

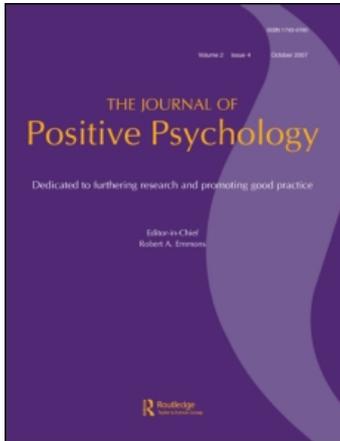
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## Back to the future: the effect of daily practice of mental time travel into the future on happiness and anxiety

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The ability to project oneself into the future has previously been found to be related to happiness and anxiety. The purpose of the present study was to investigate the causal effect of deliberate mental time travel (MTT) on happiness and anxiety. More specifically, we address whether purposely engaging in positive, negative, or neutral future MTT would lead to different levels of happiness and anxiety. Results show a significant increase of happiness for subjects in the positive condition after 2 weeks but no changes in the negative or neutral condition. Additionally, while positive or negative MTT had no effect on anxiety, engaging in neutral MTT seems to significantly reduce stress over 15 days. These findings suggest that positive future MTT is not just a consequence of happiness and might be related to well-being in a causal fashion and provide a new approach in happiness boosting and stress-reducing activities.

**Keywords:** episodic future thinking; mental time travel; happiness; anxiety

### Introduction

Of the many abilities that humans possess, one of the most amazing is the process by which we envision our future. This ability to imagine personal future events has been explored in a great variety of areas of psychology and, depending on the field, has been referred to under different names encompassing different aspects of the concept such as *mental simulation* (e.g., Pham & Taylor, 1999; Taylor, Pham, Rivkin, & Armor, 1998), *future thinking* (e.g., MacLeod & Byrne, 1996; MacLeod & Salaminiou, 2001), *anticipation of future experiences* (e.g., MacLeod & Conway, 2005), or *goal striving* (e.g., Sheldon & Elliot, 1999). Recently, a fast-growing number of studies have addressed the ability to envision the future under the term *mental time travel* (MTT; e.g., D'Argembeau & van der Linden, 2006; Quoidbach, Hansenne, & Mottet, 2008; Suddendorf & Corballis, 2007; Tulving, 2002). MTT refers to the faculty that allows humans to mentally project themselves backward in time to relive, or forward to pre-live, events (Suddendorf & Corballis, 1997). The ability to relive past events is also known as *episodic memory* in the literature and has been extensively investigated (e.g., Tulving, 2002, 2005), while the ability to project the self forward in time to pre-experience an event has been labeled *episodic future thinking* (Atance & O'Neill, 2001). Past and future travels rely on a common set of processes by which

past experiences are used to envision the future (Atance & O'Neill, 2001; Buckner & Carroll, 2007; Hassabis, Kumaran, Vann, & Maguire, 2007; Okuda et al., 2003; Wheeler, Stuss, & Tulving, 1997), and both importantly involve auto-noetic consciousness, i.e., 'the kind of consciousness that mediates an individual's awareness of his or her existence and identity in subjective time extending from the personal past through the present to the personal future' (Tulving, 1985, p. 1). Future MTT implies, therefore, a conscious act of pre-experiencing future events involving the self and located in specific time and space. In this way, it is distinct from merely knowing that some event is likely to happen and from the general way that one apprehends the future (i.e., pessimism/optimism).

MTT into the future is considered as a crucial ability for human beings (Gilbert, 2006; Gilbert & Wilson, 2007; Suddendorf & Corballis, 1997, 2007; Wheeler et al., 1997). Indeed, from an evolutionary perspective, MTT offers a critical selective advantage insofar as it enhances individuals' flexibility in novel situations and versatility to develop and adopt strategic long-term plans to suit selected goals (Suddendorf & Corballis, 2007). The ability to imagine personal future events may also provide a motivational break that counters a natural tendency to time discounting and impulsive, opportunistic behavior. This capacity is advantageous in the long term, especially given that

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humans depend on cooperation and coordination (Boyer, 2008). Finally, most individuals' decisions are influenced by their (often biased) anticipated hedonic reactions to imagined future events (i.e., *affective forecasting*; Gilbert, 2006; Gilbert & Wilson, 2007; Wilson & Gilbert, 2005).

Aside from the evolutionary point of view, MTT into the future also plays an important role in our well-being and happiness in daily life. Indeed, 12% of our daily thoughts are about the future (Klinger & Cox, 1987) and this MTT is often pleasurable, as people tend to imagine themselves achieving and succeeding rather than fumbling or failing (see Gilbert, 2006). In one study relating MTT into the future and positive outcomes, MacLeod and Conway (2005) found that positive future thinking correlated with subjective well-being in the general population. The authors also found a positive correlation between the amount of positive projections a person could generate and the size of his social network. Moreover, there is considerable evidence that generating mental images of future success and of the process to get there can sometimes increase achievement motivation, effort, and performance (Greitemeyer & Würz, 2006; Pham & Taylor, 1999; Taylor et al., 1998; Ten Eyck, Labansat, Lord, & Dansereau, 2006). A positive image of themselves in the future can motivate action by helping people to articulate their goals clearly and develop behaviors that will allow them to fulfill these goals (Pham & Taylor, 1999; Vasquez & Buehler, 2007). Concurrently, writing about life goals was found to be associated with a significant increase in subjective well-being (King, 2001).

Conversely, there is also evidence from the other end of the emotional spectrum that people with very low levels of happiness have altered future-directed thinking. A consistent finding is that depressed and suicidal individuals differ from controls by their lack of positive thoughts about the future while being no different in the number of negative thoughts they are able to generate (MacLeod & Byrne, 1996; MacLeod, Pankhania, Lee, & Mitchell, 1997; MacLeod & Salaminiou, 2001; MacLeod, Tata, Kentish, & Jacobsen, 1997). Moreover, anxiety seems to be associated with an increase in negative future MTT but not fewer positive projections (Andersson, Kyrre Svalastog, Kaldø, & Sarkohi, 2007; MacLeod & Byrne, 1996; MacLeod et al., 1997). This finding is also observed at the personality level with healthy individuals where anxiety-related dimensions, namely neuroticism and harm avoidance, were found to predict the amount of negative future projections (Quoidbach, Hansenne, & Mottet, 2008). These findings further strengthen the importance of positive future-directed thinking to well-being and happiness. However, whereas findings relating positive future thinking and happiness are relatively unambiguous, it should be

mentioned that negative future thinking does not always have negative effects. Indeed, anticipating unpleasant events can minimize their impact. Arntz, van Eck, and de Jong (1992) showed that subjects who received electric shocks of unpredictable intensity to their right ankle (i.e., 17 painful electrical stimulations of medium intensity, alternated with only three strong stimulations) had higher subjective fear ratings and autonomic responses (skin conductance response, heart rate, and respiration) than the matched controls who received 20 predictable strong stimulations. The inability to anticipate a slightly negative future event makes it more painful than an anticipated considerably negative event. In addition, negative future thinking helps to develop prudent and prophylactic behaviors (Gilbert, 2006). Finally, studies on defensive pessimism show that mentally playing through or reflecting on all the possible negative outcomes for a given situation helps anxious individuals to manage their anxiety, and so it does not interfere with their performance (see for a review Norem & Chang, 2002).

Foundationally, research on MTT into the future and well-being must address the issue of whether positive or negative episodic future thinking is a cause of happiness or anxiety, per se, or merely a side effect that people with high or low well-being frequently experience. Indeed, previous studies on the topic have only been correlational. Of course, the most direct and unambiguous way to determine whether MTT exerts a causal effect on happiness and anxiety would be in the context of experimental studies in which MTT was manipulated and its effects on measures of happiness and anxiety were observed. This is the purpose of the present study. More specifically, we address whether focusing on positive, negative, or neutral future thinking will lead to different levels of happiness and anxiety. Based on the above findings, we predict that self-guided, positive MTT daily exercises will lead to heightened happiness over a 2-week period relative to a focus on negative or neutral projections. As previous findings are controversial concerning negative future thinking and anxiety, showing both that negative MTT is related to high anxiety and that it can sometimes reduce it, the investigation of the effect of the daily practice of MTT on anxiety is purely exploratory.

## Method

### *Participants*

Subjects in the present study were recruited from the local university workers via an intranet advertisement asking them to participate in a study on how people imagine the future. A total of 210 healthy adults originally indicated their willingness to participate in the study by completing the baseline measures of

happiness and anxiety, and were randomly assigned to one of the three experimental groups (positive projection, negative projection, and neutral projection) or to the control group (no projection). Attrition was quite prevalent in the experimental groups. Forty-three participants never started the actual study and another 61 subjects were dropped from data analysis because of missing or incomplete data,<sup>1</sup> leaving a total of 106 participants. This was not surprising given the demanding daily nature of the task and the fact that these subjects were unpaid volunteers. However, there were no group differences in the exclusion/dropout rate for each experimental group ( $\chi^2 = 0.42$ ;  $p = 0.98$ ) and no differences between subjects who dropped out and those who did not regarding their initial level of happiness and anxiety ( $p = 0.70$  and  $p = 0.85$ , respectively). The effective sample was made up of 69 women with a mean age of 31.2 years ( $SD = 10.76$ ) and 37 men with a mean age of 35.03 years ( $SD = 14.8$ ). The experimental groups were composed of 15 subjects (6 men) for the positive projection group, 16 subjects (7 men) for the negative projection group, and 18 subjects (5 men) for the neutral projection group. The control group was made up of 57 subjects (19 men). All participants gave written, informed consent to participate in the study.

### Procedure

After being given instructions and information about the study procedure, participants were provided with an individual login and password for the study website. Participants were then invited when they first logged on to complete the pre-test, which consisted of an online version of the Subjective Happiness Scale (Lyubomirsky & Lepper, 1999) and of the State Trait Anxiety Inventory (Spielberger, 1983). After that, participants started receiving emails every day with a link to their online daily projection questionnaire. A first, reminding email was sent to every participant at 5 p.m. and another one was sent at 8 p.m. to participants who had not yet completed their questionnaire. Participants had to complete their daily questionnaire between 5 p.m. and midnight for 15 consecutive days. The first day was considered a practice day and was not counted in the observation period, resulting in a total of 14 daily reports that were used in the analyses. Finally, participants were contacted by email and asked to complete once again the happiness and anxiety scales on the day following their last daily questionnaire (post-test).

### Conditions

Beside the control group that did no intervention and just had to complete the happiness and anxiety scales

twice in a 15-day interval, participants were randomly assigned by the website program to one of the three experimental conditions (positive, negative, or neutral projections) and were provided with one of the three following instructions:

- (1) *'Please try to imagine, in the most precise way, four positive events that could reasonably happen to you tomorrow. You can imagine all kinds of positive events, from simple everyday pleasures to very important positive events.'* Examples of positive events imagined by participants were as follows: 'Before going to bed I could get an SMS from my ex-boyfriend,' 'I can see myself savoring meatballs and French fries at the Rendez-Vous Café with my friend Evelyne right after our Pilates workout at the gym', and 'After a great job interview, the boss of the company I applied to work for will tell me I got the job.'
- (2) *'Please try to imagine in the most precise way, four negative events that could reasonably happen to you tomorrow. You can imagine all kinds of negative events, from everyday hassles to very important negative events.'* Examples of negative events imagined by participants were as follows: 'My hairdresser will ruin my hair tomorrow while I'm already in a hurry for Julie's wedding,' 'When I take a shower tomorrow morning, the water will suddenly turn very cold for a few seconds,' and 'My doctor will inform me that he just got the results of the medical exam and that my recent sight problem is caused by a tumor.'
- (3) *'Please try to imagine, in the most precise way, four neutral and routine events that could reasonably happen to you tomorrow. Imagined events have to be things really neutral that you are used to doing such as taking a shower, tying your shoe laces, or turning on your computer.'* Examples of neutral events imagined by participants were as follows: 'waking up at 9 a.m.,' 'borrowing my friend's cognitive neuroscience book,' 'taking the bus to work', and 'brushing my teeth.'

Depending on the condition, one of these instructions was written on the daily questionnaire, followed by general additional instructions reminding participants that imagined events had to be specific (i.e., they had to take place in a specific place at a specific moment) and inviting them to take the time to think of elements, namely, phenomenal characteristics, such as where and when the event could take place, the people and objects surrounding, other sensory details such as sounds or smells, and emotions they could feel. Instructions were followed by four blank text boxes for participants to write a brief summary

Table 1. Effect of experimental condition on 15-day mean emotion elicited by projections.

	Positive projection	Negative projection	Neutral projections	$F(2, 50)$	$p$
Mean emotion elicited by projections	1.81	-1.5	0.63	200.49	<0.0000
<i>SD</i>	0.51	0.49	0.44		

of their future projections. For each projection, participants were also asked to rate emotions they would experience if the event was actually taking place, on a 7-point scale ranging from -3 (extremely negative) to +3 (extremely positive).

### Happiness

Happiness was assessed by a French back-translated version of the Subjective Happiness Scale (Lyubomirsky & Lepper, 1999). The measure is composed of four items and uses a 7-point Likert-type scale. Examples of items include 'Compared to most of my peers, I consider myself (from 1=less happy to 7=more happy)' or 'Some people are generally not very happy. Although they are not depressed, they never seem as happy as they might be. To what extent does this characterization describe you? (from 1=not at all to 7=a great deal).' Lyubomirsky and Lepper (1999) reported good internal consistency with alpha ( $\alpha$ ) ranging from 0.79 to 0.94. The internal consistency of the French translation of the scale used in our sample was also good with  $\alpha$  of 0.81.

### Anxiety

Anxiety was assessed with the State-Trait Anxiety Inventory (STAI) (Spielberger, 1983). The STAI consists of two 20-item scales: the state and trait anxiety scales. The trait anxiety (STAI-T) scale was used in the current study and considers long-term manifestations of anxiety. Items are rated on a 4-point Likert scale (from 'almost never,' to 'almost always'). The validated French version of the STAI has excellent internal consistency and high retest reliability (Schweitzer & Paulhan, 1990). The Cronbach's alpha ( $\alpha$ ) for the STAI-T in the current study was 0.94.

## Results

### Manipulation check

As a reminder, participants were asked to rate for each projection emotions they would experience if the event were actually taking place. In order to check whether each experimental condition (i.e., positive projection, negative projection, and neutral projection) effectively elicited differential emotional valence in projections, a one-way analysis of variance (ANOVA) was conducted

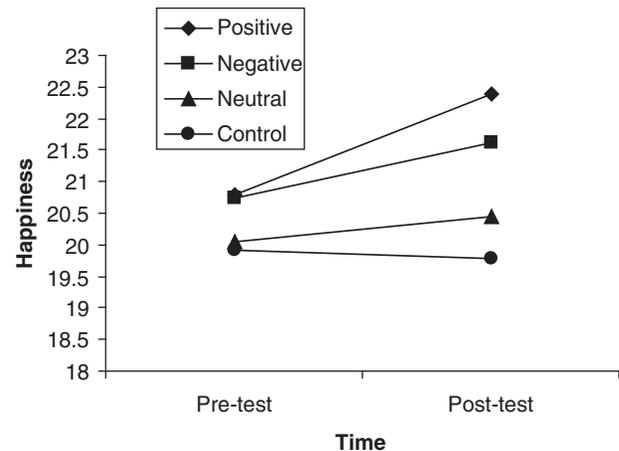


Figure 1. Effect of MTT intervention on happiness across experimental conditions.

with the mean daily rating of emotional content of projections as the dependent variable and the three experimental conditions as the three levels of the independent variable. The means and standard deviations of the mean emotion of projections are depicted in Table 1. Results showed that the manipulation was effective, as the three experimental groups effectively differed on the emotional content of their daily projections ( $F(2, 46) = 198.48, p < 0.0001$ ). Post hoc comparisons revealed that the positive group significantly differed from the negative ( $p < 0.001$ ) and the neutral group ( $p < 0.001$ ), and the negative group significantly differed from the neutral group ( $p < 0.001$ ).

In addition, there were no significant differences between the four groups regarding their basic level of happiness ( $F(3, 102) = 0.31, p = 0.82$ ) and anxiety ( $F(3, 102) = 1.40, p = 0.25$ ).

### Subjective happiness

Scores on subjective happiness scales for each group before and after 2 weeks of daily projection are presented in Figure 1. A two-way, repeated-measures ANOVA with the factor of time as within factor and with projection condition as between-subjects factor was conducted. Results shows a significant effect of time ( $F(1, 102) = 7.87, p < 0.01$ ) and a significant interaction ( $F(3, 102) = 2.87, p = 0.04$ ).

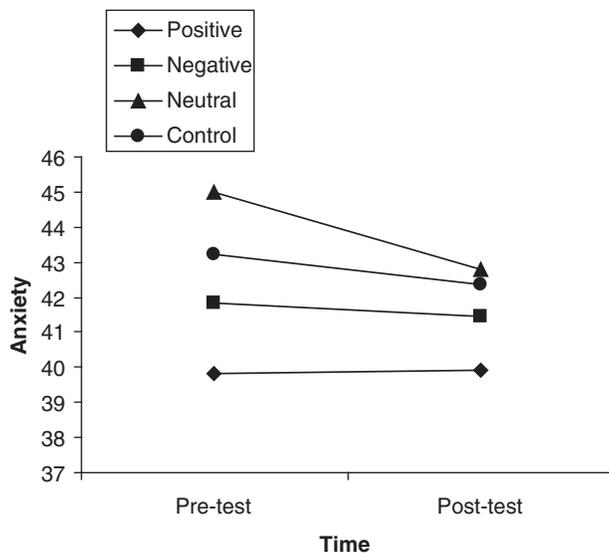


Figure 2. Effect of MTT practice on anxiety across experimental conditions.

Comparisons yielded a significant increase in happiness for the positive projection group ( $F(1, 102) = 8.13, p < 0.01$ ). Modifications in the level of happiness after the 2-week program for the negative projection group ( $F(1, 102) = 2.59, p = 0.11$ ), the neutral projection group ( $F(1, 102) = 0.58, p = 0.45$ ), and the control group ( $F(1, 102) = 0.18, p = 0.67$ ) were not significant.

### Anxiety

Mean STAI scores for each group before and after the 2-week daily projection are presented in Figure 2. A two-way, repeated-measures ANOVA with the factor of time as within factor and with projection condition as between-subjects factor was conducted. Results yielded no significant effect of time ( $F(1, 102) = 3.13, p = 0.08$ ) and no significant interaction either ( $F(3, 102) = 1.24, p = 0.30$ ). Because there is a trend toward significance for an effect of time, additional comparisons were conducted. These analyses revealed a significant reduction of anxiety in the neutral projection group ( $F(1, 102) = 5.64, p < 0.02$ ) but no significant changes in the positive group ( $F(1, 102) = 0.11, p = 0.75$ ), the negative group ( $F(1, 102) = 0.14, p = 0.71$ ), or the control group ( $F(1, 102) = 2.90, p = 0.09$ ).

### Discussion

Understanding the roots of well-being and scientifically developing and validating activities to improve it are among the main goals of positive psychology. The first purpose of the present study was to investigate the direction of the causal relationship between MTT into the future and happiness; that is, to examine whether

purposely engaging in positive future thinking could boost one's subjective sense of happiness over 15 days. Results show that while participants who had to imagine everyday neutral or negative events showed no significant increase in their levels of happiness, subjects in the positive condition were significantly happier than 2 weeks earlier. This suggests that positive episodic future thinking is not just a consequence of happiness and might be related to well-being in a causal fashion. Therefore, this intervention could be usefully added to the growing number of scientifically validated self-help tools (e.g., Emmons & McCullough, 2003; Lyubomirsky, 2008), and further studies should investigate its effect on depressed patients. Additionally, though the relationship between future MTT and well-being is well established (e.g., MacLeod & Conway, 2005; MacLeod & Salaminiou, 2001), the present research cannot exclude the possibility that the observed increase in happiness is due to the fact that participants in the positive MTT condition also had more positive cognitions and experiences than the other groups. Future research should include another positive cognitions control condition in order to establish with certainty the specific key role played by MTT. However, it should be mentioned that the present results, though not significant, show a surprising increase in happiness in the negative condition. A possible explanation could be that most of the negative events imagined in the negative group did not actually happen, a fact that could have led participants to evaluate themselves as relatively lucky and, therefore, happy people. This finding raises the question of how MTT might interact with affective forecasting. For example, is the mere anticipation of good events enough to increase happiness? Do imagined positive events still lead to happiness when one is disappointed by the actual events (as has been shown in research on affective forecasting bias; see Wilson and Gilbert, 2005)? The differential impact of imagining events that do or do not happen could be interestingly investigated in the future.

The second aim of this study was to investigate the effects of all three types of MTT into the future on anxiety. No particular hypotheses were formulated at this level given the fact that, though negative future thinking seems to be associated with anxiety at the clinical level (MacLeod & Byrne, 1996) and the personality level (Quoidbach et al., 2008), it was also found to be a way to cope with anxiety in some other cases (Arntz et al., 1992; Norem & Chang, 2002). In the present study, neither positive nor negative future thinking practices had influence on levels of anxiety. This absence of effect in the negative MTT group seems to indicate that intentional negative future thinking does not directly cause anxiety. Negative thoughts about the future might therefore be consequences rather than causes of trait anxiety.

Hence, the frequently observed relationship between negative future thinking and anxiety (MacLeod & Byrne, 1996; MacLeod et al., 1997; MacLeod & Salaminiou, 2001; MacLeod et al., 1997; Quoidbach et al., 2008) might be explained by the fact that imagined negative events affect anxious people more than others, either because the negative things they think of are worse or because they are more sensitive and therefore the subjective impact is greater, or both these causes may apply. This explanation is in line with recent findings indicating that subjects who scored high in neuroticism experienced more emotion while imagining negative future events (Quoidbach et al., 2008).

Unexpectedly, participants in the neutral MTT group did show a significant reduction of their levels of anxiety. This surprising result has yet to be explained, as most of the literature on MTT and anxiety addresses anticipation of negative events. A possible explanation of this effect might lie in the structuring nature of neutral MTT. Indeed, a qualitative analysis of the written projections, using a formal coding procedure, revealed that the content of subjects' projections in the neutral group were mainly related to daily routines such as driving, eating or washing oneself (52%) and to planning (i.e., things participants had to do the next day such as going to the grocery store, picking up children from school, or paying a visit to friends or relatives; 44%). Thus, mentally preparing for and organizing the upcoming day might have a significant reducing effect on stress. This finding is in line with previous findings that improving individuals' planning abilities reduces negative affect (MacLeod, Coates, & Hetherington, 2008). Further studies could investigate this kind of MTT as a way to cope with anxiety.

Before we conclude, several limitations of the present study should be mentioned. First, the attrition rate in the present study was quite high and, even though there were no group differences in the exclusion/dropout rate for each experimental group, a possible selection effect cannot be excluded. Second, the *N* of the study is a bit small, though the statistical analysis shows that it is large enough to obtain significant results.

### Acknowledgement

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### Note

1. Due to the study website software requirements, participants could only complete post-test happiness and anxiety scales if they had completed all of their 15 daily questionnaires.

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