary study, people reported more thoughts about future than past, but these were mainly concentrated on the near future.

Happiness and Meaning

An empirical exploration of the differences between meaning and happiness suggested that happiness focuses more on the present whereas meaning links across time (Baumeister, Vohs, Aaker, & Garbinsky, 2013). The present study offered the opportunity for a prospective test of that paper's post hoc conclusion. Participants rated their current happiness (and, separately, the pleasantness of the particular thought) as well as the meaningfulness of their thoughts.

The theoretical context is that feeling happy depends on current pleasures, satisfactions, and goal attainment. Happiness may thus be maximized when the focus is on the present. Mindfulness advocates likewise contend that anxiety, worry, anger, and other negative feelings can dissipate if one cultivates intense awareness on the here and now (Keng, Smoski, & Robins, 2011). Meaning, in contrast, can be understood as nonphysical connection (see Baumeister & Landau, 2018), which is the main way by which the future can be imported to the present. If the future has any causal impact on the present, it is not by means of physical causality running backward through time, and so presumably meaning is the only pathway. That is, people construct mental representations (meanings) of future events and use them to guide present actions. Hence thinking about the future, at least, should be highly meaningful. The importance of connection in meaning also suggests that thoughts that invoke multiple time zones (e.g., thinking about how present events are related to past and/or future ones) should be experienced as highly meaningful.

The Present Studies

We report two experience-sampling studies. Experience sampling is an expensive, labor-intensive method in which information is gathered from people as they go about their lives (Hektner, Schmidt, & Csikszentmihalyi, 2006). The key benefit of this method is that events, thoughts, and feelings can be assessed close to their occurrence in a natural context (Mehl & Conner, 2012; Shiffman, Stone, & Hufford, 2008). Compared to traditional surveys, experience sampling minimizes retrospective biases and, compared to laboratory assessments, it allows researchers to gather a more ecologically valid view of everyday phenomena. Compared to laboratory studies conducted on samples of undergraduates (which have a restricted range of demographics and psychographics; Henrich, Heine, & Norenzayan, 2010), experience sampling studies capture people's experience of daily life. Psychology has advanced enormously by studying thinking under controlled laboratory conditions, in which participants are assigned topics or presented with stimuli and instructed to think about them. The present investigation aimed to complement that work by studying people's thoughts as they occur outside the laboratory, in the contexts in which individuals find themselves in daily life.

Study 1 was a large experience-sampling study, in which people were prompted at random points while going about their daily lives and asked to report on their most recent thought. Study 2, which used a smaller sample over a much greater duration, was a check and conceptual replication attempt of Study 1's main findings. A key difference between the two studies is that while Study 1 allowed participants to indicate whether their most recent thought was related to the past, present, and/or future, Study 2 constrained participants to select only the past, present, or future as the major focus of their thoughts. This methodological difference means that any similar patterns found in both studies suggest especially robust phenomena.

We have cited some recent work using experience sampling with thoughts and examining the temporal dimension. The present work adds several new features. First, we have a much larger sample than previous studies. Second, instead of assigning participants to designate each thought as past, present, or future, Study 1 had participants rate them separately for each of those. That enabled us to study thoughts that combined different time periods (e.g., present plus future). It also revealed a large set of thoughts that did not have a time dimension. Third, we included a much greater set of ratings of thoughts than in previous work, thereby enabling a richer picture of everyday thinking.

STUDY 1

Study 1 was a large-scale experience sampling study designed to measure the frequency and correlates of past, present, and future thought in a community sample of Americans. People were contacted via their own smartphone at random moments throughout a three-day period and reported what had been their most recent thought.

We made an a priori decision to define the present as within five minutes of the instantaneous present, and told participants to think of it as such. Thus, the past was anything that happened prior to five minutes before the present moment and the future five minutes beyond it. Mindful of other possible configurations, however, and also aware that thinking about what to have for lunch in an hour might be meaningfully different from planning a ten-year research project, we had people report how far into

the past or future was their thought. We report time span analyses and supplementary analyses that adopted more remote definitions of the past and future, starting a week from when participants were responding.

METHOD

Sample

We aimed for a minimum target sample size of 200 participants based on recent studies using experience-sampling (e.g., Hofmann et al., 2012). We report all data exclusions and all manipulations. Datasets and unabridged materials for both studies are available online (https://osf.io/9uytp/?view_only=16eab289b837412999faab504f21806a). Participants were recruited via advertisements (e.g., Craigslist, Backpage, panel mailing lists). This process yielded 492 adults who registered, verified that their smartphone could use the sampling program, and completed screening and intake surveys (64% female; $M_{\text{age}}=28.81$ years, $SD= 9.61$; range: 18-67 years; 55% White, 11.5% African-American, 9.8% Hispanic/Latino, 19.0% Asian, 0.4% Native American or Pacific Islander, and 4.2% were of other backgrounds). Overall, 47.9% of participants reported they were currently a college student. Participants received \$5 for initial surveys and \$.50 for every mobile survey to which they responded, thus making them eligible for a total of \$14 sent to them as a gift card. In addition, a lottery rewarded some participants for completing each mobile phase.

Procedure

Participants first completed an intake survey assessing demographics and personality traits (not in the focus of the present contribution). The 3-day experience-sampling phase began the day after the intake survey.

The experience-sampling phase used a customizable web-based system that relies on cellphone text messaging to signal participants when a survey was available to complete (Hofmann & Patel, 2015). Each text message contained a hyperlink that directed participants to an online, secure webpage displayed on the smartphone's browser.

Six signals, distributed throughout a 12 hr period (from 9 am to 9 pm), were sent each day. The daily time window was divided into six equal blocks of 144 minutes (Hektner et al., 2006). Within each block, an exact time was randomly selected with the condition that two consecutive signals were spaced at least 45 minutes apart. Participants were encouraged to respond as soon as possible but survey links were valid for 2 hrs. The median delay in responding was 8 minutes. Only one mobile survey response per measurement occasion was allowed. The total number of signals participants could receive was 18.

Protocol

At each signal, participants indicated their current emotional state. They reported their current happiness on a scale from -3 (*very sad*) to +3 (*very happy*) and current level of arousal on a scale from -3 (*very relaxed*) to +3 (*very excited*). (The term "excited" was used because many laypersons construe arousal as specifically sexual arousal.) Moreover, participants reported the extent to which their thought had been shallow (-3) versus meaningful (+3), and under very low control (-3) versus very high control (+3), in a randomized order.

To assess the time aspect of thoughts, participants reported whether their most recent thought was "about the past (beyond 5 minutes ago)," "the present, now (within

the current 5 minutes),” “the future (beyond 5 minutes hence),” or whether there was “no time aspect.” Participants could indicate more than one option.

The survey then branched into time-aspect specific assessments (with the exception of thoughts deemed to have “no time aspect”), again allowing for more than one option to be selected. If the past had been chosen, participants indicated how long ago their past thought referred to: earlier today; yesterday; a few days ago; 1-4 weeks ago; 1-12 months ago; more than a year ago; more than 10 years ago; before they were born. Next, they reported on the content of the past thought by checking all that applied from list of 16 options (Figure 4, upper panel). The category “other” was available if participants wished to type in an individualized response. More than one option could be selected.

If participants had reported that their most recent thought had been about present, they reported on its content using 18 response options (Figure 4, middle panel).

If participants’ thought had referred to the future, they indicated its time span from a list of 9 options: later today; tomorrow; a few days from now; etc., up to “after life.” Again, they then provided more concrete information on the content of their future thoughts by checking one or more options, such as “planning,” “wondering what will happen,” and “what you hope to do” (Figure 4, lower panel).

Next, participants completed overall ratings of their most recent thought. To assess valence, participants reported the extent to which their thoughts were about something very unpleasant (-3) to very pleasant (+3).

A few other measures were taken, regarding specific mood states (e.g., anger, surprise); communication activities (whether participants had been receiving or communicating information; interacting with people; they consumed any alcohol or drugs), that are not reported here. (For the full protocol see Open Materials.)

Analysis Strategy

Analyses involving continuous outcome variables were conducted within a multilevel framework using the SPSS MIXED command in order to account for the nested structure of the experience sampling data (observations nested within persons). Dependent variables were left in their original metric. Continuous level-2 predictors were grand-mean centered in dispositional analyses with the exception of age because it has a natural zero-point. Level 1 contrast tests (e.g., time aspect vs. no time aspect) were conducted by entering the contrast of interest as dummy-coded variable.

Because we tested various hypotheses about an assortment of variables, the collection of hypotheses tested does not constitute a “family” for which multiplicity adjustment, such as Bonferroni correction, would be appropriate (Hochberg and Tamhane, 1987). We therefore report uncorrected p -values (except as otherwise noted, e.g., in Supplementary Tables). Results with uncorrected $p < .05$ are reported as significant, with the general caveat that these analyses are exploratory.

Because our main focus was on the average (i.e., fixed) effects across participants, and for reasons of parsimony, we decided to only let intercepts vary randomly between participants. A sensitivity analysis confirmed that parameters were only minimally affected and statistical conclusions did not change when random slopes were added.

Time-of-day was treated as a continuous variable measured in minutes, with the zero point (intercept) set to 9am. Day was included as a control variable through a set of effects-coded variables to control for possible differences in response rates across the course of the study. Furthermore, to investigate whether past, present, and future thought frequencies were reliably associated with dispositional variables, we applied Poisson regression to the person-level counts of thoughts within each time zone.

To estimate time of day effects on the likelihood of past, present, future, and no time-related thought (Figure 2), we applied a series of multilevel logistic regression analyses with the occurrence of past, present, or future thought as binary dependent variables. Day of experience sampling was included as a set of effect-codes to control for possible differences in response rates across the course of the study. For visual display (Figure 2), the estimates were transformed from logits to percentages.

Linear and quadratic time trend analyses (Table 6; Figure 7) were conducted by treating the fine-grained assessment of time categories as a temporal scale ranging from “before you were born” (-8) to more than fifty years from now (+8), with the present coded 0 (Figure 1). The rare and extreme category “after life” (+9) was not included in those analyses. The linear and quadratic terms of time span were entered jointly.

RESULTS AND DISCUSSION

Response Rates

Participants submitted a total of 6,686 mobile surveys. On average, participants replied to 13.6 out of 18 total signals, indicating a satisfactory mean response rate of 75.5% (median response rate: 86.1%). The mean completion time per survey was 5.0 minutes (excluding extreme outliers). A small fraction of surveys (2.3%) were incomplete.

Basic Distribution of Thoughts

Thoughts in time. Time-related responses can be sorted into those that indicated only one ‘time zone’ (past, present, or future) and those that combined two or all three. (Responses that indicated no time aspect will be covered in the next section.) Responses indicating only one time zone were more common than combinations (77% vs. 23%).

When only one time zone was indicated, the present was by far the most popular (53.1%), although thinking purely about the future was also somewhat common (18.8%; Table 1). Thinking exclusively about the past was relatively rare: 5.0% of time-related thoughts. Thoughts that included only the future were about three and a half times as frequent as thoughts that included only the past, and thoughts about the present were over ten times as frequent as any thoughts that included only the past. Apparently people devote very little time to thinking only about the past.

There were time-of-day differences in how often people thought about the past, present, and future (Figure 2). One might have expected evening thoughts to turn to preparation for the next day, or to roam back to the day’s incidents, but there was no sign of that happening. Rather, thinking about the future became less common as the day wore on ($b = -.00085$, 95% CI $[-.00112, -.00059]$, $p < .001$), as did thinking about the past ($b = -.00063$, 95% CI $[-.00108, -.00019]$, $p = .006$). By contrast, thoughts about the present increased ($b = .00037$, 95% CI $[.00011, .00064]$, $p = .006$). Furthermore, thoughts out of time (without a time-aspect) showed little or no change in frequency across the day ($b = .00031$, 95% CI $[-.00001, .00064]$, $p = .060$), suggesting that the differences in

time-related thoughts are specific to the present versus the past and future. Mental time travel is less common later in the day. Here time was measured in minutes, so the above effects are log odds ratios associated with one-minute intervals.

Thoughts that combined two or three time zones (that is, combinations of past, present, and future; see Table 1) were rather infrequent, with one major exception: Thoughts that combined the present and future were fairly frequent, amounting to 19% of all time-related thoughts (this includes about 3% that combined past, present, and future). It seems that prospection can be sorted into two categories that were about equally frequent: thinking purely about the future and thinking about the present as well as the future. Analyses on the qualities of these two kinds of thoughts did not yield substantial differences between the two (see below), suggesting that much thinking about the future is in relation to the present. It may be that many thoughts blur the line between being purely about the future and future in relation to present.

Altogether, most thinking concerns the here and now. In terms of mental time travel, about two out of every five time-related thoughts (39.1%; or 29.6% of all thoughts) invoked the future on its own or in combination with the present. In contrast, very little is devoted to thinking about the past — either exclusively or in combination with the present or future.

Thoughts out of Time. For the most part, participants' thoughts were related to the past, present, and/or future. Yet, a substantial minority of thoughts (24.4%) were described as having no link to time. Briefly summarized (Table 2), thoughts with no time aspect were accompanied by lower feelings of happiness, less meaningful than thoughts in time, and were associated with lower arousal. Thoughts outside of time also were less under voluntary control.¹

Past thoughts' distance from the present. Thoughts about the past tended to emphasize the recent past (Figure 1), with 37.9% referring to “earlier today” and 24.5% to “yesterday.” (Categories overlapped, as it was possible to select more than one option.) The categories “yesterday,” “a few days ago,” “1-4 weeks ago,” “1-12 months ago,” and “more than a year ago” each garnered about 20% of past thoughts. The distant past elicited a few thoughts, with about 10% of past thoughts referring to times “more than 10 years ago” and 4.5% “before you were born.” Thoughts about times before one was alive were less than 1 per 200.

Future thoughts' distance from the present. Similar to the near-term time frame of past thoughts, over half the thoughts about the future referred to later the same day (51.2%) (Figure 1). Beyond that the distribution was rather flat, with 27%-30% each for tomorrow, a few days from now, 1-4 weeks from now, and 1-12 months from now. Thinking about the more distant future dropped off sharply, with 14% referring to more than a year hence, 6% more than 10 years hence, and a tiny few referring to more than 50 years hence or when one expects to be dead.

Alone or Together?

Being with others (versus alone) was associated with thoughts that revolved around time. The seven time-aspect categories were statistically associated with being

¹ **Footnote:** A handful of responses indicated that the participant had been sleeping or almost sleeping when signaled. These responses generally indicated no time zone. We repeated analyses omitting those responses, and the results were nearly identical.

in the presence of others (versus alone), $\chi^2(7) = 209.7$, $p < .001$, Cramer's $V = .18$. When in the presence of others as opposed to being alone, people reported thoughts that were much more likely to be in the present (Figure 3). Thus, the present is the social time. The mind wanders into past and future more when one is alone than with others. The minority of thoughts that did not invoke time, in contrast, were associated with being alone.

The implication is that being with others is being in time, especially being in the present. Being alone allows one to escape from time. The presence of others focuses one's mind on the here-and-now. When others are absent, the mind wanders into past and future and even out of time (cf. Smallwood & Schooler, 2006). To be sure, this is a difference, not a law. All categories of time were more common when people were together than when alone, but all occurred when alone also.

Pragmatic Prospecction

Past thoughts. Among the 15 possible options of thought content, the most frequently reported for thoughts about the past was "implications of the past for the future," which was checked nearly half (45.1%) of the time (Figure 4). Combined with the infrequency of thoughts about the past for its own sake, this finding underscores the forward-looking, and thus pragmatic, nature of mental time travel.

When thinking about the past, people felt unable to control their thoughts. The thoughts themselves were rated as relatively unpleasant. Thoughts involving the past were fairly meaningful, more so than present thoughts but less so than future thoughts (Figure 5).

Present thoughts. The pragmatic utility of focusing on the present would presumably be found in attending to one's current activity, either so as to perform the task effectively or so as to enjoy it. The two most frequently checked categories of thoughts about the present were "doing what I intend to do / what I am supposed to do" (45%) and "paying attention / zeroed in on what I am doing" (39%) (Figure 4). Many other categories reflected task performance, though there was also ample evidence of enjoying or savoring the moment.

As for the thoughts themselves, they were under one's control, pleasant, and not very meaningful (Figure 5). Overall, much present focus seems to be about task performance and enjoying the moment.

Future thoughts. Consistent with the pragmatic prospecction perspective, the category of planning dominated thoughts about the future. Three quarters (74.1%) of thoughts about the future included planning (Figure 4).

Given the particular importance of planning, a series of analyses compared planning against other responses that involved the future (Table 3). Thoughts that included planning were rated as more meaningful, more under their control, and happier than other thoughts about the future. Planning seems to be a central way of thinking about the future, both in quality and frequency.

Planning emphasizes that the future is indeterminate (in the sense that it contains multiple possibilities). Indeterminacy is also implicit in the next most frequently cited categories of future-oriented thought, namely "what you hope to do" and "what you hope will happen." These two categories were significantly correlated but shared only about 13% of variance ($r = .365$), so they are clearly not the same experience. Both categories comprised around 45% of thoughts invoking the future, with the next several

most common responses, “what I will do,” “imagining”, and “wondering what will happen,” being indicated in around 35-40% of future-related thoughts.

Arousal. Arousal is one indicator of being in a goal-directed state (Brehm & Self, 1989). Accordingly we analyzed reports across time zones in order to test whether the future is more closely associated with arousal, as would be expected if people’s future thoughts are linked to goal pursuit.

Thoughts about the future were the most exciting, whereas thoughts about the past were relatively low in arousal (Figure 5). Thoughts about the present had moderate levels of excitement (representing arousal). Thus, thinking about the future was characterized by feeling energized, consistent with a prospective state of mind.

Happiness and Meaning

Single time zones. One way to test differences in thought is to compare levels of happiness and meaning across time zones. (No-time thoughts were excluded from these analyses.) While the present was characterized by the strongest feelings of happiness, the thoughts themselves were not very meaningful (Table 4).

Thoughts about the future were characterized by the highest levels of meaningfulness. They also were associated with lower levels of happiness than thoughts about the present (Table 4).

When people reported thinking about the past, the experience was distinctly more negative than thoughts about the present or future. Thoughts involving the past were the least happy, in relative terms. Yet they were fairly meaningful, more so than present thoughts but less so than future thoughts (Table 4).

One versus multiple time zones. Another way to test what kinds of thoughts are associated different levels of happiness and meaning is to make comparisons according to whether the thought was exclusively about one time zone (past, present, or future) versus some combination. The main analyses simply compared the three pure time zone responses against all possible combinations (Table 4). (No-time thoughts were excluded from these analyses.) A secondary analysis strategy calculated a temporal integration index based on how many time zones were invoked for each thought, ranging from zero (no time zone) to three (past and present and future). The latter analysis strategy yielded largely comparable conclusions (Figure 6; Table 5).

Participants rated their thoughts as being more under control and pleasant when they were confined to one time zone than when involving more than one. Happiness was significantly higher for thoughts related to single time zones than for thoughts with combinations. As reported above, most thoughts in just one time zone concerned the present, and focusing on the present is known to be associated with happiness (Brown & Ryan, 2003). Additionally, thoughts that were focused on both the present and the future were associated with relatively high happiness.

We predicted that meaningfulness of thoughts would be higher when thoughts linked more than one time zone, based on theories that define meaning as number of mental associations (Heine, Proulx, & Vohs, 2006), which likely are greater for multi-time zone thoughts. In line with predictions, thoughts that spanned time zones were much more meaningful than those focusing on a single time zone (Table 4). Analyses using the more fine-grained temporal integration index confirmed that meaningfulness rose steadily and significantly as thoughts took on more time dimensions (Figure 6).

The least meaningful thoughts were those outside of time, thus suggesting that people link meaning and time (Figure 6). Thoughts about one time zone were meaningful, and thoughts about two time zones were a step more meaningful. The thoughts that combined three time zones were the most meaningful of all, substantially more than thoughts that combined only two. Thus, the meaningfulness of thoughts rises with thoughts that link more time zones. Meaning is the essential connection across past, present, and future, despite the undeniable importance of physical causation from the present to the near future.

STUDY 2

Study 1 was partly exploratory, and therefore we sought converging evidence. By fortunate coincidence, a previous study had collected relevant experience sampling data for another study on counterfactual thought, which included measures of the time focus of people's thoughts (Summerville & Roese, 2008). Analyses of those data for the present project are entirely new.

The methods, measures, samples, and goals of the two studies were quite different and complementary in design, so any convergence of findings would be highly encouraging. Study 1 sampled people across three days, while Study 2 sampled participants across a full 14 days. In multilevel designs, power depends on both the number of participants and the number of repeated observations within participants. Thus, whereas Study 1 attained relatively high statistical power from the sampling of a large number of people (for a relatively short duration of time), Study 2 gained power by repeatedly sampling many times (from a smaller number of participants).

Study 1 permitted people to indicate more than one time zone, as well as to report that their thought was not relevant to time. In comparison, Study 2 required that every thought pertained to one and only one time zone. This difference in procedure is particularly relevant to thoughts about the future, which Study 1 differentiated among thoughts purely about the future and thoughts about the future in combination with the present (of which there were many). Moreover, all of Study 1's thoughts that participants classified as having no time zone would have been assigned a time zone in Study 2. The differences in procedures suggest that consistent findings between the two studies warrant confidence.

METHOD

Participants

Thirty-four paid participants (15 women, $M_{age} = 22.3$ yrs, $SD = 4.25$, 50% White, 14.7% African-American, 34.3% Asian or Asian-American, 17.6% Hispanic) recruited from the local community of a large university in the Midwest United States provided a total of 2,361 experience sampling reports. On average, each participant provided 69.1 reports ($SD = 19.6$).

Procedure

Participants were given a Palm Zire running iESP software, which signaled them seven times during a daily 10-hr window, with alerts occurring every 1-2 hrs for 14 days. Participants had 10 mins to respond to the signal and 2 mins to respond to each question. The software automatically classified trials with unanswered questions as missed, and these trials were removed from analysis (19.8% of trials). On average, participants responded to 75.4% ($SD = 18.0\%$) of alerts during the two-week session.

Participants first answered questions about how many people they were with and how close they felt to those people using a 100-point slider (1=not close; 100=very close). They also indicated whether their thoughts were primarily focused on the past, present, or future.

Participants classified their thoughts as being descriptions, opinions, comparisons, or “other.” Thoughts then were rated for goal pursuit using four sliders (1=no; 100=yes). Items started with the stem, “Right now I am thinking about...” and pertained to achieving positive outcomes (approach motivation); avoiding negative outcomes (avoidance motivation); obligations or duties; and goals and ideals. Then, participants used 100-point sliders to rate their current arousal levels as indicated by, “Right now, I am feeling...” with anchors “calm” to “excited.” Affect was also measured (see Supplementary Table 2).

Results and Discussion

Distribution of thoughts in time. Analyzing the frequency of each time zone across all trials and thought types showed roughly the same pattern as in Study 1: 6.2% of thoughts focused on the past, 68.0% on the present, and 25.8% on the future. Given that the procedures differed (forced choice of a single time zone vs. being able to indicate multiple time zones at once), it is impressively convergent evidence that in both studies thoughts about the future were three and a half times as frequent as thoughts about the past.

Presence of others. A multinomial regression was conducted in SPSS MIXED to predict time zone as a function of the presence of others, nesting trials within participants. In line with Study 1’s results, thoughts about the present were more likely when with others than alone ($b=.37$, $F(2,2356)=5.50$, $p=.004$). Thoughts about the present versus other times (past and future combined) were more likely as the number of others increased ($b=0.17$, $F(2,2356)=4.65$, $p=.01$). This finding converges with Study 1: the present is social time.

Pragmatic prospection. Data were analyzed with linear mixed models using the lme4 package in R, regressing the continuous measure onto time zone, dummy coded for past and future thoughts with the present used as the baseline, and nesting trials within participants (Bates et al., 2015).

Thinking about the future was broadly associated with goal strivings. Table 7 presents adjusted means for each time zone and contrasts between times computed from mixed model regression coefficients. Compared to thoughts about the present and past, thinking about the future was associated with greater approach motivation, avoidance motivation, achievement of goals and ideals, and meeting duties and obligations. These results provide useful confirmation of the pragmatic prospection perspective, insofar as they indicate that thinking about the future is highly relevant to pragmatic motivations and achievement goals.

Thoughts about the past, compared to thoughts about the present, were less focused on meeting duties and obligations. Thinking about the past and present did not

differ with respect to motivations to approach, avoid, or achieve ideals. Thus, the pragmatic thrust is more evident in thoughts about the future than the present or past.

Reports of arousal (excitement) showed patterns consistent with a prospection theory and with Study 1. People felt more excited when thinking about the future compared to the past. The present did not differ from either the past or future. Thus, both Studies 1 and 2 linked thinking about the future to feeling excited.

GENERAL DISCUSSION

To what extent and with what effects do people think consciously about the present, past, and future in their everyday lives? The two studies presented here provide a useful picture of mental time travel in everyday cognition. Despite methodological differences between our two studies, indeed despite the fact that they were conducted independently, the findings converged in important respects.

Primacy of Prospection

Both studies emphatically found that people report many more thoughts about the future than the past (see also Anderson & McDaniel, 2019). Indeed, despite different measurement approaches, both our studies found that people think about the future roughly three and half times as often as the past. Focus on the present was most frequent, but the future was also quite common, whereas thinking only about the past was fairly rare. Thus, human mental time travel tends to move forward into the future.

Moreover, thoughts about the present were rated highest on conscious control. Thus, people exert effort in order to keep their thoughts on the present. A tentative impression is that human conscious thought is predisposed to roam into the future (e.g., Smallwood & Schooler, 2014; Stawarczyk et al., 2011).

Study 1 permitted people to indicate that their current thought addressed more than one (or none) of the three time zones of past, present, and future. The most common combination by far was present plus future, and indeed about half the thoughts that were rated as pertaining to future also pertained to the present. In contrast to the traditional psychological emphasis on the past, it seems that among human thoughts, the present is much more strongly linked to the future than to the past. One likely explanation for the future-present link is that this is a pragmatic focus, namely thinking about what should be done now to prepare for upcoming events.

Is Thinking for Doing?

James (1890) famously proposed that thinking is always for doing. It is risky for social scientists to make “always” assertions, and the present data cannot support the thinking-doing link as a universal law without some huge interpretive leaps. Nevertheless, pragmatism clearly predominated in our sample of thoughts, thus supporting the general spirit of James’s assertion even if it falls short of absolute universality.

The view of future-oriented thoughts in particular as chiefly pragmatic was amply supported. Planning is essentially pragmatic (because it explicitly prepares future

actions). Though we expected there would be planning, frankly we were quite surprised by the extent: three quarters of all thoughts about the future involved planning.

Other findings underscored the pragmatic nature of prospection. There was much more thinking about the near than the distant future, presumably because it is clearly more urgent to prepare for the near than distant future (see also D'Argembeau et al., 2011). Arousal prepares for action (Brehm & Self, 1989), and despite quite different methods, both our studies found that thinking about the future was associated with relatively higher levels of arousal. (Meanwhile the past, which is impervious to objective change and thus lacking pragmatic engagement, was associated with relatively lower levels of arousal.) Apart from planning, many of the most frequently reported contents of prospective thought had pragmatic relevance: thinking about obligations and intentions, pondering one's own next actions or anticipating what others will do, and deciding what to say or do.

We suspect that much of the planning is in simple forms. Plausibly even the prospective memory patterns demonstrated in other studies of prospection (Anderson & McDaniel, 2019) showed up in our data as planning. Whether laypersons think of prospective memory thoughts (e.g., "I should stop on the way home to buy milk") as planning can be verified by future research.

Study 2 added a key motivational dimension to the pragmatic aspect of prospection. Thoughts about the future were significantly correlated with more approach and more avoidance motivation, more meeting duties and obligations, more striving toward goals and ideals — all even much more than thoughts about the present were. (Thoughts about the past, meanwhile, were less associated with those goal-striving and motivational aspects.)

James's (1890) view that thinking is for doing was also largely supported in our data about thoughts regarding present and past. The most frequently reported category of thoughts about the past in Study 1 was its implications for the future. Nearly half the thoughts about the past had this aspect. Other pragmatically relevant and frequently reported categories for thoughts about the past were trying to figure out what happened or learn from past events. Thus, even when people think about the past, they have an eye on the future. As for the present, thinking about implications for the future was again somewhat common, but present-oriented pragmatic thoughts dominated: People often said they were focused on the task at hand and thinking about what they were doing. Trying to figure out or understand some aspects of the present situation was also frequently reported (and again presumably quite pragmatic in most cases).

To be sure, there were thoughts whose pragmatic relevance was difficult to see. A substantial minority of present-oriented thoughts involved enjoying or savoring the present, which may serve hedonic rather than utilitarian goals. People reported ruminating idly about past events. Even a few present-oriented thoughts seemed pragmatically useless, such as feeling sorry for oneself. Likewise, some thoughts about the future lacked clear pragmatic relevance, such as worrying.

Nevertheless, the assertion that thinking is for doing emerges from these data as broadly correct, even if James (1890) overstated the case to assert its universality. Everyday human conscious thought does occasionally range far and wide and addresses diverse topics, but the vast majority of it seems relatively narrow and precise. Some thoughts, such as ruminations about past events, may be pragmatically useless (though some rumination can be quite adaptive and beneficial for learning; see Ciarocco et al., 2010).

The exceptions to pragmatic thought may indeed be simply exceptions. The human capacity for mental time travel may well have evolved to facilitate and improve adaptive action, even if it is sometimes used in useless or even counterproductive ways.

Time and Social Life

The importance of time in human cognition may have an important social basis. Study 1 found that all seven categories of temporal cognition (past, present, future, plus all combinations) were all more common in the presence of others than when alone. In contrast, no-time cognitions were more common when alone than when with others. Social interaction is linked to time-related thoughts.

Study 1 also found that the present was the most social of times. Mental time travel was relatively more common when alone than when with others. Study 2 replicated the finding that thoughts about the present were more common when with others than alone. It added the important finding that present focus varied with quantity of other people: The more people the participant was currently with, the more his or her thoughts converged on the present.

Indeed, the richness of both social and mental life seems linked to time. Study 1 found a hefty proportion of thoughts that had no time aspect, and these were rated as weaker on a variety of subjective measures, including being lower in meaningfulness, emotion, and excitement.

As Smallwood et al. (2009) contended, the mind wanders naturally into past and (especially) future. Social interaction curbs mind-wandering, thereby enforcing an emphasis on the present. Thus, social interaction favors all time-related cognitions but especially favors present-oriented cognitions. Of course, these are general patterns rather than laws. All kinds of temporal and no-time cognitions occurred both when alone and when with others, but the preponderances were significantly different.

Subjective Experience

Our research design offered three different possible controls for prospection. Thinking about the future can be compared with past (and perhaps present), to see what is specific and distinctive about the future. Second, the effects of mental time travel can be tested by comparing future plus past against present. Third, thinking about future, along with present and past, can be compared with no-time thoughts. All these types of comparisons yielded significant differences.

The abundance of significant quadratic effects (Table 6; Figure 7) indicates that the main difference is between thinking about future or past versus the present. Thus, mental time travel changes subjective reactions, as compared to staying focused on the here and now. Still, often the future differed from the past — and generally in a more positive manner.

There were some purely linear effects, most notably with excitement (arousal). These showed that the farther into the future thoughts ranged, the more exciting they were rated as being. This roughly fits a pragmatic view, such that arousal is preparation for action — though one might have expected more arousal for thoughts focused on the near than distant future. One could argue that present-oriented thoughts would also be somewhat arousing, insofar as one is engaged in action, though many present moments do not involve goal pursuit (e.g., enjoying social time with friends, a major segment of our data). Possibly the lower average arousal for thinking about present as compared to future was due to the fact that often the present is inescapably boring — and although the future will also contain some boring periods, people may not think as much about these in advance. Also, arousal, like all subjective ratings, was correlated with the participant's rating of the time farthest from the present, whenever multiple times were indicated, so some thoughts about distant future may have also pertained to the near future. If so, then the highest arousal might have been linked to impending events that have long-term future implications.

Conscious control of thoughts was highest for thinking about the present and lowest for thinking about the past. The latter finding presumably reflects involuntary rumination about past events. Meanwhile, staying focused on the present, such as to perform one's duties, often requires conscious effortful control, as the mind wanders naturally into past and future. Actual planning was high on conscious control, but other forms of thinking about the future (e.g., worrying) may occur rather involuntarily. In short, the presence of others seems to intensify focus on the present, but when that is lacking, conscious control is needed to stay focused on the here and now.

Happiness and Meaningfulness

Some of the most interesting elements of subjective experience concerned happiness versus meaningfulness. One clear set of a priori predictions was based on a previous study that suggested that happiness is linked to the present whereas meaning is about the future or, more broadly about linking past, present, and future (Baumeister et al., 2013). The present findings provided robust support for that conclusion. Study 1 regressed subjective states on the time aspect of each thought. Both linear and quadratic (curvilinear) effects were significant, but in opposite directions for meaning versus happiness.

Crudely summarized, the present is the most pleasant, and the future is more pleasant than the past. Happiness was highest when people thought only about the present. The rating of the pleasantness of the thought itself showed if anything an even sharper curve, with thinking about the present being far more pleasant than thinking about past or future (and future again significantly more pleasant than past, as indicated by significant quadratic effect). The peak of the curve was very slightly into the near

future, possibly reflecting the hedonic value of anticipation. By analogy, Loewenstein (1987) found that people were hypothetically willing to pay more to kiss their favorite movie star three days from now than today, suggesting that some pleasant anticipation enhanced the value of the experience. In any case, these findings are strong endorsement of the claim of mindfulness practitioners, that focusing on the present maximizes well-being (Keng et al., 2011). They also dovetail with Szpunar's (2010) coverage of episodic future thinking, indicating that most such thoughts focus on the near future (pragmatically) and are generally pleasant. The most unpleasant thoughts seem to focus on the past.

Meaningfulness was quite different, however. On average, people rated thoughts about the present as lowest in meaningfulness. Again, future thoughts were more meaningful than past ones (hence the significant linear effect in addition to the quadratic one). These are consistent with the analysis of meaning as nonphysical connection (Baumeister & Landau, 2018) and thus as the essential means by which teleological cognitive causation can occur.

Of particular interest, Study 1 was able to compare thoughts that invoked one time zone (or indeed none) against those that invoked two or all three. The finding was a robust correlation between number of time zones and meaningfulness. The no-time thoughts were rated as the least meaningful, whereas those invoking all three were the most, and two times zones reliably elicited higher ratings of meaningfulness than one. This strongly supports the hypothesis that meaning, as nonphysical connection, connects across different times and is a crucial means by which the future can exert a causal influence on the present.

Personality

The Supplementary Materials record our largely fruitless search for personality predictors of what sorts of people would think more or less about the future. Our measures did yield multiple significant findings as to who thinks about the past. The reversal is ironic, because we selected the measures aiming to predict thoughts about the future, but those same measures succeeded mainly at predicting thoughts about the past.

The tentative conclusion is therefore that everybody thinks about the future. Thinking about the past is optional, and some people do it plenty more than others. But thinking about the future (at least the near future) is essential and/or natural. This fits the view that the human mind is designed for prospection (see also Hawkins & Blakeslee, 2004; Klein, 2013).

Limitations and Methodological Notes

Methodologically, our investigation has useful advances over prior work, including our much larger sample. Most important, Study 1 departed from all previous work in how it assessed the time dimension of thought. To our knowledge, all prior studies have relied on a forced-choice procedure in which participants classified their thoughts as past, present, or future. Our Study 1 asked separately about each of those,

and we encourage future researchers to adopt this method. One benefit was that about a quarter of thoughts had no time dimension, and these differed in multiple ways from time-linked thoughts. Another was that many responses indicated people were thinking about more than one time zone, with present plus future being especially common. The meaningfulness of thoughts correlated heavily with how many time zones were involved, such that the thoughts that each invoked all three were rated as the most meaningful, whereas the no-time thoughts were least meaningful.

In our view, the most serious limitation of this work is its reliance on American adults, all recruited from Chicago. These findings may generalize to other North Americans and even Europeans, but we hesitate to generalize to quite different cultures. Modern Asians have been shown to differ from Westerners with regard to prospection, such as by emphasizing the past relatively more (for review, see Gao, 2016). Vastly different cultures, such as hunter-gatherer groups, may have quite different mental relationships to time.

Concluding Remarks

In this sample of everyday thoughts among modern, Western citizens, the future looms large — indeed much larger than the past. The emphasis on present and future rather than past presumably reflects their greater pragmatic importance. (Even the few thoughts about the past did predominantly indicate pragmatism, such as in learning lessons or exploring implications of the past for the future.) Animals may live mainly in the present, but human thoughts often invoke the future, especially the near future, for which it is useful to prepare.

Not all thoughts involve time, but time seems vital for the richness of human social life. Thoughts outside of time were more common when people were alone than with others, and in general such thoughts were less emotionally evocative and less meaningful than thoughts that linked to time. Moreover, subjective experience fluctuated with temporal focus. People were happiest and least anxious when focused on the immediate present, whereas meaningfulness was maximized among thoughts that integrated past, present, and future, with the future being the most meaningful.

Thus, the particular power to integrate past, present, and future, and in particular to engage in planning and other thoughts to prepare for future action, is an important and distinctive feature of human mental life. Thinking in time not only empowers individuals to benefit pragmatically but is also linked to social interaction. The frequency and richness of human mental time travel are indicative of its powerful, adaptive utility. We recommend that future studies of human thinking and feeling continue to appreciate the future.

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Table 1. Frequency of Thoughts about Past, Present, and Future, for Exclusive and Combined Focus; Study 1

Time zone(s)			Percent of time-related thoughts	Percent of all thoughts
<i>Exclusive focus (one time zone)</i>				
Past			5.0	3.8
	Present		53.1	40.1
		Future	18.8	14.2
		Total:	77.0	58.2
<i>Combined focus (2-3 time zones)</i>				
Past	Present		2.7	2.0
Past		Future	1.2	0.9
	Present	Future	16.1	12.2
Past	Present	Future	3.0	2.3
		Total:	23.0	17.4

Note: "Exclusive" indicates thoughts that participants reported as being related to only one time zone. "Combined" indicates thoughts that participants reported as being related to two or more time zones.

Table 2. Subjective Experience of Thoughts With versus Without a Time Aspect; Multilevel Analyses, Study 1

Dependent Variable	Means		Test of Difference		
	No Time Aspect	Time Aspect	<i>t</i>	<i>df</i>	<i>p</i>
Excitement (Arousal)	-0.62	-0.12	10.56	6574.6	<.001
Control over thoughts	0.77	1.02	5.34	6592.9	<.001
Happiness	0.87	0.97	2.48	6538.7	.013
Meaningfulness	0.13	0.66	11.75	6593.7	<.001
Thought pleasantness	0.86	0.78	1.87	6523.0	.062

Table 3. Comparisons of Future-Oriented Thoughts Concerning Planning (n = 1,446) versus Other Thoughts (n = 505); Multilevel Analyses, Study 1

Dependent Variable	Means		Test of Difference		
	Planning	No Planning	<i>t</i>	<i>df</i>	<i>p</i>
Excitement (Arousal)	0.01	0.08	0.87	1948.1	.386
Control over thoughts	1.06	0.58	5.85	1911.5	<.001
Happiness	0.93	0.70	3.39	1900.9	.001
Meaningfulness	0.88	0.71	2.18	1925.1	.029
Thought pleasantness	0.83	0.43	5.00	1901.57	<.001

Table 4. Comparisons of Thoughts about a Single Time Zone (Past, Present, or Future Only) versus Thoughts Connecting Two or Three Time Zones; Multilevel Analyses, Study 1.

Dependent Variable	Means		Test of Difference		
	Single Time	Combined Times	<i>t</i>	<i>df</i>	<i>p</i>
Excitement (Arousal)	-0.17	0.05	4.13	4962.5	< .001
Control over thoughts	1.07	0.85	4.18	4942.5	< .001
Happiness	1.01	0.79	5.13	4888.9	< .001
Meaningfulness	0.60	0.87	5.29	4936.7	< .001
Thought pleasantness	0.85	0.53	6.4	4896.4	< .001

Table 5. Subjective Qualities of Thoughts Varying in Temporal Integration; Study 1.

Dependent Variable	Regression Coefficients		Test of Effect		
	Intercept	Temporal Integration Index	<i>df</i>	<i>t</i>	<i>p</i>
Excitement (Arousal)	-0.54	0.32	6577.6	10.86	<.001
Control over thoughts	0.92	0.05	6591.9	1.61	.107
Happiness	0.99	-0.04	6536.5	1.91	.057
Meaningfulness	0.18	0.37	6592.6	13.08	<.001
Thought pleasantness	0.95	-0.16	6522.5	6.23	<.001

Note: Temporal integration index indicates the number of time zones invoked for each thought, ranging from 0 (no time element) to 3 (a thought about the past, present, and future).

Table 6. Multilevel Analyses of Linear and Quadratic Trends of Time Span on Qualities of Thought; Study 1.

Dependent outcome	Intercept	Linear Time Frame Effect	<i>p</i>	Quadratic Time Frame Effect	<i>p</i>
Excitement (Arousal)	-0.177	0.042	<.001	0.001	.814
Control over Thoughts	1.094	0.020	.033	-0.010	<.001
Happiness	1.042	0.006	.400	-0.008	<.001
Meaningfulness	0.483	0.041	<.001	0.015	<.001
Thought Pleasantness	0.860	0.034	<.001	-0.011	<.001

Note: Figure 7 provides a visualization of these patterns.

Table 7. Estimated Adjusted Means (With 95% C.I.) For Motivations In Each Time Zone; Study 2.

Dependent Outcome	Estimated Adjusted Mean (95% C.I.)			Contrast <i>t</i> (<i>p</i>)		
	<i>Past</i>	<i>Present</i>	<i>Future</i>	<i>Past v. Pres.</i>	<i>Fut. v. Pres.</i>	<i>Fut. v. Past</i>
Approach	69.1 (65.1, 73.1)	67.0 (61.5, 72.4)	77.4 (73.1, 81.6)	1.02 (.31)	4.70 (< .001)	7.10 (< .001)
Avoidance	62.5 (57.6, 67.4)	61.3 (54.9, 67.6)	68.6 (63.5, 73.8)	0.54 (.59)	3.08 (.002)	4.88 (< .001)
Ideals	51.1 (46.6, 55.6)	51.9 (45.7, 58.1)	61.1 (56.3, 66.0)	-.33 (.74)	3.65 (< .001)	7.53 (< .001)
Obligations	53.5 (49.9, 57.1)	46.8 (40.9, 52.8)	58.4 (54.4, 62.5)	2.49 (.01)	4.10 (< .001)	3.34 (.001)
Excitement (Arousal)	40.8 (37.1, 44.5)	41.4 (36.2, 46.6)	43.3 (39.4, 47.3)	-.27 (.79)	0.91 (.36)	2.21 (.03)

Note: Adjusted means, C.I.s, and contrasts are computed from multilevel regression coefficients for each dependent outcome. Contrast *t* s have d.f. between 2325-2346.

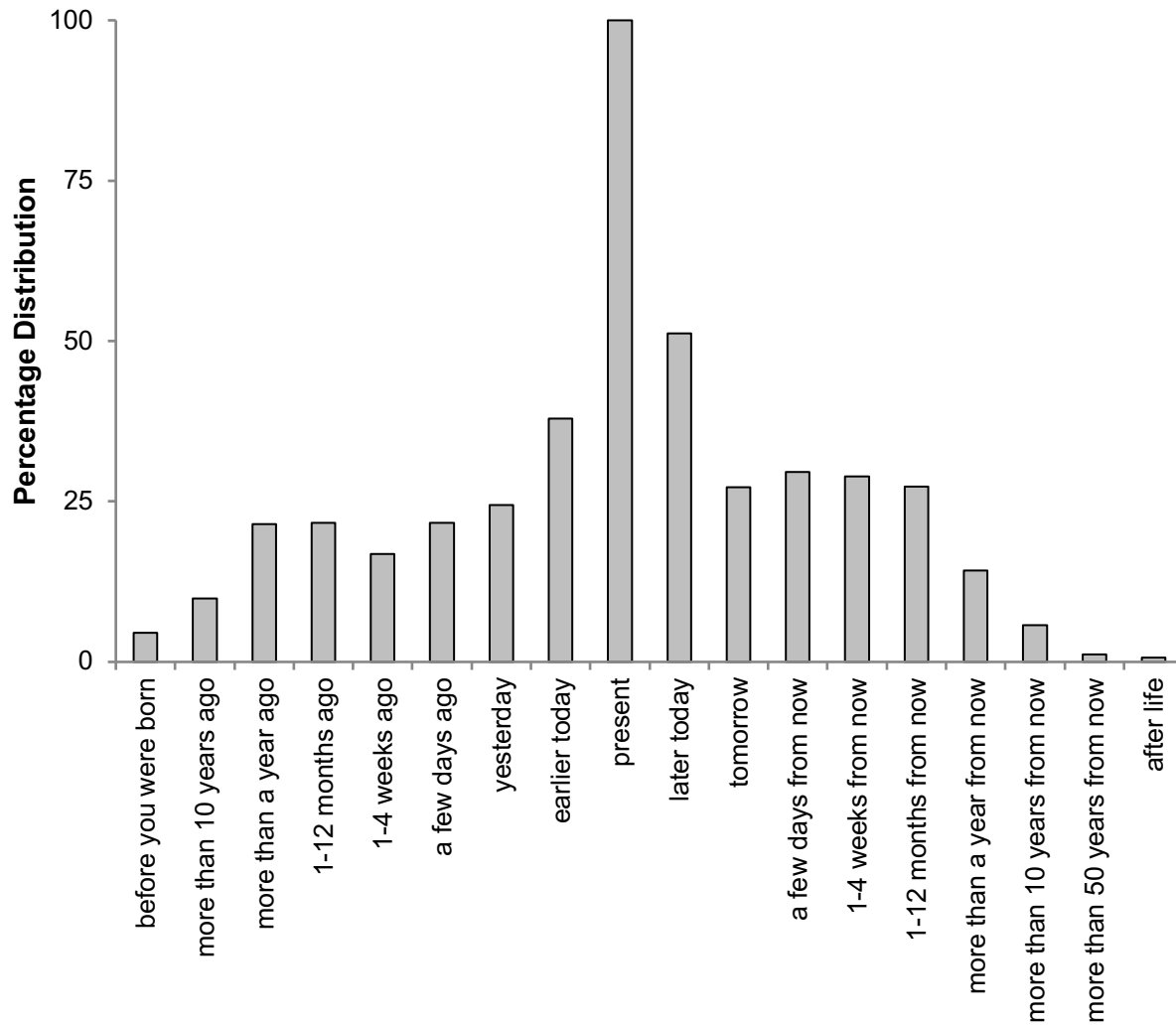


Figure 1. Percentage of thoughts about the past, present, and future; Study 1.

Note: Past and future thought percentages were calculated based on the overall number of past and future thoughts, respectively. For present thoughts, no time span categories were presented.

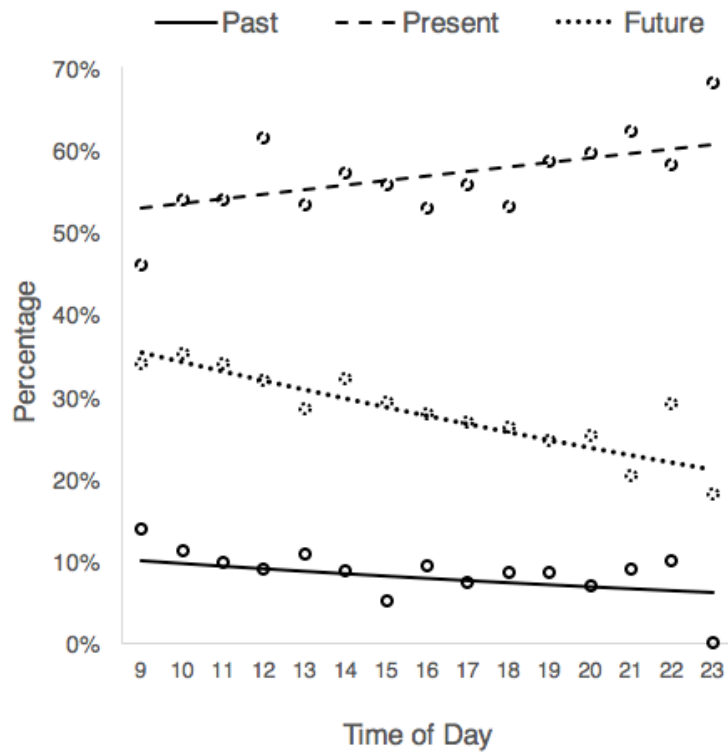


Figure 2. Linear time trends of past, present, and future thought percentages; Study 1.

Note: Estimates are from three multilevel logistic regressions that modeled the likelihood of past, present, or future thoughts as binary (yes vs. no) outcomes. Time of day was measured in minutes, centered at 9a.m., and experience-sampling day was included as covariate. Estimates were transformed from logits to percentages. Circles represent raw percentages, calculated for each 1-hour window (e.g., 9am to 10am).

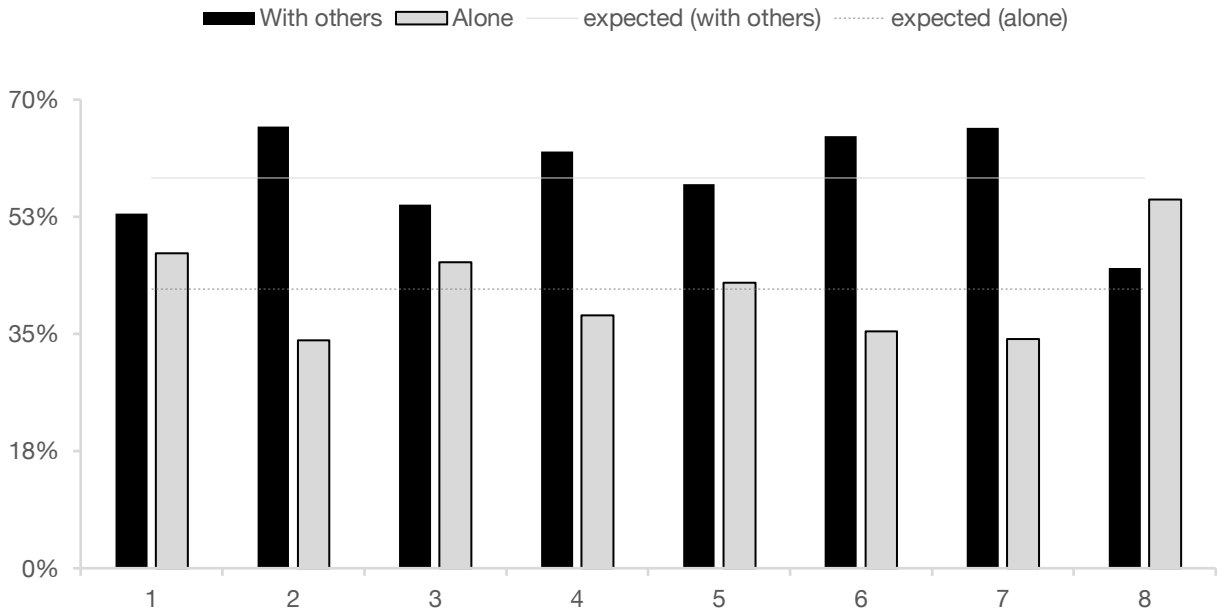


Figure 3. Frequency of time aspect as a function of whether being with others or alone; Study 1. 1=past (only); 2=present; 3=future; 4=both past and present; 5=past+future; 6=present+future; 7=past, present, and future; 8=no time.

Note: Expected lines indicate expected percentages under the assumption of statistical independence.

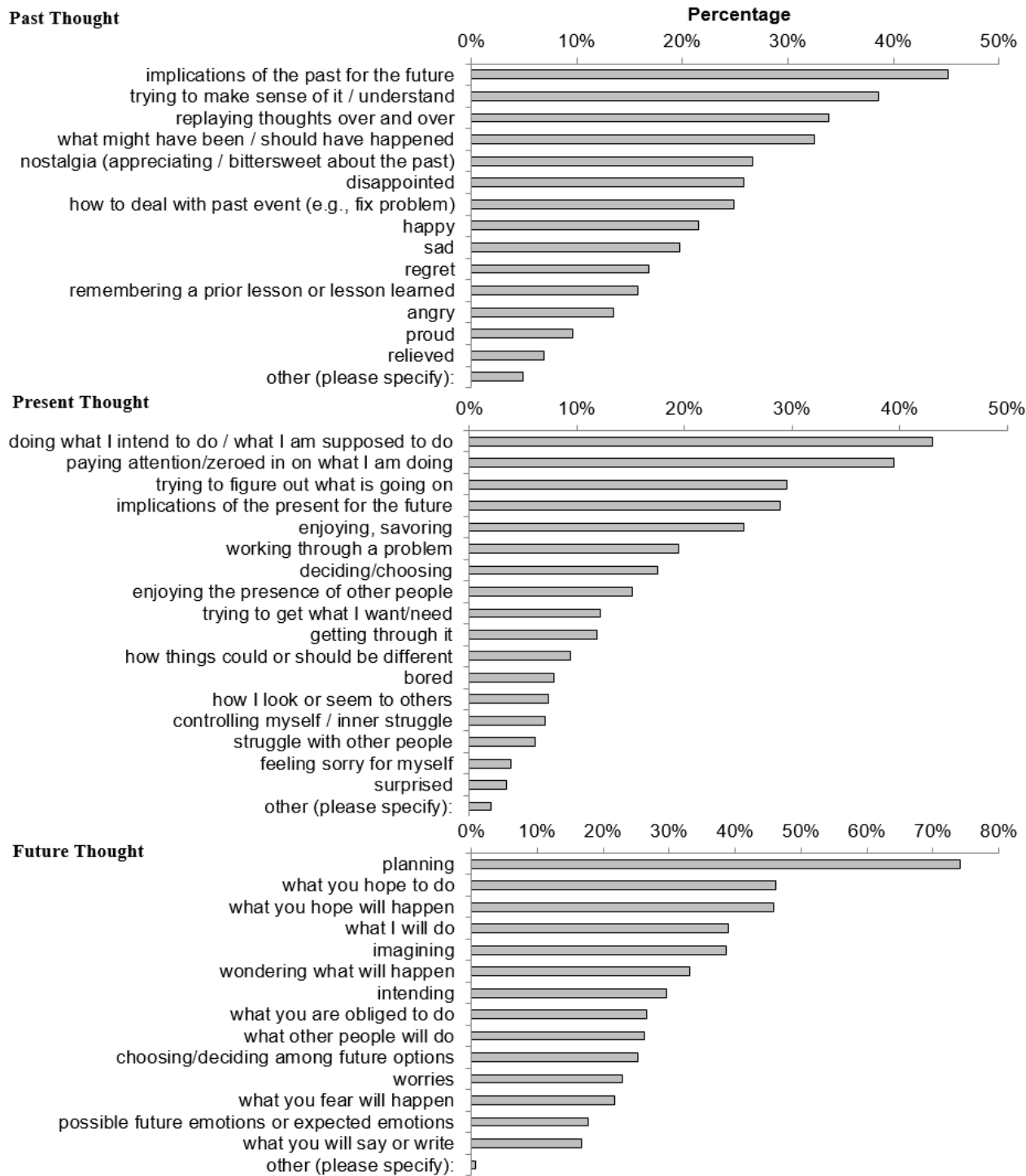


Figure 4. Past, present, and future thought content; Study 1.



Figure 5. Subjective Experience of Past, Present, and Future Thoughts; Study 1.

Note: Variables were measured on a scale from -3 to +3. Bars with different superscripts differ significantly from each other at $p < .05$, as indicated by simple contrasts. Overall F tests were significant for all variables, $ps < .003$.

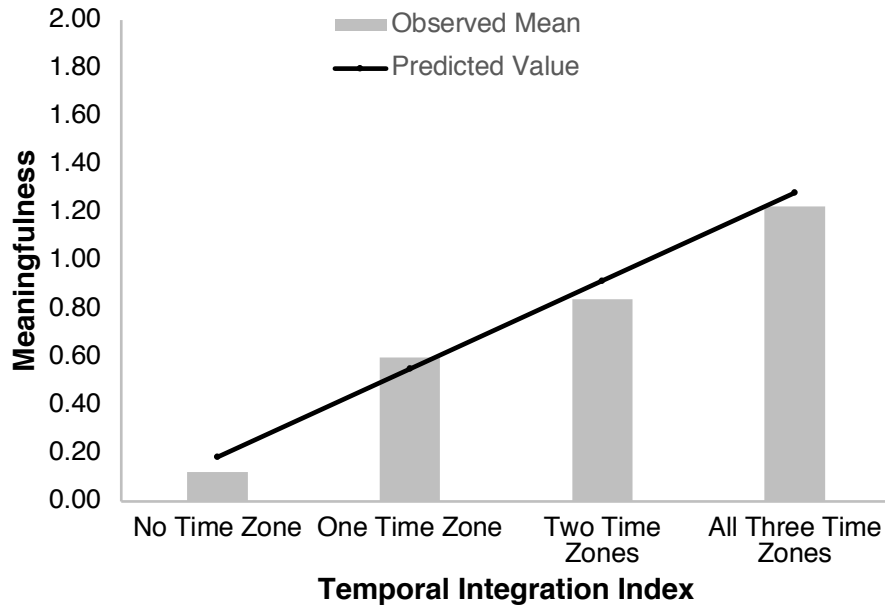
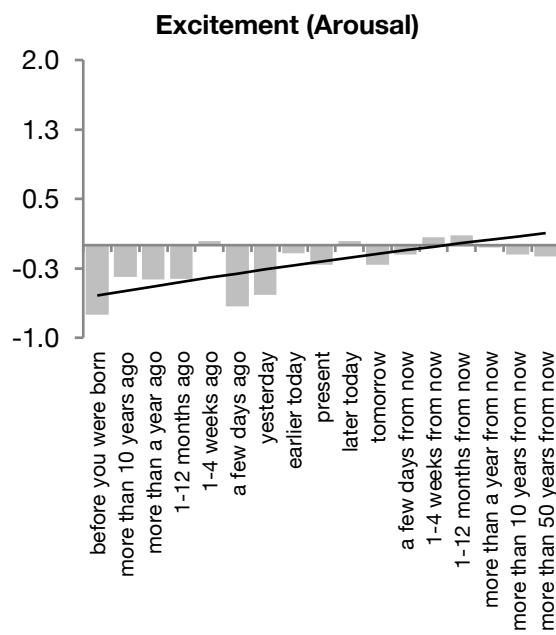
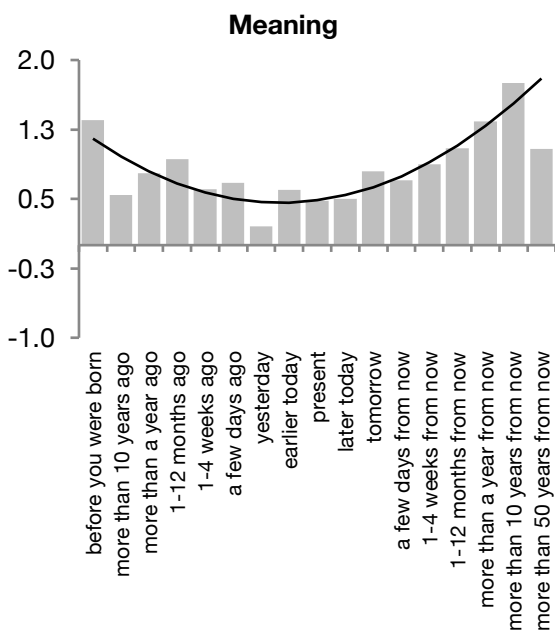
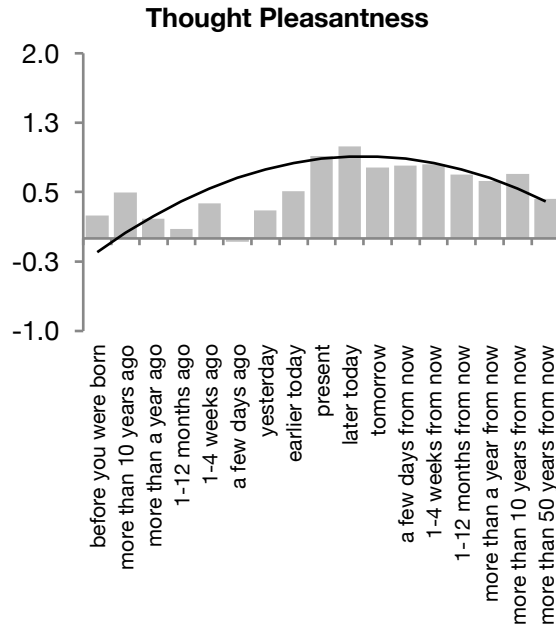
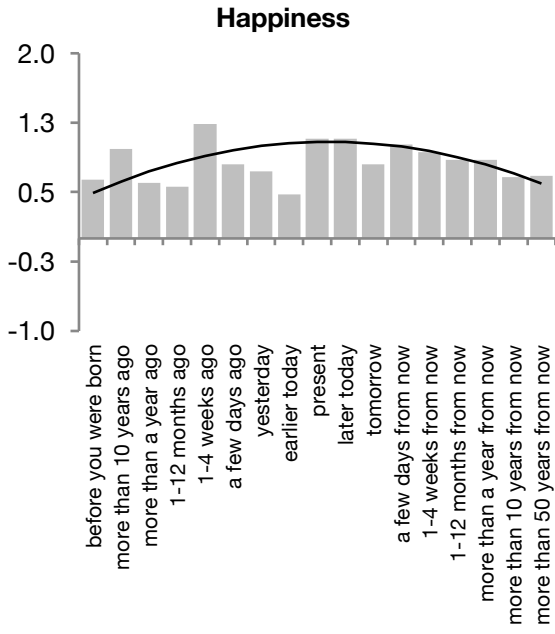


Figure 6. Meaningfulness of Thought as a Function of Time Zones Invoked; Study 1.

Note: Grey bars represent the observed category means (multilevel analysis). All bars are significantly different from each other at $p < .003$. The black line illustrates predicted values based on multilevel regression analyses (Table 6).



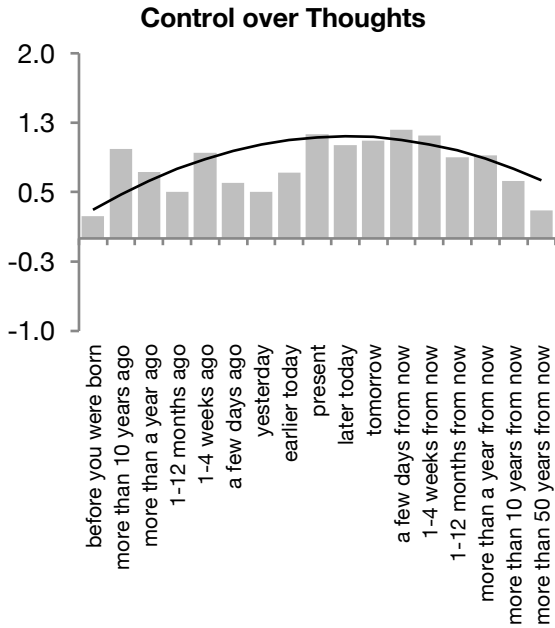


Figure 7. Illustration of combined linear and quadratic time trends for subjective qualities associated with thoughts in time; Study 1.

Note: Each thought was classified using the farthest point in time from the present. To strike a balance between the richness of the data and the goal to summarize temporal patterns, analyses tested for both linear and quadratic (curvilinear) relationships simultaneously (reported in Table 7).

Supplementary Materials for

Everyday Thoughts in Time:

Experience Sampling Studies of Mental Time Travel

Supplementary Table 1. Within-Subject Correlations Among Main Continuous or Dichotomous Level-1 Outcome and Predictor Variables in Study 1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Thought Pleasantness							
(2) Happiness	.50***						
(3) Meaning	.03	-.01					
(4) Control over Thought	.29***	.29***	.08***				
(5) Arousal	.10***	.01	.13***	.01			
(6) Alone (1) vs. With Others (0)	-.12***	-.04*	-.09***	-.03	-.15***		
(7) Planning (1) vs. No Planning (0)	.08*	.12***	.06	.14***	.01	-.04	
(8) Combined Focus (1) vs. Single Focus (0)	-.07***	-.09***	.08***	-.06**	.06**	-.02	-.03
(9) Temporal Integration Index	-.03	-.08***	.16***	.02	.13***	-.13***	-.03
(10) Time Span	-.05*	-.01	.12***	-.02	.07***	.01	.05

Note: Within-subject correlations were estimated using the rmcrr package in R, and the Holm adjustment was applied to the p-values. * p<.05; ** p<.01; *** p<.001.

Supplementary Table 2. Within-Subject Correlations Among Main Continuous or Dichotomous Level-1 Outcome and Predictor Variables in Study 2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Approach Motivation								
(2) Avoidance Motivation	.57***							
(3) Achievement of Goals and Ideals	.34***	.25***						
(4) Meeting Duties and Obligations	.37***	.34***	.44***					
(5) Affect	.08**	-.06	.03	-.08**				
(6) Arousal	.12***	.09***	.12***	.07**	.05			
(7) Alone (1) vs. With Others (0)	.00	.06	.01	.05	.13***	.09***		
(8) Past Focus (1) vs. Present (0)	-.04	-.03	-.02	-.07*	-.08**	.00	.04	
(9) Future Focus (1) vs. Present (0)	.15***	.10***	.15***	.08**	-.01	.05	.06*	.17***

Note: Within-subject correlations were estimated using the rmcrr package in R, and the Holm adjustment was applied to the p-values. * p<.05; ** p<.01; *** p<.001.