Frequency, characteristics, and perceived functions of emotional future thinking in daily life

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Abstract

While many thoughts and mental images that people form about their personal future refer to emotionally significant events, there is still little empirical data on the frequency and nature of emotional future-oriented thoughts (EmoFTs) that occur in natural settings. In the present study, participants recorded EmoFTs occurring in daily life and rated their characteristics, emotional properties, and perceived functions. The results showed that EmoFTs are frequent, occur in various contexts, and are perceived to fulfill important functions, mostly related to goal pursuit and emotion regulation. When distinguishing between anticipatory and anticipated emotions (i.e., emotions experienced in the present versus emotions expected to occur in the future), a positivity bias in the frequency of EmoFTs was found to be restricted to anticipated emotions. The representational format and perceived function of EmoFTs varied according to their affective valence, and the intensity of anticipatory and anticipated emotions were influenced by the personal importance and amount of visual imagery of EmoFTs. Mood states preceding EmoFTs influenced their emotional components, which, in turn, impacted ensuing mood states. Overall, these findings shed further light on the emotional properties of future-oriented thoughts that are experienced in daily life.

Keywords: future thinking, prospection, mental time travel, anticipatory emotion, anticipated emotion, mood.

Over the last decade, important progress has been made in understanding the representations and processes that support our ability to mentally explore possible futures (Atance & O'Neill, 2001; Gilbert & Wilson, 2007; Schacter et al., 2012; Seligman, Railton, Baumeister, & Sripada, 2013). This capacity —often termed "future thinking" or prospection— is central to many aspects of human cognition and behavior, from decision making and planning, to self-regulation and the sense of identity (Bechara & Damasio, 2005; Conway, 2005; Suddendorf & Corballis, 2007; Taylor, Pham, Rivkin, & Armor, 1998; for a recent perspective on the functions of future thinking, see Szpunar, Spreng, & Schacter, 2014). The proportion of daily time we spend projecting ourselves into the short-term and long-term future is far from being trivial: on average, during a typical day, young adults might experience sixty future-oriented thoughts, that is, about one future-oriented thought every sixteen minutes (D'Argembeau, Renaud, & Van der Linden, 2011). Some of these thoughts and mental images refer to emotionally significant events, either positive situations that we strive to achieve or negative situations that we would rather avoid (D'Argembeau et al., 2011). When anticipating such future events, people might experience intense emotional reactions (Van Boven & Ashworth, 2007), which in turn might influence motivation, behavioral intentions, and ultimately behavior (Baumgartner, Pieters, & Bagozzi, 2008). Therefore, the emotional component of future-oriented thoughts is a key aspect of prospection that likely plays critical roles in goal pursuit. Relatively little is known about the characteristics of emotional future-oriented thoughts that are experienced in daily life, however, and the purpose of the present study is to shed further light on this phenomenon.

One of the earliest findings on prospection was the identification of a valence effect on the characteristics of future-oriented thoughts. Compared with representations of negative future events, positive future events are more frequent and imagined faster (MacLeod & Byrne, 1996; Newby-Clark & Ross, 2003), are associated with more sensorial details, clearer

representations of contextual information, greater feelings of pre-experiencing, and include more social contents (D'Argembeau & Van der Linden, 2004; de Vito, Neroni, Gamboz, Della Sala, & Brandimonte, 2014; Painter & Kring, in press; Rasmussen & Berntsen, 2013). In addition, details associated with positive future-event simulations are better remembered than details associated with negative ones (Szpunar, Addis, & Schacter, 2012), and repeated simulations of emotional events make them seem more plausible (Szpunar & Schacter, 2013). Overall, these findings are consistent with the idea that most people are optimistic and tend to conceive their personal future in a favorable light (Sharot, Riccardi, Raio, & Phelps, 2007; Taylor & Brown, 1988; Weinstein, 1980; but see Harris & Hahn, 2011).

The aforementioned findings have been observed in laboratory studies in which positive and negative future-oriented thoughts were produced in response to experimentally provided cues. On the other hand, little is known about the nature of emotional prospection occurring in natural settings. Results from diary studies have indicated that involuntary future event representations are as common as involuntary autobiographical memories in daily life, and that future event representations are more positive and idyllic than memories for past events (Berntsen & Jacobsen, 2008; Finnbogadóttir & Berntsen, 2013). In addition, positive future-oriented thoughts are more frequent (D'Argembeau et al., 2011), more specific, and associated with more visual images than negative future-oriented thoughts (Finnbogadóttir & Berntsen, 2011; D'Argembeau et al., 2011). Beyond this valence effect, the emotional properties of the future-oriented thoughts that occur in daily life remain unknown. In particular, these previous studies did not assess whether the reported prospections were actually accompanied by emotions when they occurred. Here we focus on this emotional component of prospection and we designate thoughts that are accompanied by an emotional

response when they occur as "emotional future-oriented thoughts" (EmoFTs).[1] The first aim of the present study was therefore to examine thoroughly the conditions of occurrence, characteristics (notably the emotional properties), and perceived functions of EmoFTs arising in natural settings, using a diary method (Bolger, Davis, & Rafaeli, 2003).

To further investigate the affective dimension of prospection, we distinguished between two kinds of future-oriented emotions: *anticipatory emotions*, which refer to the emotions experienced in the present in response to the prospect of future events, and *anticipated emotions*, which refer to the emotions that are expected to be experienced in the future, if and when imagined events occur (Baumgartner et al., 2008). Research has shown that anticipatory and anticipated emotions are both useful to predict behavior. In a recent study, Carrera, Caballero and Muñoz (2012) indeed found that anticipatory emotions better predict the subjective probability that a behavior will actually be performed (i.e., behavioral expectations; Davis & Warshaw, 1992), whereas anticipated emotions better predict the amount of effort one is willing to exert to attain a goal (i.e., behavioral intentions; Ajzen, 1991). While anticipated emotions, or affective forecasts, have been under the scope of a wide range of studies (e.g., Wilson & Gilbert, 2005; Hoerger, Chapman, Epstein, & Duberstein, 2012; for a recent review, see Miloyan & Suddendorf, 2015), the anticipatory emotions that accompany the simulation of future events have received less attention. Hence, an important aim of this study was to better characterize both anticipatory and anticipated emotions associated with EmoFTs, and to investigate whether they are related to other properties of future-oriented thoughts. In particular, considering previous work on the role of visual images

[1] It should be noted that EmoFT is conceived here as a broad phenomenon that include any type of future-oriented thought that is accompanied by an emotion. Therefore, this notion could potentially include more specific types of future-oriented thoughts that have been previously described in the literature, such as worries (which predominantly involve verbal thoughts about negative events that we are afraid might happen in the future; Borkovec, Ray, & Stober, 1998).

in inducing emotional responses (Daselaar et al. 2008; Holmes & Mathews, 2010), we expected that visual imagery would be a significant predictor of anticipatory emotions. Furthermore, we sought to investigate whether the previously reported effects of valence on the characteristics of future-oriented thoughts (see above) is similar for anticipatory and anticipated emotions.

We also investigated the perceived functions of EmoFTs. Whereas the various functions of autobiographical memories have been much investigated and are now well-characterized (e.g., Bluck, Alea, Habermas, & Rubin, 2005; Harris, Rasmussen, & Berntsen, 2014; Rasmussen & Berntsen, 2009), relatively little work has been devoted to the functions of future-oriented thoughts. Future-oriented thoughts are perceived as serving various functions, such as decision making, action planning, and emotional regulation (D'Argembeau et al., 2011), and it has been found that thoughts involving positive events have more social and self-regulating functions than thoughts involving negative events (Rasmussen & Berntsen, 2013). Drawing on the distinction between anticipatory and anticipated emotions as defined above, our aim here was to investigate whether valence effects in the perceived functions of prospections are similar for these two kinds of emotions.

Another aim of the present study was to investigate the potential impact of the emotional properties of EmoFTs on mood. Insofar as intense emotional reactions can accompany prospections (Van Boven & Ashworth, 2007), one might hypothesize that these emotions would influence ensuing mood states. Recent results have shown that the affective content of mind-wandering episodes (i.e., thoughts that are unrelated to current perception and ongoing actions; Smallwood & Schooler, 2006) sampled in daily life is not only predicted by previous mood, but has also an impact on subsequent mood (Poerio, Totterdell, & Miles, 2013). More precisely, Poerio et al. (2013) found that the affective content of mind-wandering is congruent with feelings preceding the episode of mind-wandering, and in turn predicts

subsequent mood, even after previous mood has been taken into account. Considering that the content of a non-negligible part of mind-wandering refers to the anticipation and planning of future events (Smallwood, Nind, & O'Connor, 2009; Song & Wang, 2012; Stawarczyk, Cassol, & D'Argembeau, 2013), these findings suggest that the affective content of EmoFTs might significantly impact ensuing mood states. In the present study, we investigated this possibility by asking participants to assess the mood states they experienced before and after the occurrence of EmoFTs.

In summary, the main purpose of this study was to shed light on the emotional components of future-oriented thoughts that arise in natural settings. More specifically, we aimed at providing a detailed account of the frequency, conditions of occurrence, characteristics, and perceived functions of emotional prospections in daily life, notably as a function of emotional valence. Furthermore, we aimed at characterizing the anticipatory and anticipated emotions associated with EmoFTs and their relation with other properties of future-oriented thoughts. A final goal of this study was to investigate the relationships between mood states and the emotional components of EmoFTs. To address these questions, we used a diary method in which participants recorded and described a sample of emotional future-oriented thoughts that they experienced in their daily life, before rating them on the characteristics of interest.

METHOD

Participants

Eighty-nine individuals, recruited via personal contacts and referrals, volunteered to take part in the study. The data of thirteen participants were not included in the analysis because they did not follow the instructions properly: a substantial part of their thoughts were rated more than 16 hours after their occurrence (see Materials and Procedure section). The 76

remaining participants (44 females) were aged between 19 and 29 years (M = 23.7, SD = 2.5). They were undergraduate students at the Universities of Liège and Geneva or young workers from these areas (27 lived in Belgium and 47 in Switzerland). Overall, 44 were undergraduates students, 30 were young workers, and 2 were unemployed. They had completed between 10 and 23 years of education (M = 16.2, SD = 2.8).

Materials and procedure

The study consisted of three phases. The first phase aimed at determining the number of EmoFTs experienced during three typical days in participants' lives. The second phase involved more detailed assessments (thematic content, phenomenological characteristics, and perceived functions) of a total of 10 EmoFTs. In the third phase, participants completed a series of questionnaires assessing personality traits and psychopathological symptoms; these questionnaires are not the object of the present article and thus will not be discussed further.

Prior to the first phase, an information session took place in order to familiarize participants with the concept of EmoFT. They were explained that the research focused on EmoFTs that are experienced in everyday life. EmoFTs were described as thoughts that are oriented towards the future and that are accompanied by a positive or a negative emotion (e.g., joy, fear, pride, anger, fear, or sadness). It was specified that EmoFTs could be thoughts that refer to events that might happen at a specific time in the future (e.g., an event scheduled next Saturday) or more general thoughts about the future that do not refer to specific events (e.g., thinking about possible professional orientations in abstract terms); intentional thoughts or thoughts that come spontaneously to mind; thoughts referring to a near future (e.g., later the same day or within a week) or to a more distant future (e.g., in several months or years); thoughts whose content might be more or less plausible. In summary, it was clearly explained that we were interested in any kind of future-oriented thought that participants might experience, provided that these thoughts were accompanied by a positive or a negative

emotion when they occurred. This information was given both orally and in a written format, and was discussed with the participant until the experimenter was sure that it was clearly understood, allowing to give the instructions for the first phase of the study.

In the first phase of the study, participants were asked to record all EmoFTs that they experience during three consecutive days, starting from when they wake up on the first day up to when they fall asleep on the third day. In order to do so, they were provided with a mark sheet, that they were requested to carry along, as well as a pen, during the whole phase. Participants were instructed to tick the mark sheet each time an EmoFT comes to their mind. In case it was not possible to record an EmoFT immediately when it happened (e.g., while driving), they had to record the thought as soon as possible. Participants were allowed to start this first phase at their convenience, provided that they choose typical days of their life for recording EmoFTs (e.g., holidays were excluded as a recording period). Following this first phase, participants came back to the laboratory to return their completed mark sheet. In addition, they were asked to rate on 7-point Likert scales the extent to which they omitted to record certain thoughts because they did not have the time or desire to record them (1 = not at all, 3 = a little, 5 = a lot, 7 = tremendously), and the extent to which they experienced more future-oriented thoughts than usual because they had to record them (1 = not at all, 3 = a little, 5 = a lot, 7 = tremendously).

The instructions for the second phase of the study were then provided. This time, participants were asked to record in more detail a total of 10 EmoFTs – whose aforementioned definition was reminded. There was no time limit for carrying out this task; instead, participants were instructed to report the first 10 distinct EmoFTs that come to their mind, from the moment they awake on a typical day of their lives. In order to do so, they were provided with a small booklet to record and rate each of their EmoFTs. For each EmoFT, they first had to briefly describe its content, in such a way that a reader would be able to

understand what it was about. In case some thoughts would be judged by the participants as too intimate to disclose them, it was specified that they could merely indicate "private" instead of describing their content. Participants were also asked to describe the context of occurrence of each EmoFT: the time and the place where the EmoFT occurred, their current activity, and whether or not they were alone.

Participants then rated, on a series of 7-point Likert scales, the following characteristics of their thought: its representational format (i.e., the amount of visual images and inner speech; 1 = not at all, 7 = extremely), the way the thought came to their mind (1 = completely spontaneous, 7 = completely voluntary/intentional), the extent to which the thought was triggered by the environment (1 = not at all, 7 = extremely), its personal importance (1 = not at all; 7 = extremely), its relation to identity (1 = not at all, 7 = extremely), and its recurrence (i.e., the extent to which the thought has been previously experienced; 1 = never, 7 = very frequently). Participants also rated the extent to which the thought helped them to handle a present or future situation (1 = not at all, 7 = completely), their inclination to suppress the thought (1 = not at all, 7 = completely), to share it with others (1 = not at all probable; 7 = extremely probable), and the probability of occurrence of the thought's content (1 = not at all probable; 7 = extremely probable). Participants also reported the future time period which the thought referred to, which could be either specified (e.g., in one day, next week, in two months) or undefined.

In addition to these characteristics, two aspects of the affective dimension of each thought were assessed. First, participants rated, on a scale ranging from -3 (very negative) to +3 (very positive), the valence and intensity of anticipatory emotions (i.e., emotions currently experienced when thinking about something that could happen in the future; see Baumgartner et al., 2008) and they indicated what specific emotion(s) was involved (i.e., joy, fear, pride, anger, fear, sadness; an "other" category was also available in order to allow the participant to

specify any other emotion). Second, participants completed the exact same ratings regarding anticipated emotions (i.e., the emotions that a person imagines experiencing in the future if and when the event occurs; see Baumgartner et al., 2008). Furthermore, mood states prior and after the EmoFT occurred were both assessed, on a scale ranging from -3 (very negative) to +3 (very positive).

Finally, participants were requested to report the perceived function(s) of their EmoFT by selecting among distinct categories, which were related to goal pursuit (i.e., making a decision, planning an action, setting oneself a goal) or emotional regulation (either with a present-oriented focus, i.e., reassuring oneself or feeling better, or with a future-oriented focus, i.e., preparing oneself to deal with an anticipated emotion). Two supplementary categories were also available to allow the participant to specify another perceived function, or to indicate that no function was identified.

The experimenter reviewed all the items of the questionnaire with each participant to ensure their full understanding. Participants were asked to describe and rate each thought immediately after the thought came to their mind, or as soon as possible. In any case, they had to report the time at which they performed the thought rating. When participants came back to the laboratory to return their completed mark sheet, they were asked to rate on 7-point Likert scales the extent to which they omitted to record certain thoughts because they did not have the time or desire to record them (1 = not at all, 3 = a little, 5 = a lot, 7 = tremendously), and the extent to which they experienced more future-oriented thoughts than usual because they had to record them (1 = not at all, 3 = a little, 5 = a lot, 7 = tremendously).

Coding of content

The content of each EmoFT was coded by first author according to its specificity. An EmoFT was coded as specific if it referred to a unique event, precisely located in time and

lasting no more than a day (e.g., going to the theater tomorrow evening; cf. Williams, Ellis, Tyers, Healy, Rose, & MacLeod, 1996). Events taking place over extended time periods (e.g., next summer vacation in France), as well as abstract thoughts devoid of any reference to particular events (e.g., thinking about being a parent), were coded as non-specific. Finally, undescribed private events were categorized as unclassifiable. A random selection of 10% of the thoughts was scored by an independent rater, which showed a good inter-rater reliability (K = .90; agreement = 95%).

RESULTS

Frequency, specificity, and context of occurrence of EmoFTs

In the first phase of the study, participants reported having experienced, on average, 28 emotional future-oriented thoughts during the three consecutive days (SD = 18.7; min = 2, max = 83). Participants felt that they omitted to record a few EmoFTs (M = 3.01, SD = 1.22, on the 7-point rating scale) because they did not have the time or did not feel like to do it; a similar tendency was also apparent for the second phase of the study (M = 3.54, SD = 1.36). Besides, participants also reported to have experienced a little more thoughts than usual because they were requested to record them, both in the first phase (M = 2.87, SD = 1.50) and in the second phase (M = 2.34, SD = 1.26) of the study. During the second phase, each of the 76 participants recorded 10 thoughts. However, 31 of these thoughts were excluded from the analyses because they had been rated too long (i.e., more than 16 hours) after their occurrence, and 5 additional thoughts were also discarded because their description indicated that they were actually not future-oriented. The data therefore consisted of a total of 724 EmoFTs.

Among these thoughts, 49% referred to specific events, whereas 45% were non-specific; 6% could not be classified according to specificity. Twenty-two percent of EmoFTs did not refer to any specified time period. Among the EmoFTs involving a specified time

period, 31% referred to an event occurring later the same day, 31% to an event occurring within one week, 14% to the period between one week and one month, 17% to the period between one month and one year, 5% to the period between one year and five years, and 2% to more than 5 years. Therefore, the vast majority of EmoFTs associated with a specified time period referred to the near future, with 76% of EmoFTs referring to events that might happen within the next month.

When examining the context of occurrence of EmoFTs, we found that 52% of thoughts occurred at home, 25% at work, 11% in transport, 8% in public places, and 3% at a relative's or friend's place (the remaining 1% could not be classified according to these categories). With regard to ongoing activities, we found that 29% of EmoFTs happened while participants were working, 21% while resting, 13% while eating, grooming, or dressing, 11% while watching movies, playing video games or surfing on the web, 8% while driving, 7% during conversations, 6% while doing housework, and 3% during leisure activities (the remaining 2% could not be classified according to these categories). Forty-nine percent of EmoFTs were experienced when participants were alone.

Emotional characteristics and perceived functions of EmoFTs

On average, anticipatory emotions (emotions currently experienced in association with the thoughts) were rated as slightly positive (M = 0.35, SD = 2.04) and, when looking at the specific type of emotion experienced, we found that 49% of EmoFTs were accompanied by joy or enthusiasm, 38% by fear, anxiety, or a feeling of stress, 13% by sadness, 10% by pride, 9% by anger, 4% by shame, and 12% by other kinds of emotions. With regard to anticipated emotions (the emotion that one would expect to experience if the future-oriented thought materialized), we also found that EmoFTs were rated as slightly positive (M = 1.05, SD = 2.15). Anticipated emotions were described as joy or enthusiasm (63% of EmoFTs), pride

(18%), fear, anxiety, or a feeling of stress (17%), sadness (13%), anger (9%), and shame (6%); 10% of anticipated emotions fell off these categories.

To investigate whether some specific type of emotions were more frequently reported as anticipatory or anticipated emotions, we computed for each participant the number of reported anticipatory and anticipated emotions for each emotion category. A series of paired samples *t*-tests (see Table 1) indicated that joy, pride, and shame were more frequently reported as anticipated emotions than as anticipatory emotions, whereas fear was more frequently reported as an anticipatory emotion than as an anticipated emotion; there was no significant difference in the reports of anger, sadness, and others emotions.

- INSERT TABLE 1 ABOUT HERE -

As regards the perceived functions of EmoFTs, 40% were judged as helpful to plan actions, 21% were related to intention formation (i.e., setting oneself a goal), 21% were considered to allow emotion regulation with a present-oriented focus (i.e., to reassure oneself or feel better), 17% were judged as helpful to allow emotion regulation with a future-oriented focus (i.e., preparing oneself to deal with an anticipated emotion), and 10% were regarded as helpful to make a decision; 20% of EmoFTs were considered devoid of any apparent function, and 5% were reported to involve other kinds of functions, for instance daydreaming (note that these percentages do not sum up to 100% because participants were allowed to select more than one function for each thought, if appropriate).

EmoFTs associated with positive versus negative anticipatory emotions

One of the aims of the present study was to compare the characteristics of EmoFTs that were associated with positive versus negative anticipatory emotions. To do so, each of the 724 EmoFTs was classified as positive or negative based on ratings of anticipatory emotions

(positive and negative EmoFTs were associated with a rating > 0 or < 0, respectively), which left 19 thoughts unclassified (note that although these thoughts were rated 0, they were nonetheless reported as accompanied by some anticipatory emotions, as indicated by the participants' selection of specific emotions; in some cases, these EmoFTs implicated both positive and negative emotions that might have offset each other; in other cases, it is possible that the selected emotion was not deemed sufficiently intense to receive a positive or negative value on the rating scale). A series of paired samples *t*-tests was conducted in order to examine whether EmoFTs associated with positive anticipatory emotions differed from EmoFTs associated with negative anticipatory emotions regarding frequency, specificity, phenomenological characteristics, and perceived functions.

- INSERT TABLE 2 ABOUT HERE -

As shown in Table 2, overall, participants did not report more positive than negative EmoFTs, and specificity also did not differ between two types of thoughts. Regarding their representational format, negative EmoFTs were more likely to take the form of inner speech, while positive EmoFTs were more frequently experienced as visual images. On average, the thoughts were slightly more likely to come to mind spontaneously rather than voluntarily, and the two kinds of thoughts did not differ in this respect. Negative EmoFTs were judged to be triggered by the environment to a larger extent than positive EmoFTs, and were also rated as more helpful to handle a present or future situation. Overall, the thoughts were judged quite important but only moderately related to the participants' sense of self-identity; there was no difference between positive and negative EmoFTs on these dimensions. The reported EmoFTs had sometimes already been experienced on a previous occasion and were judged as moderately likely to be shared, with positive EmoFTs being rated as more likely to be shared than negative ones. The inclination to suppress EmoFTs was judged higher for negative than positive thoughts. On the other hand, the perceived probability of EmoFTs was higher for

positive than negative thoughts. Finally, with regard to the perceived functions of the thoughts, negative EmoFTs were judged as more related to decision making, and as more helpful to prepare oneself to deal with a potential future emotion (i.e., future-oriented emotional regulation), whereas positive EmoFTs were judged as more helpful to reassure oneself or to feel better (i.e., present-oriented emotional regulation).

EmoFTs associated with positive versus negative anticipated emotions

We also examined whether the characteristics of EmoFTs varied depending on the valence of anticipated emotions. Each of the 724 EmoFTs was classified as associated with a positive or negative anticipated emotion, according to the corresponding ratings (positive and negative EmoFTs were associated with a rating > 0 or < 0, respectively), which left 15 thoughts unclassified. As indicated in Table 3, participants reported more thoughts involving positive rather than negative anticipated emotions, while specificity did not differ between the two kinds of thoughts. Emotional future-oriented thoughts were more likely to take the form of visual images when associated with a positive anticipated emotion, whereas, conversely, they were more frequently experienced as inner speech when associated with a negative anticipated emotion. Positive EmoFTs were rated as more likely to be shared with others and as more probable than negative EmoFTs, whereas the latter were judged as more likely to be suppressed than the former. There were no difference between positive and negative EmoFTs in terms of their intentional aspect, relation to the environment, importance, relevance to identity, recurrence, and role in handling present or future situations. With regard to the perceived functions of the thoughts, negative EmoFTs were judged as more helpful to prepare oneself to deal with a potential future emotion (i.e., future-oriented emotional regulation), while positive EmoFTs were rated as more helpful to reassure oneself or to feel better (i.e., present-oriented emotional regulation).

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Predicting the intensity of anticipatory and anticipated emotions

Our next goal was to investigate to what extent the intensity of anticipatory and anticipated emotions (as indexed by the absolute values of the ratings) can be predicted by properties of EmoFTs, such as their representational format, personal importance, and recurrence. Due to their hierarchical structure (i.e., the sampled EmoFTs were nested within participants), data were analyzed using multilevel modeling (Goldstein, 2011), with EmoFTs as level 1 units and participants as level 2 units; these analyses were performed using MLwiN (Rasbash, Charlton, Browne, Healy, & Cameron, 2009). The intercorrelations between the variables at level 1 (i.e., within-participants) are shown in Table 4. As can be seen, the intensity of both anticipatory and anticipated emotions increased with visual imagery, personal importance, and relevance to identity; in addition, the intensity of anticipatory emotions decreased for EmoFTs involving more inner speech.

- INSERT TABLE 4 ABOUT HERE –

Next, we constructed a series of multilevel models to investigate the independent contribution of the different EmoFT properties that showed a significant bivariate association with anticipatory emotion intensity. Although some of the predictor variables included in these models were intercorrelated (see Table 4), simulation experiments have shown that the fixed-effect parameter estimates and standard errors are relatively unbiased in multilevel modelling for this magnitude of correlations among level 1 predictors (Shieh & Fouladi, 2003). We first looked at the effect of the subjective significance of EmoFTs and found that both personal importance and relevance to identity were significant predictors of anticipatory emotions when they were entered simultaneously in a random intercept model (personal importance: standardized coefficient = 0.21, SE = 0.04, Z = 5.25, $p < .001$; relevance to

identity: standardized coefficient = 0.09, *SE* = 0.04, *Z* = 2.25, *p* = .02). Adding variables assessing the representational format of EmoFTs (visual imagery and inner speech) in this model resulted in a significantly better fit (likelihood ratio (LR) = 27.17, 2 d.f., $p < .001$); however, only personal importance (standardized coefficient = 0.23, *SE* = 0.04, *Z* = 5.75, $p < .001$) and visual imagery (standardized coefficient = 0.14, *SE* = 0.04, *Z* = 3.32, $p < .001$) remained significant predictors. Thus, the best and most parsimonious model was to use personal importance and visual imagery to predict the intensity of anticipatory emotions associated with EmoFTs.

Similar analyses were conducted to investigate the independent contribution of different EmoFT properties to the intensity of anticipated emotions. We first looked at the effect of the subjective significance of EmoFTs and found that only personal importance was a significant predictor of anticipated emotions (standardized coefficient = 0.30, *SE* = 0.04, *Z* = 7.50, $p < .001$), when both personal importance and relevance to identity were entered simultaneously in a random intercept model. Adding visual imagery to a model that already included personal importance as predictor resulted in a significantly better fit (LR = 21.02, 1 d.f., $p < .001$); both personal importance (standardized coefficient = 0.31, *SE* = 0.04, *Z* = 7.75, $p < .001$) and visual imagery (standardized coefficient = 0.16, *SE* = 0.04, Z = 4.62, $p < .001$) were significant predictors of anticipated emotions in this model. Thus, as for anticipatory emotions, the best and most parsimonious model was to use personal importance and visual imagery to predict the intensity of anticipated emotions associated with EmoFTs.

EmoFTs and mood states

A final goal of this study was to investigate the relationships between the emotional content of future-oriented thoughts and mood states. We assumed that pre-EmoFT mood would impact on both anticipatory and anticipated emotions, which, in turn, would influence

post-EmoFT mood. In addition, we hypothesized that the tendency to suppress EmoFTs might exert a detrimental impact on post-EDT mood, given the association between thought suppression and mood (Wenzlaff & Wegner, 2000). The intercorrelations between these variables at level 1 (i.e., within-participants) are shown in Table 5. As expected, both pre- and post-EmoFT mood states were related to anticipatory and anticipated emotions.

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To further investigate the independent contribution of the emotional dimensions of future-oriented thoughts on subsequent mood, we conducted a series of multilevel models with post-EmoFT mood as dependent variable. First, we fitted a model in which pre-EmoFT mood was as a predictor of post-EmoFT mood, and then we added the ratings of anticipatory emotions accompanying EmoFTs as predictor. This latter model fitted the data significantly better than the simpler model that included only pre-EmoFT mood as predictor (LR = 811.97, 1 d.f., $p < .001$). Then, we added anticipated emotions to the latter model, which resulted in a significantly better fit (LR = 29.17, 1 d.f., $p < .001$). Finally, we examined whether the tendency to suppress EmoFTs influenced subsequent mood, once the effects of preceding mood, anticipatory emotions, and anticipated emotions had been taken into account. Adding suppression to the previous model provided a significantly better fit to the data (LR = 22.02, 1 d.f., $p < .001$). Despite the fact that some of the predictor variables were highly intercorrelated (i.e. anticipatory and anticipated emotions), which might introduce bias into the standard errors of coefficients and reduce statistical power (Shieh & Fouladi, 2003), pre-EmoFT mood (standardized coefficient = 0.14, $SE = 0.02$, $Z = 6.43$, $p < .001$), anticipatory emotions (standardized coefficient = 0.64, $SE = 0.03$, $Z = 21.33$, $p < .001$), anticipated emotions (standardized coefficient = 0.11, $SE = 0.03$, Z = 3.56, $p < .001$), and suppression (standardized coefficient = -0.12, $SE = 0.03$, $Z = 4.72$, $p < .001$) were all significant predictors of post-

EmoFT mood in this model. Together, these four variables accounted for 74% of the within-participants variance in post-EmoFT mood.

DISCUSSION

The present study aimed at examining the frequency, conditions of occurrence, characteristics, and perceived functions of prospections that are accompanied by emotions in natural settings. Our results show that EmoFTs occur quite frequently in daily life, although there is substantial variation across individuals in this respect. This observation complements earlier investigations of future thinking in natural settings that did not specifically target the emotional component of prospection (Berntsen & Jacobsen, 2008; D'Argembeau et al., 2011; Finnbogadóttir & Berntsen, 2013; Klinger & Cox, 1987). For example, when examining any kind of future-oriented thoughts that might occur in daily life, D'Argembeau et al. (2011) found that, on average, around sixty future-oriented thoughts were experienced each day and the content of about 60% of reported thoughts was judged to have an affective (either positive or negative) tone. However, thoughts about positive or negative futures are not necessarily accompanied by an emotional response (i.e., by an anticipatory emotion; Baumgartner et al., 2008), and the present study indeed suggests that only a subset of prospections experienced in daily life (on average, around 9 thoughts per day) is truly infused with emotion.

We found that EmoFTs occur in various contexts (e.g., at home, at work, in transports) and during a wide range of distinct activities (e.g., working, resting, eating). Around half of the reported EmoFTs referred to a specific event, whereas the other half were more abstract in nature, in line with earlier findings (D'Argembeau et al., 2011). This result is consistent with the idea that prospection involves knowledge structures at different levels of specificity—episodic details (Schacter & Addis, 2007), semantic information (Irish & Piguet, 2013), and conceptual autobiographical knowledge (D'Argembeau, 2015)—which can be flexibly

combined to produce various forms of future-oriented thoughts, ranging from detailed episodic simulations of specific events to highly abstract considerations about possible futures (Szpunar et al., 2014). In terms of temporal location, we found that around one fifth of EmoFTs did not refer to any specified time period (except, of course, that they pertained to the future), while most of the EmoFTs targeting a specified time period referred to future events that were likely to occur within the next month; the frequency of EmoFTs decreased with increasing temporal distance, replicating the temporal gradient previously observed in another diary study of future-oriented thoughts (D'Argembeau et al., 2011).

An important goal of the present study was to investigate valence effects in emotional future thoughts that arise in natural settings. Previous findings have shown that most people tend to have a positive view of their personal future: in laboratory studies, positive events are generated faster and are more detailed than negative events (D'Argembeau & Van der Linden, 2004; de Vito et al., 2015; Newby-Clark & Ross, 2003; Painter & Kring, in press; Rasmussen & Berntsen, 2013), and diary studies have evidenced that positive future thoughts are more frequent than negative ones in daily life (Berntsen & Jacobsen, 2008; D'Argembeau et al., 2011). A specific contribution of the present study is to distinguish between two types of emotions (anticipatory and anticipated), a distinction that has not been made explicit in previous studies. Interestingly, we found that valence effects in the number of reported thoughts depended on the kind of emotions under consideration: a positivity bias was observed for the anticipated emotional content of EmoFTs (i.e., participants reported positive forecasts more frequently than negative ones), whereas there was no significant difference in the frequency of EmoFTs associated with positive versus negative anticipatory emotions. Thus, the positivity bias in the frequency of future thoughts that has been observed in previous studies seems restricted to affective forecasts, without extending to the emotional impact of future-oriented thoughts in the here and now. When looking at specific emotion

categories, we found that fear was more frequently reported as an anticipatory emotion than as an anticipated emotion, while joy, pride, and shame followed the opposite pattern. Overall, these findings highlight the importance of distinguishing between anticipatory and anticipated emotions in characterizing the emotional properties of EmoFTs. In particular, the tendency to conceive one's personal future in a favorable light (Taylor & Brown, 1988) seems to involve anticipated rather than anticipatory emotions.

Notwithstanding these differences between anticipatory and anticipated emotions, the effect of valence on several characteristics of EmoFTs was similar for these two types of emotions. Notably, for both anticipatory and anticipated emotions, positive EmoFTs were more likely to take the form of visual images, whereas negative EmoFTs were more frequently experienced as inner speech, which replicates earlier findings (e.g., D'Argembeau & Van der Linden, 2004; D'Argembeau et al., 2011; Stawarczyk et al., 2013). Positive EmoFTs were also judged as more likely to be shared with others, in line with previous findings (Rasmussen & Berntsen, 2009, 2013), and were perceived as more probable than negative EmoFTs; on the other hand, negative EmoFTs were more likely to be suppressed. Besides these similarities in the effect of valence, some differences were also observed: for anticipatory emotions (but not anticipated emotions), negative EmoFTs were more likely to be triggered by the environment and were judged as more helpful to handle present or future situations. Overall, these findings suggest that although people may be more willing to consider and share positive future events, EmoFTs that are associated with negative anticipatory emotions may nevertheless play important roles in managing present and future situations (see below for further discussion of the perceived functions of EmoFTs).

The present study also sheds light on the determinants of both emotional components of EmoFTs. The intensity of anticipatory and anticipated emotions correlated with multiple characteristics of EmoFTs, including visual imagery, personal importance, relevance to

identity, and recurrence. When looking at the independent contribution of these characteristics, we found that visual imagery and personal importance were the best predictors of anticipatory and anticipated emotions. Previous work by Holmes and colleagues has shown that mental images have a particularly powerful affective impact, notably with respect to imagined future events (for review, see Holmes & Mathews, 2010). The present findings provided additional support to this view by showing that the emotions evoked by future-oriented thoughts in natural settings are more intense when people experience them through visual imagery.[2] The second factor that contributed to the prediction of anticipatory and anticipated emotions (i.e., personal relevance) has long been considered an important component of appraisal processes leading to emotion (Scherer, 2001; Ellsworth & Scherer, 2003; see also Brosch & Sander, 2014). The present findings are in line with this componential view of emotion and show that it applies to emotions that are elicited by internally generated thoughts, such as prospections.

Another goal of this study was to investigate the relationships between the emotional components of EmoFTs and mood states. First, we found that anticipatory and anticipated emotions were significantly related to mood states preceding the occurrence of EmoFTs. Second, anticipatory and anticipated emotions were both significant predictors of post-EmoFT mood, even when pre-EmoFT mood was taken into account. These results are in line with recent findings showing similar relationships between mood states and mind-wandering episodes (Poerio et al., 2013). More generally, these observations are in line with the *mood congruency hypothesis*, according to which positive/negative mood states increase the

[2] Recent evidence has shown that the spatial component of mental imagery is particularly important when constructing future simulations; moreover, when the spatial component of mental imagery is disrupted during future thinking, while the depictive component of mental imagery is spared, less emotional details are reported (De Vito, Buonocore, Bonnefon, & Della Sala, 2014). The measure of visual imagery that was used in the present study does not allow us to distinguish between spatial and depictive components, and it would be interesting in future studies to investigate whether these components show specific relationships with the emotional intensity associated with prospection in daily life.

accessibility of material of the same valence (Blaney, 1986; Bower, 1981). Our findings thus extend the extensive literature on mood congruent memory (for review, Sedikides, 1992) by showing that mood states also contributed to determine the affective dimension of prospective thoughts. Emotions associated with EmoFTs in turn influenced subsequent mood and, interestingly, the inclination to suppress an EmoFT was also a significant predictor of post-EmoFT mood, with higher suppression leading to worse mood. This detrimental impact of suppression on post-EmoFT mood is consistent with earlier evidence showing an association between thought suppression and negative mood (Wenzlaff & Wegner, 2000). Thought suppression is indeed a dysfunctional emotion regulation strategy (John & Gross, 2004) that has the paradoxical effect of conducing to the state of mind that one is striving to avoid (Wenzlaff & Wegner, 2000). Attempts at suppressing a negative EmoFT might thus actually increase its prominence, leading to a greater degradation of mood. Consequently, an inclination to systematically suppress EmoFTs could play a role in the development or maintenance of some psychopathological states (for a review on psychopathology and thought suppression, see Magee, Harden, & Teachman, 2012): repeated attempts to suppress negative prospections could induce negative mood states, which in turn would result in an increased accessibility of negative thoughts, thus leading to a vicious cycle of mutually reinforcing EmoFTs and mood states.

Future-oriented emotions are believed to play an important role in motivation and goal pursuit (Baumgartner et al., 2008; Karniol & Ross, 1996; Taylor et al., 1998). Whereas much is known about the functions of autobiographical memories (e.g., Bluck, Alea, Habermas, & Rubin, 2005; Harris, Rasmussen, & Berntsen, 2014), little is known about the functions of emotional future thinking in everyday life. The present study contributed to this question by examining participants' beliefs about the functions of their EmoFTs. More than 60% of EmoFTs were judged to be related to planning, intention formation, or decision making,

indicating that many EmoFTs occurring in daily life are indeed perceived as highly relevant to goal pursuit. Interestingly, EmoFTs that were associated with negative anticipatory emotions involved decision making to a greater extent than positive EmoFTs, and were considered as more helpful to handle present or future situations. These results suggest that negative future thinking is not necessarily maladaptive. All in all, it is likely that an adequate balance between positive and negative future-oriented thoughts is optimal for successful goal pursuit. It should be emphasized, however, that the present results pertain to participants' beliefs about the functions of their EmoFTs. These beliefs might be partly biased and it remains to be investigated to what extent positive and negative EmoFTs actually contribute to effective goal pursuit.

While most EmoFTs were perceived as serving goal pursuit, a substantial proportion of EmoFTs were linked to other functions and, notably, emotional regulation. Indeed, around 40% of EmoFTs were perceived as contributing to emotion regulation (Gross, 2002), either with a present-oriented focus (i.e., reassuring oneself or feeling better) or a future-oriented focus (i.e., preparing oneself to deal with an anticipated emotion). Interestingly, for both anticipatory and anticipated emotions, positive EmoFTs were judged as more helpful for present-oriented emotional regulation, whereas negative EmoFTs were judged as more helpful for future-oriented emotional regulation. Again, this finding suggests that negative future-oriented thoughts might convey some adaptive advantages. In particular, envisioning negative future possibilities might contribute to situation selection, situation modification, and attentional deployment, which all constitute antecedent-focused emotion regulation processes (see Gross, 1998).

In summary, the current findings show that emotional prospections are frequent in daily life, occur in various contexts, and take on different representational formats. The positivity bias in the frequency of EmoFTs appears to be restricted to anticipated emotions without

extending to anticipatory emotions. Anticipatory and anticipated emotions are both influenced by the visual imagery and personal importance of EmoFTs, and have an important impact on ensuing mood states. Finally, emotional future thinking serves a range of important functions related to goal pursuit (i.e., planning, intention formation, and decision making) and emotion regulation (either with a present-oriented focus or with a future-oriented focus).

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Table 1. Mean number of anticipatory and anticipated emotions reported for each type of emotion category (SD are in parentheses)

	Anticipatory	Anticipated	t	d.f.	*p*-value
Fear	3.64 (1.90)	1.57 (1.36)	10.06	75	<.001
Joy	4.66 (1.85)	5.89 (1.92)	5.93	75	<.001
Pride	0.97 (1.18)	1.70 (1.70)	5.18	75	<.001
Anger	0.86 (1.15)	0.80 (1.11)	0.44	75	0.66
Shame	0.36 (0.60)	0.53 (0.74)	2.13	75	0.04
Sadness	1.21 (1.40)	1.22 (1.31)	0.10	75	0.92
Others	1.12 (1.24)	0.92 (1.15)	1.43	75	0.16

Table 2. Characteristics of emotional future-oriented thoughts associated with positive versus negative anticipatory emotions (mean ratings; *SD* are in parentheses)

	Positive	Negative	d.f.	t	*p*-value
Number of thoughts	4.92 (1.82)	4.36 (1.93)	75	1.37	.17
Specific thoughts (%)	51 (31)	48 (31)	73	0.82	.42
Non-specific thoughts (%)	44 (31)	47 (32)	73	0.95	.48
Unclassifiable thoughts (%)	6 (17)	5 (15)	73	0.22	.83
Characteristics (mean ratings)					
Inner Speech	3.53 (1.28)	4.50 (1.39)	73	5.72	<.001
Visual Images	4.76 (1.32)	3.63 (1.28)	73	7.68	<.001
Intentionality	3.75 (1.32)	3.69 (1.29)	73	0.39	.69
Environment	3.45 (1.37)	3.89 (1.36)	73	2.12	.04
Personal Importance	5.00 (1.07)	5.11 (1.39)	73	0.90	.37
Handling	3.86 (1.30)	4.40 (1.36)	73	2.52	.01
Identity	3.32 (1.28)	3.36 (1.16)	73	0.28	.78
Sharing	4.44 (1.34)	3.95 (1.32)	73	2.94	< .01

Recurrence	3.82 (1.07)	3.86 (1.02)	73	0.36	.72
Suppression	1.48 (0.74)	3.43 (1.26)	73	12.99	<.001
Probability	5.88 (0.94)	5.18 (1.09)	73	5.16	<.001
Function (%)					
Decision Making	7 (14)	13 (20)	73	2.21	.03
Planning	41 (29)	42 (29)	73	0.19	.85
Intention Formation	19 (23)	20 (20)	73	0.18	.86
P.-O. Emotional Regulation	28 (27)	16 (22)	73	2.84	<.01
F.-O. Emotional Regulation	8 (16)	28 (29)	73	5.40	<.001
Other	5 (15)	4 (14)	73	0.50	.62
None	21 (24)	18 (23)	73	0.69	.49

Note. d.f. = 73 since two participants did not experience any negative EmoFTs; P.-O. = present-oriented; F.-O. = future-oriented

Table 3. Characteristics of emotional future-oriented thoughts associated with positive versus negative anticipated emotions (mean ratings; *SD* are in parentheses)

	Positive	Negative	d.f.	t	*p*-value
Number of thoughts	6.51 (2.00)	2.82 (1.86)	75	8.64	<.001
Specific thoughts (%)	51 (28)	49 (37)	69	0.37	.71
Non-specific thoughts (%)	43 (28)	43 (37)	69	0.04	.97
Unclassifiable thoughts (%)	6 (17)	8 (22)	69	0.81	.42
Characteristics (mean ratings)					
Inner Speech	3.80 (1.22)	4.34 (1.58)	69	2.81	<.01
Visual Images	4.51 (1.28)	3.78 (1.52)	69	3.98	<.001
Intentionality	3.75 (1.29)	3.57 (1.66)	69	0.87	.39
Environment	3.57 (1.89)	3.80 (1.67)	69	0.98	.33
Personal Importance	5.01 (0.95)	5.12 (1.27)	69	0.77	.44
Handling	4.06 (1.21)	3.99 (1.61)	69	0.30	.77
Identity	3.27 (1.24)	3.46 (1.27)	69	1.40	.16
Sharing	4.42 (1.29)	3.79 (1.64)	69	3.07	< .01

Recurrence	3.90 (1.00)	3.80 (1. 25)	69	0.65	.51
Suppression	1.71 (0.78)	3.91 (1.44)	69	12.45	<.001
Probability	5.77 (0.92)	4.95 (1.23)	69	5.37	<.001
Function (%)					
Decision Making	9 (14)	14 (27)	69	1.45	.15
Planning	41 (25)	34 (33)	69	1.39	.17
Intention Formation	22 (20)	17 (25)	69	1.38	.17
P.-O. Emotional Regulation	26 (23)	11 (25)	69	3.58	<.001
F.-O. Emotional Regulation	11 (15)	35 (37)	69	5.15	<.001
Other	5 (15)	4 (15)	69	0.50	.62
None	19 (20)	24 (34)	69	1.28	.20

Note. d.f. = 69 since five participants did not reported any negative anticipatory emotion; P.-O. = present-oriented; F.-O. = future-oriented

Table 4. Intercorrelations between the characteristics of EmoFTs at level 1 (within-participants)

	1	2	3	4	5	6	7	8
1. Visual images								
2. Inner speech	**-.53**							
3. Intentionality	.01	-.01						
4. Environment	-.01	-.07	.01					
5. Importance	-.04	.09	.02	.01				
6. Identity	.06	.05	-.01	-.03	**.40**			
7. Recurrence	-.03	.05	.03	-.08	**.24**	.12		
8. Anticipatory emotions	**.16**	**-.13**	-.05	.01	**.23**	**.15**	.07	
9. Anticipated emotions	**.16**	-.10	.03	-.07	**.28**	**.14**	.11	**.47**

Note: correlations in bold are significant at $p < .001$.

Table 5. Intercorrelations between mood states and emotional properties of EmoFTs at level 1 (within-participants)

	1	2	3	4
1. Pre-EmoFT mood				
2. Post-EmoFT mood	**.28**			
3. Anticipatory emotions	**.23**	**.84**		
4. Anticipated emotions	**.14**	**.71**	**.78**	
5. Suppression	-.03	**-.58**	**-.58**	**-.59**

Note: correlations in bold are significant at $p < .001$.