

Cognitive forecasting and its link to life satisfaction: An investigation of accurate and optimistic prospection and retrospection

Joline Guitard · Aaron Jarden

Abstract: Prospection can be defined as mental representations of possible futures which individuals use to make daily decisions. The current study aimed to assess the links between a specific type of prospection, cognitive forecasting of life satisfaction, and various wellbeing and illbeing indicators. More specifically, this study aimed to assess individuals' accuracy at cognitive forecasting, their accuracy at retrospective recall of life satisfaction, and the optimism of their life satisfaction forecasts in relation to wellbeing and illbeing indicators. To assess life satisfaction in the past, present, and future, we used the *Temporal Satisfaction with Life Scale*. Data from 576 English speaking individuals who took part in the *International Wellbeing Study* was analysed. Results showed that, as expected, individuals who exceeded their predictions of future life satisfaction and those who were accurate had stronger relationships with wellbeing indicators, while individuals who did not meet their expectations had stronger relationships with illbeing indicators. For retrospective recall, contrary to our expectations, individuals who believed their past life satisfaction to be worse than it had been and those who were accurate had stronger relationships with wellbeing indicators, while those who believed their past life satisfaction to be better than it had been had stronger relationships with illbeing indicators. Finally, regarding optimism of forecasts, and also contrary to our expectations, it was found that optimistic individuals had stronger relationships with illbeing indicators, while less optimistic individuals had stronger relationships with wellbeing indicators. Our results are interpreted following the *Relative Standards Model*.

Keywords: affective forecasting; cognitive forecasting; life satisfaction; prospection; retrospection; wellbeing

1. Introduction

Humans make many types of decisions about the future: from simple, to complex, to important. To make different types of decisions individuals use *prospection*: a mental representation of possible futures given the information available in the present and from past experiences (Gilbert & Wilson, 2007; Seligman et al., 2013; Seligman et al., 2016). Individuals then decide and pursue the possible future they perceive as having the most favourable outcomes, and avoid the possible future they perceive as having less favourable outcomes (Christophe & Hansenne, 2016; Hoerger et al., 2010; Lench et al., 2019; Seligman et al., 2013). During prospection, an individual can forecast how they will feel for a specific possible outcome. Prospection about feelings is called *affective forecasting* and is defined by Wilson and Gilbert as “people’s predictions about their

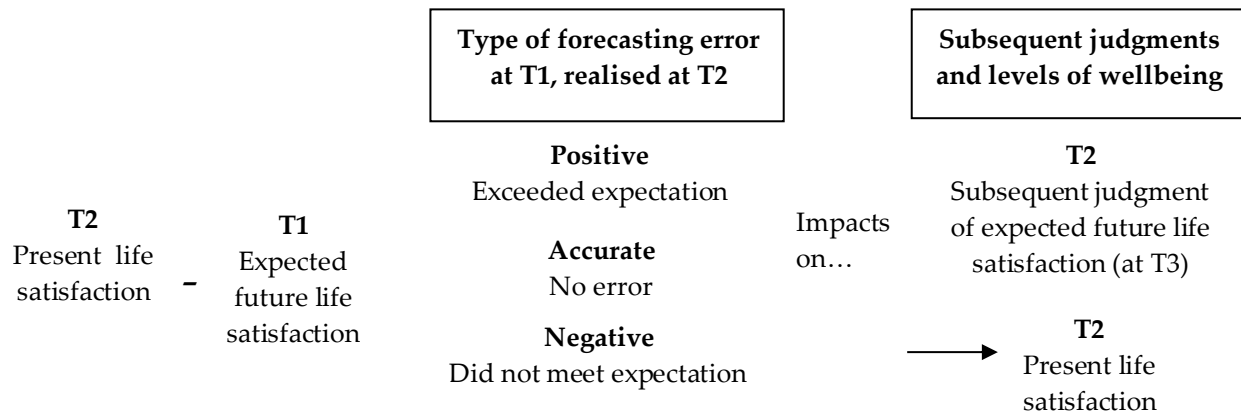
future feelings” (2003, p. 346). These predictions can relate to different aspects of future feelings, such as the specific emotion (i.e., happiness, joy, awe), the valence (the feelings intrinsic attractiveness), the intensity of the emotion, and the emotion’s duration (Gilbert & Wilson, 2007). Prospection can also be used by individuals to project into the past and recall past moods, termed retrospective recall (Safer & Keuler, 2002).

Research on affective forecasting suggests that individuals are not that accurate at predicting the impact of future events on their emotions. Studies have highlighted a tendency for individuals to overestimate future emotions in intensity (e.g., the prediction that an emotion will feel stronger than it does when experienced) and in duration (e.g., the prediction that the emotional experience will last longer than it does when experienced) (Gilbert et al., 1998; Wilson & Gilbert, 2003; Wilson et al., 2000). This overestimation of the intensity and the duration of future emotions is called *impact bias* (Gilbert et al., 2002) and is defined by Wilson and Gilbert as “the tendency to overestimate the enduring impact that future events will have on our emotional reactions” (2003, p. 351). One explanation for impact bias is that during prospection individuals neglect the efficiency or the availability of their coping mechanisms that come into play after the event occurs (called *immune neglect*: Gilbert et al., 1998). Other explanations for impact bias include *adaptation neglect* (where individuals fail to account for how quickly they will adapt to events) and *focalism* (where individuals fail to account for how other events not considered at the time of the forecast will impact the individuals’ emotional state in the future) (Gilbert et al., 2000; Lench et al., 2019; Wilson & Gilbert, 2008). Research suggests that retrospective recall is biased in a similar way to affective forecasting, with individuals remembering longer lasting and more intense emotions than they experienced (Wenze et al., 2012; Wilson et al., 2003).

Much of prospection research over the last 25 years has focused on affective forecasting; prospection of future emotional reactions to an event. However, in recent years, interest in a different type of prospection has emerged from affective forecasting research: cognitive forecasting. As opposed to affective forecasting, cognitive forecasting regards prospection about life in general, where individuals need to account for numerous aspects, such as emotions, life events, cognitions and thoughts (i.e., judgments of future life satisfaction). The most relevant research to date related to cognitive forecasting is from Bertoni and Corazzini (2018). They investigated how overestimation, underestimation, and accurate estimation of future life satisfaction (a cognitive judgment according to Bertoni & Corazzini) impacts subsequent levels of subjective wellbeing. Figure 1 below shows an overview of their experimental design.

As indicated below, Bertoni and Corazzini (2018) looked at over-and-underestimations in a novel way and described these as positive and negative forecasting errors. As such, a positive forecasting error happens when an individual surpasses their previous expectation of future life satisfaction. For example, at Time 1 an individual forecasts that their life satisfaction would be 6/10 at Time 2, yet at Time 2 it is 7/10. Oppositely, a negative forecasting error happens when an individual’s expectations about future life satisfaction are unmet. For example, at Time 1 an individual forecasts that their life satisfaction would be 6/10 at Time 2, yet at Time 2 it is 5/10. An accurate forecast is when the same value was produced (i.e., they expected a 6/10 in the future at Time 2, and at Time 2 reported present life satisfaction as 6/10). Bertoni and Corazzini’s (2018) results indicated that forecasting errors do have an impact on wellbeing such that there is a higher cost to wellbeing when expectations are unmet (i.e., a negative forecasting error) than there is a gain when expectations are surpassed (i.e., a positive forecasting error). In other words, when things do not turn out as well as expected, this impacts a person’s wellbeing negatively, but importantly, to a greater extent than when things turn out more favourably.

Figure 1
 Overview of Bertoni and Corazzini's (2018) experimental design



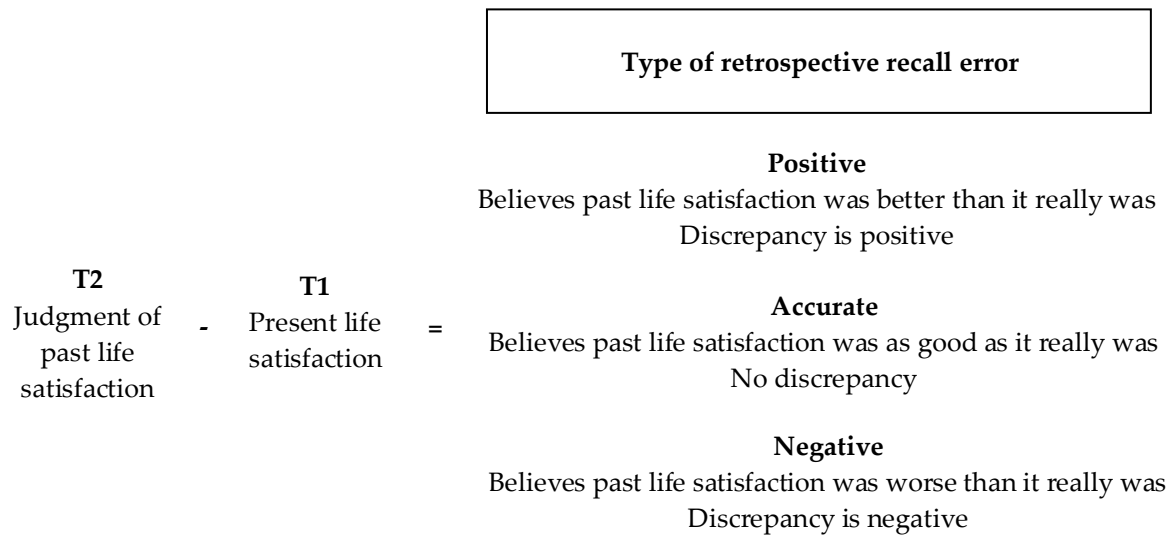
Note. This figure shows a simplified overview of Bertoni and Corazzini's (2018) conceptualization of positive, negative and accurate forecasting errors and their impacts on subsequent levels of wellbeing. "T" indicates the time point of surveying where T1 is the first time of survey and T2 the second.

The current research assesses the accuracy of cognitive forecasts by using a similar conceptualization of forecasting errors to that of Bertoni and Corazzini (2018). In addition, retrospective recall accuracy is also assessed in terms of errors according to the discrepancy between the judgment of past life satisfaction at a given time and present life satisfaction at that previous point in time. As shown in Figure 2 below, a positive retrospective recall error is defined as a view that past life satisfaction was better than in reality (i.e., the individual was moderately satisfied with life at Time 1 or 6/10, but now, at Time 2, believes that their past life satisfaction at Time 1 was very good or 8/10). On the other hand, a negative retrospective recall error is defined as a view that past life satisfaction was worse than in reality (i.e., the individual was moderately satisfied with life at Time 1 or 6/10, but now believes at Time 2 that their past life satisfaction at Time 1 was poor or 4/10). Finally, an accurate retrospective recall is when the same value was produced (i.e., the individual was moderately satisfied with life at Time 1 or 6/10, and now believes at Time 2 that their past life satisfaction at Time 1 was moderate or 6/10).

To our knowledge, past studies have looked at forecasting data by comparing two or more different times of surveying where at one time the prediction of the future is assessed, and at another time the actual experience of affect is assessed and any discrepancy calculated (Bertoni & Corazzini, 2018; Christophe & Hansenne, 2016; Frank et al., 2021; Hoerger, 2012; Hoerger et al., 2016; Hong et al., 2016; Kaplan et al., 2020; Lench et al., 2019; Levine et al., 2012; Wenzel et al., 2012). The same occurs for retrospective recall where at a first time of surveying the current experience is measured, and at a later time the judgment of the past is assessed, and any discrepancy calculated (Hayman et al., 2012; von Wirth et al., 2021; Wenzel et al., 2012). By comparing two or more times of measure, researchers can assess accuracy of forecasting and retrospective recall, as well as the degree and type of errors present. For example, in Bertoni and Corazzini's (2018) study, during the first survey they assessed the prediction of future life satisfaction using a single question, and at the second time point they assessed participants current life satisfaction with a single question. By comparing anticipated with subsequent current life satisfaction, they could determine the presence and extent of positive or negative forecasting errors made at Time 1.

Figure 2

Representation of retrospective recall positive, negative and accurate errors in the current study



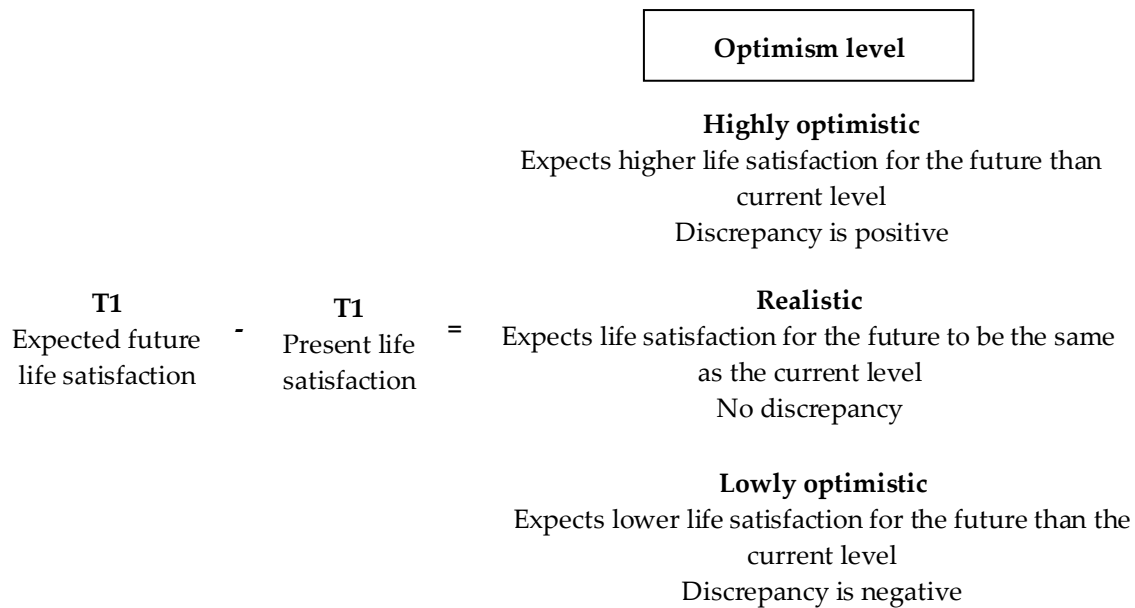
Note. This figure demonstrates how we have conceptualized and calculated the types of errors in retrospective recall. The average retrospective recall scores were calculated by computing the mean score of discrepancies between judgments of past life satisfaction and present life satisfaction at the previous time of measure over five times of measurement, each three months apart (explained further below). “T” indicates the time point of surveying.

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In addition to looking at accuracy of forecasts and of retrospective recall in a similar, but more extensive and robust way than Bertoni and Corazzini (2018), we propose a new way to explore forecasting data by evaluating not just accuracy, but the level of optimism about the future an individual portrays in their forecasts. As shown in Figure 3 below, this is the discrepancy (rather than any realised value *per se*) between anticipated future life satisfaction and current life satisfaction at the same point in time (i.e., within the same survey period).

This way of looking at the data gives new information about prospectors. More specifically, we determine if someone is more optimistic (favourable), realistic (neither favourable nor unfavourable), or less optimistic (unfavourable) in their forecasts of their future life satisfaction given their present evaluations. Highly optimistic forecasting defines an estimation for the future

Figure 3
Representation of highly optimistic, realistic and lowly optimistic forecasts in the current study



Note. This figure demonstrates how we have conceptualized and calculated levels of optimism of the forecasts. The average optimism scores were calculated by computing the mean score of discrepancies over five times of measurement, each three months apart (explained further below). “T” indicates the time point of surveying.

that is higher than the currently experienced life satisfaction (e.g., an individual may be currently moderately satisfied with life or a 6/10, but they expect to be more satisfied with life in the future or 7/10). A lowly optimistic forecast is defined as an estimation for the future that is lower than the currently experienced life satisfaction (e.g., an individual may be moderately satisfied with life in the present or a 6/10, but expects to be less satisfied with their life in the future or 5/10). Finally, a realistic forecast is defined as an estimation for the future that is the same as the currently experienced life satisfaction (e.g., an individual is moderately satisfied with life in the present or a 6/10 and expects to be moderately satisfied with their life in the future or 6/10). This approach does not inform us on the subsequent accuracy of the forecasts or the relative value of the ratings of life satisfaction *per se*. For example, a lowly optimistic forecast between a current rating of 6/10 and a future forecast of 4/10 is the same as a present rating of 8/10 and a future forecast of 6/10 – both are less optimistic to the value of 2 increments. However, it gives us information about prior mindsets individuals might have regarding their future states and wellbeing.

The current study brings important contributions to the field of prospectation by 1) focusing on cognitive judgments about the future rather than judgments of affect in the future, 2) focusing more robustly and extensively on cognitive judgments about the future by using an established 15-item scale rather than single item questions, 3) investigating optimism of forecasts, 4) assessing retrospective recall of cognitive judgments, and 5) investigating more broadly how accuracy of forecasts, accuracy of retrospective recall, and optimism about future life satisfaction link to broader wellbeing and illbeing indicators.

2. Aims and hypotheses

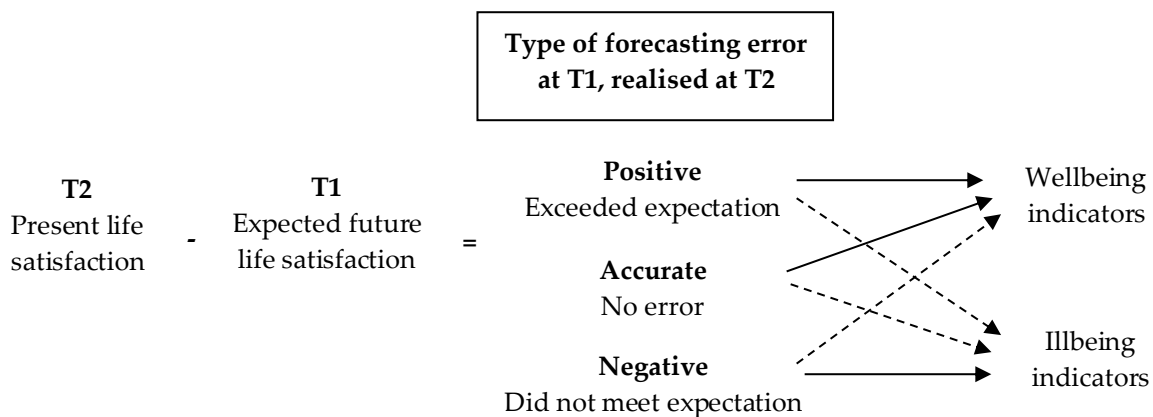
The current study has three main objectives. First, we assess how *accurate* people are at cognitive

forecasting through their forecasts of life satisfaction. In doing so, we investigate the differences between people who are more and less accurate, and how levels of accuracy relate to other wellbeing and illbeing indicators than have been studied and reported before. Second, we assess how *accurate* people are at recalling their past life satisfaction. In doing so, we investigate the differences between people who are more and less accurate and how their accuracy relates to wellbeing and illbeing indicators. Lastly, we investigate differences between a *cognitive forecasting style* in individuals who are more and less optimistic, and those that are realistic, in their forecasting of life satisfaction. In doing so, we investigate how these cognitive forecasting styles (highly optimistic, lowly optimistic, and realistic) relates to wellbeing and illbeing indicators. With these three aims our subsequent specific hypotheses were as follows:

H1a. Regarding the accuracy of cognitive forecasting, given that people are not accurate at affective forecasting (Gilbert et al., 1998; Wilson & Gilbert, 2003; Wilson et al., 2000), we expect that individuals will also not be accurate at cognitive forecasting¹. However, we do not know the extent of this accuracy.

H1b. We expect that both accuracy, and positive inaccuracy (when individuals go above their prediction making a positive forecasting error) of cognitive forecasting, are related positively to wellbeing indicators (i.e., happiness, hope, meaning in life, etc.) and negatively to illbeing indicators (i.e., depressed mood, rumination, etc.). On the other hand, we expect negative inaccuracy (when individuals do not meet their prediction therefore making a negative forecasting error) is negatively related to wellbeing indicators and positively to illbeing indicators. This hypothesis is depicted below in Figure 4.

Figure 4
Representation of H1b



Note. This figure shows the hypothesis that individuals who are accurate at cognitive forecasting and those who exceed their expectations (positive error) will have positive relationships with wellbeing (solid arrows) and negative relationships with illbeing indicators (dashed arrows). Whereas individuals who do not meet their expectations (negative error) will have positive relationships with illbeing indicators (solid arrows) and negative relationships with wellbeing indicators (dashed arrows).

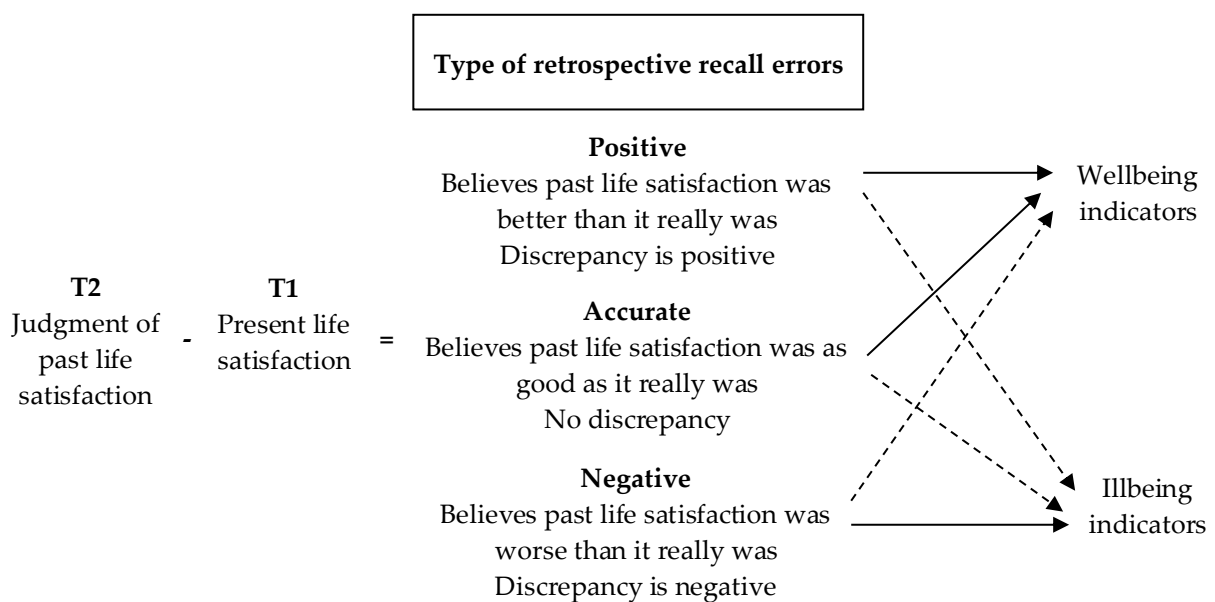
H2a. Regarding the accuracy of retrospective recall for past life satisfaction, given that individuals are not accurate at remembering past moods (Safer & Keuler, 2002; Thomas & Diener, 1990;

¹ Accuracy is hereby defined as: a discrepancy between expected life satisfaction at a future point in time and current life satisfaction at that future point in time (next time of measure), ranging between -1 and +1. Individuals whose average score of accuracy (explained further below) did not fall between these parameters were considered inaccurate (they committed a positive or negative forecasting error).

Wenze et al., 2012), we expect that individuals will also not be accurate at recalling past life satisfaction. However, we do not know the extent of this accuracy.

H2b. We expect that accurate retrospective recall of life satisfaction is positively related to wellbeing indicators (i.e., happiness, hope, meaning in life, etc.) and negatively related to illbeing indicators (i.e., depressed mood, rumination, etc.). Likewise, we expect that positive inaccuracy of retrospective recall is also positively related to wellbeing and negatively related to illbeing in the cases where individuals believe their past was better than it was. However, we expect negative inaccuracy to be negatively related to wellbeing and positively related to illbeing when individuals believe their past was worse than in reality. This hypothesis is depicted below in Figure 5.

Figure 5
Representation of H2b



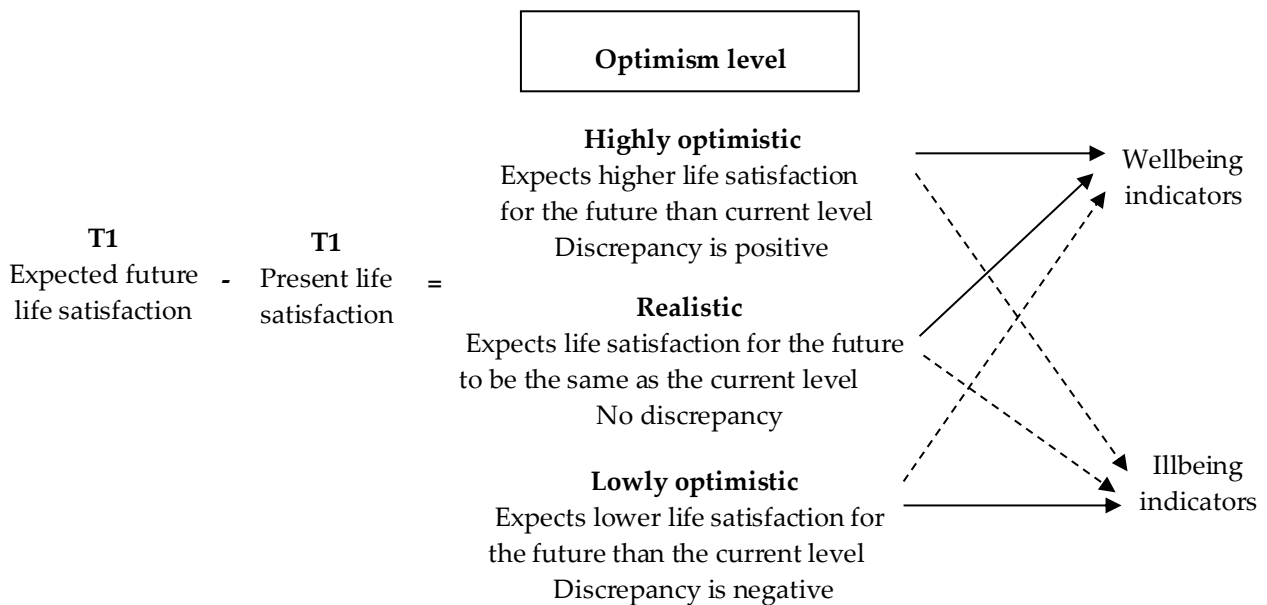
Note. This figure shows the hypothesis that individuals who are accurate at retrospective recall and those who commit a positive retrospective error will have positive relationships with wellbeing (solid arrows) and negative relationships with illbeing indicators (dashed arrows). Whereas individuals who commit a negative retrospective error will have positive relationships with illbeing indicators (solid arrow) and negative relationships with wellbeing indicators (dashed arrow).

H3a. Regarding highly and lowly optimistic, and realistic forecasts, the current study is the first to explore prospecting data and cognitive mindsets in this way. Therefore, we do not know the relative proportions of individuals who may have a highly optimistic, lowly optimistic, or realistic forecasting mindset.

H3b. Knowing that trait optimism is related to wellbeing, and pessimism to aspects of illbeing (Seligman, 1998), we expect that highly optimistic forecasters will have positive relationships with indicators of wellbeing (i.e., happiness, hope, meaning in life, etc.) and negative relationships with indicators of illbeing (i.e., depressed mood, rumination, etc.) compared to lowly optimistic forecasters. We also expect the same relationship for realistic forecasters, albeit to a lesser degree. Alternatively, we expect that lowly optimistic forecasters will have negative relationships with indicators of wellbeing (i.e., happiness, hope, meaning in life, etc.) and positive

relationships with indicators of illbeing (i.e., depressed mood, rumination, etc.) compared to highly optimistic and accurate forecasters. This hypothesis is depicted below in Figure 6.

Figure 6
Representation of H3b



Note. This figure shows the hypothesis that individuals who are highly optimistic and those who are realistic in their forecasts will have positive relationships with wellbeing (solid arrows) and negative relationships with illbeing indicators (dashed arrows). Also, individuals who are lowly optimistic in their forecasts will have positive relationships with illbeing indicators (solid arrow) and negative relationships with wellbeing indicators (dashed arrow).

3. Method

3.1 Participants

Data for the current study came from the International Wellbeing Study (IWS; www.wellbeingstudy.com) and was collected between March 2009 and March 2013. The multicultural sample consisted of 576 adults over the age of 16 (84% female; mean age 41.2, *SD* 14.6) who spoke English as their main language. As depicted in Table 1 below, participants came from 29 different countries with most being from the regions of Oceania, North America, and Europe.

3.2 Materials

The complete IWS survey battery consisted of 19 questionnaires (217 items) that were completed in an average of 29 minutes. For the current study, only eight of the measures were used for analysis (those related to wellbeing and illbeing indicators) and included the 1) Temporal Satisfaction with Life Scale, 2) Scales of Psychological Wellbeing – 18-item version, 3) Subjective Happiness Scale, 4) Adult Hope Scale, 5) Gratitude Questionnaire-6, 6) Meaning in Life Questionnaire, 7) Rumination Scale, and 8) Centre for Epidemiological Studies Depression Scale. The Temporal Satisfaction with Life Scale (TSWLS; Pavot et al., 1998) was used to assess prospection and is described below, with the remaining seven measures described and referenced further in Appendix A. All measures had adequate reliability, apart from the ‘purpose

in life' sub-scale of the Scales of Psychological Wellbeing which had a low alpha of $\alpha = .34^2$.

Table 1

Participants' world region

World region	Relative frequency (%)	Count
Oceania	56.9	328
North America	24.3	140
Europe	16.1	93
Asia	1.4	8
Africa	0.9	5
Latin America	0.3	2

Satisfaction with past, present, and future life was measured with the TSWLS (Pavot et al., 1998)³, which was developed from a previous unidimensional measure of life satisfaction; the widely used Satisfaction with Life Scale (SWLS) (Diener et al., 1985; see Jarden & Jarden, 2016). The TSWLS assesses past, present, and future life satisfaction with 15 items (five for each temporal dimension). An example past life satisfaction item is "I am satisfied with my life in the past", an example present life satisfaction item is "My currently life is ideal for me", and an example future life satisfaction item is "The conditions of my future life will be excellent". No specific timeframe (e.g., past week, past month, in general) is referenced in the scale instructions. Items are answered using a seven-point Likert type scale from (1) - *strongly disagree*, to (4) - *neither agree nor disagree* at the mid point, to (7) - *strongly agree*. Scores for each of the three subscales range from 5 to 30. In the current study, internal consistency for the scale total⁴ was good with a Cronbach's alpha of $\alpha = .91$, and subscales also had good internal consistency with alphas of $\alpha = .86$ for past, $\alpha = .90$ for present, and $\alpha = .85$ for future life satisfaction.

3.3 Procedure

Participants completed online self-report questionnaires at three months intervals (during an open week period) for a total of five times over one year (i.e., approx. 3 months apart). Even though participants started the study at different times between March 2009 and March 2012, all participants completed the five surveys in full within a year. Incentives for participation involved individuals receiving a summary report of their scores and a chance to win one of fifteen NZD100 Amazon.com vouchers.

We computed three main variables for the study analysis, and each is described below: 1) accuracy of forecasts, 2) accuracy of retrospective recall, and 3) optimism of forecasts. Average accuracy of forecasts was computed for each participant by calculating the difference between present life satisfaction and predicted future life satisfaction at the previous time of measure (e.g., if at Time 2, an individual scores 28 for present life satisfaction, and at Time 1, they predicted their future life satisfaction to be 35, they would receive a difference of -7). Differences in accuracy

² This sub-scale has previously been identified as having a low alpha. For example, Seifert (2005) reported $\alpha = 0.33$.

³ All previous research on cognitive forecasting to date has only used a one item measure. For example, Bertoni and Corazzini (2018) asked: "How satisfied are you at present with your life as a whole?" and "How satisfied do you think you will be five years from now?".

⁴ Although we report total life satisfaction scores (as a combination of past, present and future life satisfaction), it is not a focus of the current study. Therefore, results regarding total life satisfaction are not interpreted as we are instead concerned with temporal dimensionality here.

were computed between all five times of measure for a total of four accuracy differences, and we then computed the mean of those four differences to obtain a more accurate single average accuracy score for each participant.

Average accuracy for retrospective recall was computed in a similar way for each participant by calculating the difference between past life satisfaction and present life satisfaction at the previous time of measure (e.g., at Time 2, an individual scores 28 for past life satisfaction, and at Time 1, their present life satisfaction was 35, they would get a difference of -7). Differences in retrospective recall accuracy were computed between all five times of measure for a total of four accuracy differences, and we then computed the mean of those four differences to obtain a more accurate single average retrospective recall accuracy score for each participant.

Lastly, optimism of forecasts was computed. A highly optimistic forecast is an estimation for future life satisfaction that is higher than the current level of life satisfaction (e.g., the individual is currently moderately satisfied with life or 6/10, but they expect to be more satisfied with life in the future or 8/10), while a lowly optimistic forecast is the opposite (e.g., the individual is moderately satisfied with life or 6/10, but they expect to be less satisfied with life in the future or 4/10). Thus, we calculated the discrepancy between anticipated future life satisfaction and current life satisfaction at the same point in time (i.e., within the same time of surveying). If the value was positive, that indicated a highly optimistic view, and if negative a lowly optimistic view (e.g., if at Time 1 anticipated future life satisfaction was 6/10 and at Time 1 present life satisfaction was 4/10, that was a highly optimistic view of +2. Likewise, if at if at Time 1 anticipated future life satisfaction was 4/10 and at Time 1 present life satisfaction was 8/10, that was a lowly optimistic view of -2). A realistic forecast is an estimation for future life satisfaction that is the same as the current level of life satisfaction (e.g., the individual is currently moderately satisfied with life or 6/10 and expects to also be moderately satisfied or 6/10 in the future). We calculated this across all five time points, and then averaged the five scores for a more accurate optimism average.

4. Results

Results are presented in the order of research questions; we investigate the accuracy of forecasts, then the accuracy of retrospective recall, and lastly the optimism of forecasts. Full descriptive statistics and correlations for study variables at Time 1 are presented in Table 12 in Appendix B⁵, with pertinent and large correlations reported below. Correlations are interpreted following Cohen's (1988) guidelines: correlations of .10 to .29 are considered small, .30 to .49 medium, and .50 or above large.

In computing correlations between study variables, and as displayed in Table 12 in Appendix B, we found that *past life satisfaction* was largely and positively related to self-acceptance ($r = .50, p < .01$) and to present life satisfaction ($r = .52, p < .01$). With regard to *present life satisfaction*, this was largely and positively correlated with self-acceptance ($r = .62, p < .01$), environmental mastery ($r = .55, p < .01$), subjective happiness ($r = .64, p < .01$), gratitude ($r = .50, p < .01$), the agency sub-scale of hope ($r = .56, p < .01$) and total hope score ($r = .52, p < .01$). Present life satisfaction has its strongest negative correlation with depressed mood ($r = -.60, p < .01$). Regarding *future life satisfaction*, this was largely and positively related to present life satisfaction ($r = .61, p < .01$), to subjective happiness ($r = .51, p < .01$), and to the agency sub-scale of hope ($r = .50, p < .01$). In other words, and as would be expected, these results indicate that all three past, present, and future life satisfaction have strong positive links to wellbeing indicators and that present life satisfaction

⁵ We also computed results for the other four time points, which had very similar values and are available on request.

is strongly negatively related to the illbeing indicator of depressed mood.

Table 2 below presents correlations between accuracy of forecasts, accuracy of retrospective recall, optimism of forecasts, and with other study variables.

Table 2

Correlations between accuracy of forecasts, accuracy of retrospective recall, optimism of forecasts and other study variables at time 1

	Forecasting Accuracy	Retrospective Recall Accuracy	Forecasting Optimism
1. Forecasting accuracy	1		
2. Retrospective recall accuracy	-.35**	1	
3. Forecasting optimism	-.96**	.37**	1
Temporal satisfaction with life scale			
4. Past	.21**	.40**	-.25**
5. Present	.44**	-.34**	-.58**
6. Future	-.12**	-.13**	.06
7. Total Scores	.25**	-.02	-.34**
Scales of psychological wellbeing			
8. Positive relationships with others	.21**	-.01	-.24**
9. Self-acceptance	.28**	-.06	-.31**
10. Autonomy	.00	-.11**	-.03
11. Personal growth	.05	-.11**	-.09*
12. Environmental mastery	.25**	-.12**	-.31**
13. Purpose in life	.04	-.06	-.05
Subjective happiness scale			
14. Subjective happiness	.26**	-.11*	-.33**
Gratitude questionnaire			
15. Gratitude	.19**	-.08	-.23**
Adult hope scale			
16. Agency	.21**	-.08	-.26**
17. Pathway	.10*	-.10*	-.13**
18. Total Scores	.17**	-.10*	-.21**
Meaning in life questionnaire			
19. Presence	.17**	-.23**	-.22**
20. Search	-.21**	.11*	.22**
Rumination			
21. Rumination	-.24**	.11*	.28**
Centre for Epidemiological Studies depression scale			
22. Depressed mood	-.34**	.18**	.40**

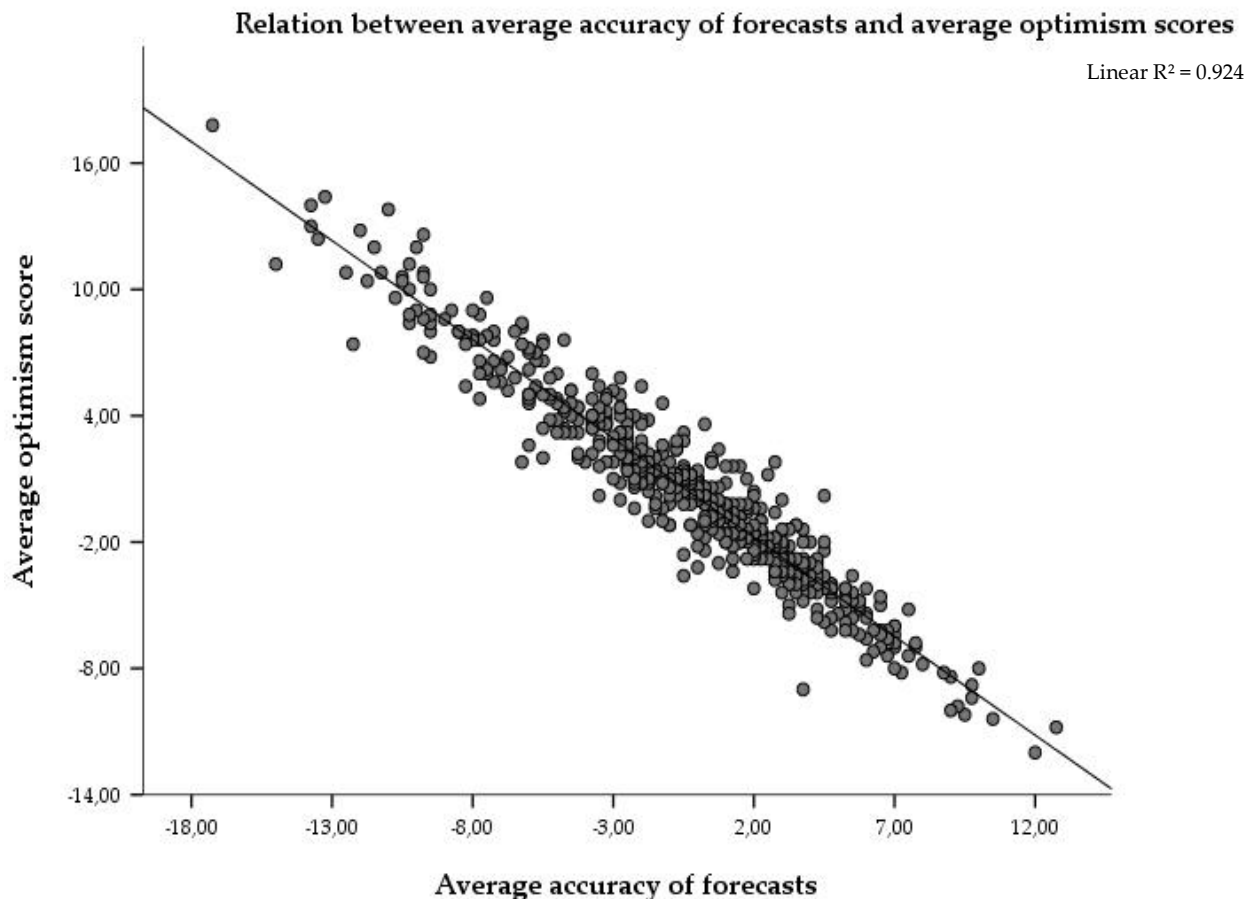
Note. $n = 576$. * $p < .05$, ** $p < .01$. Light grey: correlation of .30 or greater. Dark grey: correlation of .50 or greater.

As indicated in Table 2 above, accuracy of forecasts had a very strong negative correlation with the optimism of forecasts ($r = -.96, p < .01$). This result suggests that the more optimistic the forecast, the more negative forecasting errors individuals made and vice versa. In other words, individuals who were optimistic about their future life satisfaction were less likely to achieve

their expectation resulting in negative forecasting errors. This relationship is presented visually below in Figure 7.

Figure 7

Visual Representation of the Relationship Between Average Accuracy of Forecasts and Average Optimism of Forecasts.



Note. Average optimism ranged from -12 to 17.80. Higher scores are associated with individuals who were highly optimistic in their forecasts while lower scores are associated with individuals who were lowly optimistic in their forecasts. Scores between -1 and +1 are associated with individuals who were accurate. Average accuracy of forecasts scores ranged from -17.25 to +12.75. Higher scores are associated with individuals who exceeded their predictions, therefore creating a positive forecasting error. Lower scores are associated with individuals who did not meet their predictions, therefore creating a negative forecasting error. Scores between -1 and +1 are associated with individuals who were accurate.

Table 2 above also indicates that accuracy of forecasts is moderately positively correlated with present life satisfaction ($r = .44, p < .01$) and moderately negatively correlated with depressed mood ($r = -.34, p < .01$). Retrospective recall accuracy was moderately positively correlated with past life satisfaction ($r = .40, p < .01$) and moderately negatively correlated with present life satisfaction ($r = -.34, p < .01$). Finally, the optimism of forecasts is moderately negatively correlated with self-acceptance ($r = -.31, p < .01$), environmental mastery ($r = -.31, p < .01$), present life satisfaction ($r = -.58, p < .01$) and subjective happiness ($r = -.33, p < .01$), while it is moderately positively correlated with depressed mood ($r = .40, p < .01$). These results suggest that individuals who had a highly optimistic tendency in their forecasts of life satisfaction had a more negative relationship with wellbeing indicators, and they were less satisfied with their present life

satisfaction. They also reported more depressed mood than individuals with a less optimistic tendency.

H1a. Accuracy of forecasts – proportion accurate, positively inaccurate, and negatively inaccurate

Average accuracy of forecasts scores ranged from -17.25 to +12.75. Individuals were considered accurate if their average score (when their four accuracy results were averaged) fell between -1 and +1 (inclusively), while others were considered inaccurate – having committed a positive or negative forecasting error. Of the 576 participants, 21.0% were accurate ($n = 121$, mean accuracy = 0.08, $SD = 0.63$), 39.2% committed negative forecasting errors ($n = 226$, mean accuracy = -5.0, $SD = 3.27$) and 39.8% committed a positive forecasting error ($n = 229$, mean accuracy = 3.85, $SD = 2.19$). Therefore, with only 21% accurate, H1a (that individuals will not be accurate at cognitive forecasting) was supported.

H1b. Accuracy of forecasts – links to wellbeing and illbeing

As indicated in Table 2 above and supportive of H1b, average accuracy of forecasts was moderately positively correlated with wellbeing indicators (e.g., present life satisfaction, $r = .44$, $p < .01$) and moderately negatively correlated with illbeing indicators (e.g., scores of depressed mood, $r = -.34$, $p < .01$).

To better compare accurate, positive, and negative error individuals, and to more stringently test H1b, we investigated individuals that were most and least accurate ($n = 234$; or 40.6% of the 576 sample). Given the size of our sample, we chose to use a sub-group to test possible differences more stringently between most and least accurate individuals. Therefore, to further explore differences between individuals with different accuracy levels we divided inaccurate individuals into two groups according to the *type of forecasting error*: positive or negative. These forecasting errors are defined as in Bertoni and Corazzini (2018) and above. The individuals within the positive forecasting error group were inaccurate individuals who exceeded their prediction of future life satisfaction ($n = 57$, mean age = 46.00, $SD = 15.49$, mean accuracy = 6.98, $SD = 1.75$, range 5.00 to 12.75), individuals in the negative forecasting error group were inaccurate individuals who reported not meeting their expectation for future life satisfaction ($n = 56$, mean age = 33.64, $SD = 12.62$, mean accuracy = -9.77, $SD = 2.19$, range -7.25 to -17.25), and accurate individuals had an average accuracy within + and - 1 ($n = 121$, mean age = 41.07, $SD = 13.61$, mean accuracy = 0.08, $SD = 0.63$, range -1.00 to 1.00). Table 3 below presents the descriptive statistics for the wellbeing and illbeing indicators for each group.

We then computed a MANOVA to compare the three groups: individuals who made a positive forecasting error, accurate individuals, and individuals who made a negative forecasting error. Variables that did not meet the analysis' assumptions were treated as non-parametric. Post-hoc contrasts were done using Bonferroni's correction. Table 4 below shows the statistically significant results of this MANOVA analysis.

As indicated in Table 4 below, groups differed significantly on subjective happiness, rumination, positive relationships, the search for meaning in life, environmental mastery, past life satisfaction, and total hope scores. It is worth noting that the positive forecasting error group did not significantly differ from the accurate group on any of the variables. In terms of subjective happiness, and as displayed in Figure 8 below, the negative forecasting error group had significantly lower scores than the accurate group (mean difference = -0.67, $p = 0.01$) and than the positive forecasting error group (mean difference = -1.12, $p < 0.01$). Regarding rumination, and also displayed in Figure 8 below, individuals in the negative forecasting error group scored significantly higher than accurate individuals (mean difference = 4.69, $p < 0.05$) and higher than

individuals in the positive forecasting error group (mean difference = 7.48, $p < 0.01$).

Table 3

Descriptive statistics of study variables at time 1 of the three forecasting error sub-groups

	Positive forecasting error		Accurate		Negative forecasting error		Skewness	Kurtosis
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Temporal satisfaction with life scale								
1. Past	20.18	[7.19]	18.90	[7.96]	16.41	[7.30]	.09	-1.01
2. Present	27.26	[4.37]	22.72	[7.14]	15.30	[6.78]	-.28	-.85
3. Future	20.56	[4.55]	22.88	[6.13]	23.80	[5.43]	-.13	-.14
4. Total Scores	68.00	[12.24]	64.50	[18.90]	55.52	[15.92]	.04	-.61
Scales of psychological wellbeing								
1. Positive relationships with others	18.04	[3.36]	16.34	[3.84]	14.89	[3.90]	-.73	-.37
2. Self-acceptance	18.47	[2.75]	16.00	[4.40]	14.05	[3.98]	-.84	-.06
3. Autonomy	16.47	[3.84]	16.20	[3.55]	16.46	[2.82]	-.76	.04
4. Personal growth	19.02	[2.68]	18.83	[2.55]	18.82	[2.58]	-1.56	2.53
5. Environmental mastery	16.70	[3.10]	15.64	[3.84]	14.05	[3.76]	-.66	.01
6. Purpose in life	17.30	[2.91]	16.92	[3.13]	16.80	[3.46]	-.87	.47
Subjective happiness scale								
7. Subjective happiness	5.30	[1.12]	4.86	[1.31]	4.17	[1.36]	-.38	-.49
Gratitude questionnaire								
8. Gratitude	37.96	[4.63]	35.91	[6.08]	34.18	[5.92]	-1.13	.79
Adult hope scale								
9. Agency	26.32	[4.27]	25.12	[4.96]	23.00	[6.15]	-1.20	1.41
10. Pathway	24.95	[5.05]	25.24	[4.46]	23.91	[4.32]	-.67	.11
11. Total Scores	51.26	[8.84]	50.36	[8.60]	46.91	[9.30]	-.86	.44
Meaning in life questionnaire								
12. Presence	26.00	[6.11]	24.99	[6.85]	22.75	[7.94]	-.64	-.22
13. Search	19.00	[7.98]	20.25	[8.68]	25.05	[7.51]	-.26	-.97
Rumination								
14. Rumination	20.11	[8.60]	23.11	[9.96]	27.59	[8.62]	-.05	-.97
Centre for epidemiological studies depression scale								
15. Depressed mood	7.81	[6.08]	12.09	[10.39]	21.23	[12.13]	1.12	.32

Note. The analysis was conducted on the more stringent sub-sample comprising of 234 individuals. Positive forecasting error group $n = 57$, accurate group $n = 121$, negative forecasting error group $n = 56$. Skewness standard error = .16. Kurtosis standard error = .32.

The remaining results in Table 4 can also be interpreted in a similar way in that the positive forecasting error group reported higher wellbeing and lower illbeing compared to the negative forecasting error group, with the accurate group located between these two groups. These results support H1b, in that both positive forecasting errors and accurate forecasting of life satisfaction are related to greater wellbeing and lesser illbeing, and that negative forecasting errors of life satisfaction are related to lesser wellbeing and greater illbeing.

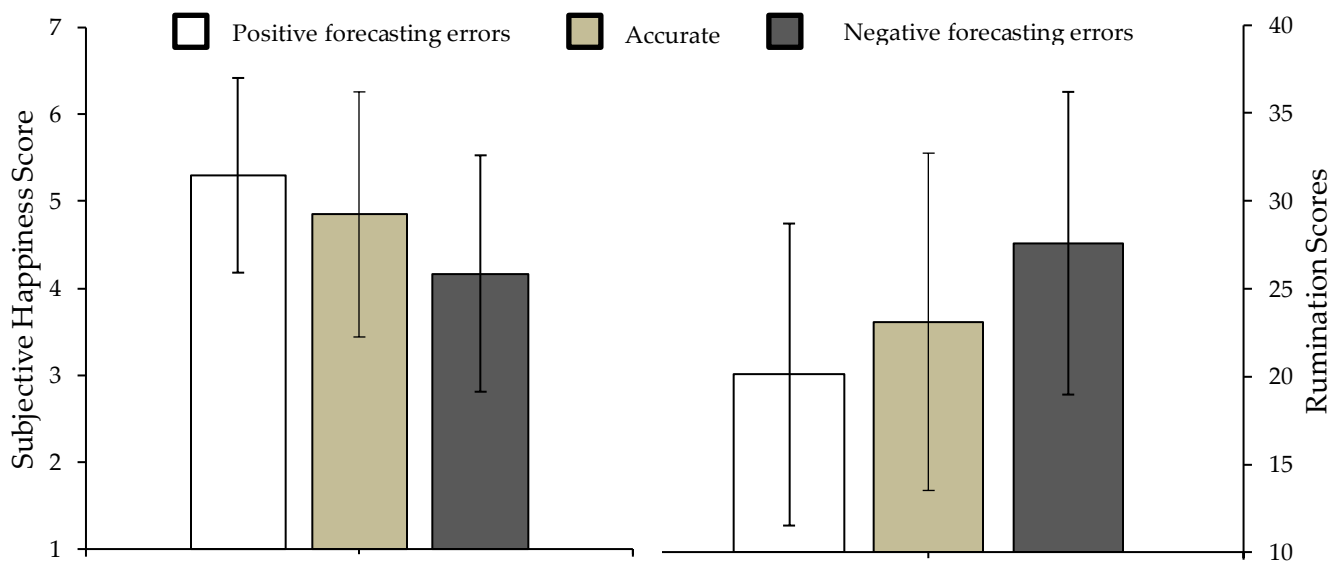
As mentioned above, variables that did not meet the MANOVA's assumptions were treated as non-parametric. Within our stringent subgroup for forecasting accuracy, the following seven

Table 4
MANOVA results for positive, accurate and negative forecasting error groups

Variable	Positive forecasting errors		Accurate		Negative forecasting errors		df	F ratio	η^2	p
	M	SD	M	SD	M	SD				
Subjective happiness	5.30	[1.12]	4.86	[1.41]	4.17	[1.36]	2, 231	11.17	.09	< .01
Rumination	20.11	[8.60]	23.11	[9.61]	27.59	[8.62]	2, 231	9.25	.07	< .01
MLQ – search	19.00	[7.98]	20.25	[8.69]	25.05	[7.51]	2, 231	8.93	.07	< .01
SPWB – environmental mastery	16.70	[3.10]	15.64	[3.70]	14.05	[3.76]	2, 231	7.55	.06	< .01
Hope – total	51.26	[8.84]	50.36	[8.51]	46.91	[9.30]	2, 231	4.03	.03	= .02
TSWLS – past	20.18	[7.19]	18.90	[7.78]	16.41	[7.30]	2, 231	3.62	.03	= .03

Note. Ranked by F ratio. SPWB = Scales of Psychological Wellbeing. MLQ = Meaning in Life Questionnaire. TSWLS = Temporal Satisfaction with Life Scale. Total = $n = 234$. Positive forecasting error $n = 57$. Accurate $n = 121$. Negative forecasting error $n = 56$. Mean of significant post-hoc contrasts are bolded.

Figure 8
Visual representation of subjective happiness and rumination post-hoc contrasts



Note. $n = 234$. Bars represent mean scores, and error bars indicate + and - 1 standard deviation.

variables did not meet the equality of variance postulate: present, future, and total life satisfaction, as well as self-acceptance, gratitude, depressed mood, and the agency subscale of hope. Results of Levene's test of equality of variances are available in Table 13 in Appendix C. Therefore, these variables were tested using a Kruskal-Wallis one factor ANOVA. Results are presented in Table 5 below.

Table 5
Kruskall-Wallis results and pairwise comparisons for positive, accurate and negative forecasting error groups

	Kruskall-Wallis test summary			Medians			Pairwise comparisons		
	Statistic	Degrees of freedom	Sig.	Negative error group	Accurate group	Positive error group	Negative vs Accurate	Negative vs Positive	Accurate vs Positive
TSWLS – present	66.34	2	< .01	15.00	23.00	28.50	< .01	< .01	< .01
TSWLS – future	9.14	2	.01	25.00	23.00	21.00	1.00	.01	.04
TSWLS – total	18.12	2	< .01	54.50	63.00	67.50	< .01	< .01	.35
SPWB – self-acceptance	35.46	2	< .01	14.00	17.00	19.00	< .01	< .01	< .01
Gratitude	13.97	2	< .01	35.00	38.00	39.00	.09	< .01	.09
Hope – agency	11.35	2	< .01	25.00	27.00	27.00	.04	< .01	.49
Depressed mood	41.89	2	< .01	19.50	9.00	7.00	< .01	< .01	.06

Note. $n = 234$. TSWLS = Temporal Satisfaction with Life Scale. SPWB = Scales of Psychological Wellbeing. Comparisons' significance levels are adjusted with Bonferroni's correction for multiple tests. Bolded results indicate significant difference between groups.

H2a. Accuracy of retrospective recall – proportion positively inaccurate, accurate, and negatively inaccurate

Average accuracy of retrospective recall scores ranged from -22.75 to +18.75. Individuals were considered accurate in their retrospective recall if their average score (when their four retrospective recall accuracy results were averaged) fell between -1 and +1 (inclusively), while others were considered inaccurate – having made a positive or negative retrospective recall error. Of the 576 participants, 18.4% were accurate in their recall ($n = 106$, mean retrospective recall accuracy = -0.10, $SD = 0.63$, all within + or - 1), 55.6% made a negative error ($n = 320$, mean retrospective recall accuracy = -6.19, $SD = 4.33$), and 26.0% made as positive error ($n = 150$, mean retrospective recall accuracy = 3.94, $SD = 2.79$). Therefore, with only 18.4% accurate, H2a (that individuals will not be accurate at retrospective recall) was supported. In addition, inaccurate individuals were more than twice as likely to make a negative retrospective recall error than a positive error (55.6% negative errors vs 26.0% positive errors).

H2b. Accuracy of retrospective recall – links to wellbeing and illbeing

As previously indicated in Table 2 above, the accuracy of retrospective recall of life satisfaction is negatively moderately correlated with the accuracy of forecasting ($r = -.35$, $p < .01$), meaning that individuals who rated their past life satisfaction as worse than it really was, also were more likely to exceed their forecasts of future life satisfaction, while individuals who rated their past life satisfaction as better were less likely to achieve their expectations of future life satisfaction. Accuracy of retrospective recall was also moderately positively correlated with the optimism of forecasts ($r = .37$, $p < .01$), meaning that individuals who rated their past life satisfaction as better

than it was tended to be more optimistic in their forecasts of future life satisfaction, while individuals who rated their past life satisfaction as worse than it was tended to be less optimistic. Moreover, and providing mixed support for H2b, accuracy of retrospective recall was positively correlated with past life satisfaction ($r = .40, p < .01$) and negatively correlated with present life satisfaction ($r = -.34, p < .01$). These results suggest that individuals who rated their past life satisfaction as better than it was reported higher scores of past life satisfaction, but also reported lower scores for their present life satisfaction.

To better compare accurate and inaccurate individuals, we investigated individuals that were most and least accurate in their retrospective recall ($n = 257$; or 44.6% of the 576 sample). Given the size of our sample, similar to the accuracy of forecasters analysis above, we chose to use a sub-group to test possible retrospective recall differences more stringently between most and least accurate individuals. Therefore, to further explore differences in individuals with different retrospective recall accuracy levels, we divided inaccurate individuals into two groups according to the *type of retrospective error*: positive or negative. The individuals within the positive retrospective error group were inaccurate individuals who judged their past life satisfaction as higher than their actual life satisfaction at the previous time ($n = 79$; 82.3% females; mean age = 36.38, $SD = 14.59$, mean retrospective recall accuracy = 5.72, $SD = 2.80$, range 3 to 18.75), individuals in the negative retrospective error group were inaccurate individuals who judged their past life satisfaction as lower than their actual life satisfaction at the previous time ($n = 72$; 88.9% females; mean age = 45.03 years old, $SD = 14.55$, mean retrospective recall accuracy = -12.76, $SD = 3.23$), and accurate individuals had an average accuracy within + and - 1 ($n = 106$; 80.2% females; mean age = 40.52, $SD = 15.26$, mean retrospective recall accuracy = -0.10, $SD = 0.63$ range -1.00 to 1.00). Table 6 below shows the descriptive statistics of the wellbeing and illbeing indicators for each group.

We then computed a MANOVA to compare three groups: individuals with positive retrospective errors, individuals with accurate retrospective recall, and individuals with negative retrospective errors. Variables that did not meet the analysis' assumptions were treated as non-parametric. Post-hoc contrasts were done using Bonferroni's correction. Table 7 below shows the statistically significant results of this analysis.

As indicated in Table 7 below, groups differed significantly on the presence of meaning in life, environmental mastery, subjective happiness, the search for meaning in life, total hope scores, hope pathways scores, rumination, hope agency scores, personal growth, and autonomy. It is worth noting that the accurate group did not significantly differ from the negative retrospective error group on any variable. In terms of subjective happiness, and as displayed in Figure 9 below, individuals who made positive retrospective recall errors scored significantly lower than individuals in the accurate group (mean difference = -0.60, $p < .05$) and than individuals in the negative retrospective error group (mean difference = -0.65, $p < .05$). Regarding rumination, and also displayed in Figure 9 below, individuals who made positive retrospective recall errors scored significantly higher than individuals who made negative retrospective recall errors (mean difference = 3.84, $p < .05$).

The remaining results in Table 7 can also be interpreted in a similar way in that the positive retrospective recall error group reported lower wellbeing and higher illbeing compared to accurate retrospective recall group, and the negative retrospective recall group.

As mentioned above, variables that did not meet the MANOVA's assumptions were treated as non-parametric. Within our stringent subgroup for retrospective recall accuracy, the following variables did not meet the equality of variance postulate: past, present, and total life satisfaction, depressed mood, and the presence of meaning in life. Results of Levene's test of equality of

variances are available in Table 14 in Appendix C. Therefore, these variables were tested using a Kruskal-Wallis one factor ANOVA. Results are presented in Table 8 below.

Table 6

Descriptive statistics of study variables at time 1 of the three retrospective recall error sub-groups

	Positive retrospective recall error		Accurate retrospective recall		Negative retrospective recall error		Skewness	Kurtosis
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Temporal satisfaction with life scale								
1. Past	21.54	[6.61]	21.55	[7.14]	12.82	[5.35]	.12	-.87
2. Present	17.71	[7.17]	22.50	[7.57]	26.64	[5.93]	-.28	-.92
3. Future	21.51	[5.83]	23.25	[5.90]	23.60	[5.55]	-.17	-.01
4. Total Scores	60.76	[16.73]	67.30	[18.72]	63.06	[14.00]	.01	-.41
Scales of psychological wellbeing								
1. Positive								
relationships with others	15.82	[4.11]	16.75	[3.68]	15.78	[3.75]	-.72	-.23
2. Self-acceptance	15.85	[3.93]	16.56	[4.20]	16.85	[4.00]	-1.06	.70
3. Autonomy	15.28	[3.64]	16.08	[3.39]	16.69	[3.41]	-.67	-.02
4. Personal growth	18.16	[2.56]	18.81	[2.80]	19.26	[2.38]	-1.51	2.33
5. Environmental mastery	14.11	[3.92]	16.25	[3.35]	16.33	[3.46]	-.67	.04
6. Purpose in life	16.16	[3.26]	17.01	[2.98]	17.42	[3.19]	-.50	-.63
Subjective happiness scale								
7. Subjective happiness	4.39	[1.45]	5.04	[1.33]	5.04	[1.24]	-.45	-.45
Gratitude questionnaire								
8. Gratitude	35.61	[5.01]	36.54	[5.83]	37.24	[5.01]	-1.07	.54
Adult hope scale								
9. Agency	23.80	[5.65]	25.25	[4.71]	25.83	[5.00]	-1.23	1.78
10. Pathway	23.01	[5.40]	24.77	[4.31]	25.04	[4.72]	-.90	.97
11. Total Scores	46.81	[9.98]	50.02	[8.29]	50.87	[9.19]	-1.04	1.37
Meaning in life questionnaire								
12. Presence	21.91	[7.71]	24.44	[7.34]	27.50	[6.28]	-.66	-.41
13. Search	22.82	[8.07]	20.45	[8.54]	18.96	[8.12]	-.15	-1.03
Rumination								
14. Rumination	26.63	[9.61]	23.24	[9.27]	22.79	[9.38]	-.17	-.92
Centre for epidemiological studies depression scale								
15. Depressed mood	18.22	[11.52]	10.89	[9.38]	9.43	[8.15]	1.05	.33

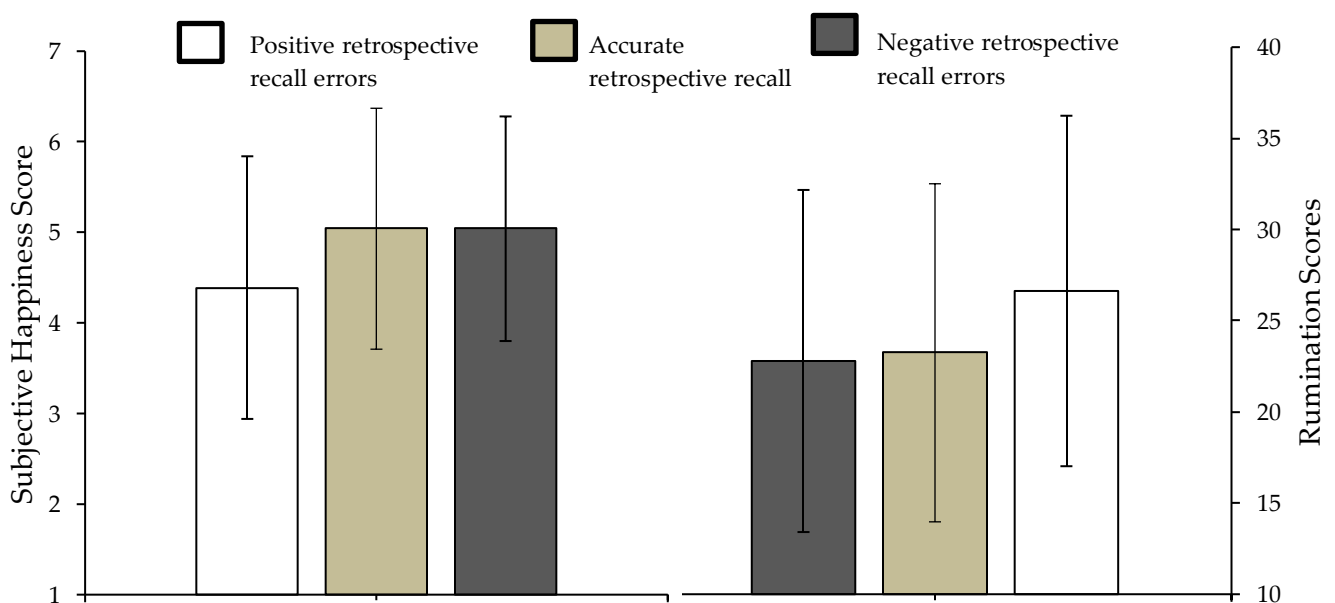
Note. The analysis was conducted on the more stringent sub-sample comprising of 257 individuals. Positive retrospective recall error group $n = 79$, accurate retrospective recall group $n = 106$, negative retrospective recall error group $n = 72$. Skewness standard error = .15. Kurtosis standard error = .30.

Table 7
 MANOVA results for accurate, positive and negative retrospective recall error groups

Variable	Positive retrospective error		Accurate retrospective recall		Negative retrospective error		df	F ratio	η^2	p
	M	SD	M	SD	M	SD				
MLQ - presence	21.91	[7.71]	24.44	[7.34]	27.50	[6.28]	2, 254	11.43	0.08	< .01
SPWB – environmental mastery	14.11	[3.92]	16.25	[3.35]	16.33	[3.46]	2, 254	10.13	0.07	< .01
Subjective happiness	4.39	[1.45]	5.04	[1.33]	5.04	[1.24]	2, 254	6.34	0.05	< .01
Hope – total	46.81	[9.98]	50.02	[8.29]	50.88	[9.19]	2, 254	4.38	0.03	= .01
Hope – pathway	23.01	[5.40]	24.77	[4.31]	25.04	[4.72]	2, 254	4.25	0.03	= .02
MLQ – search	22.82	[8.07]	20.45	[8.54]	18.96	[8.12]	2, 254	4.23	0.03	= .02
Rumination	26.63	[9.61]	23.24	[9.27]	22.79	[9.38]	2, 254	4.00	0.03	= .02
SPWB – personal growth	18.16	[2.56]	18.81	[2.80]	19.26	[2.38]	2, 254	3.40	0.03	= .04
Hope – agency	23.80	[5.65]	25.25	[4.71]	25.83	[5.00]	2, 254	3.28	0.03	= .04
SPWB – autonomy	15.28	[3.64]	16.08	[3.39]	16.69	[3.41]	2, 254	3.17	0.02	= .04

Note. Ranked by F ratio. MLQ = Meaning in Life Questionnaire. SPWB = Scales of Psychological Wellbeing. Total $n = 257$. Positive retrospective error group $n = 79$. Accurate retrospective recall group $n = 106$. Negative retrospective error group $n = 72$. Mean of significant post-hoc contrasts are bolded.

Figure 9
 Visual representation of subjective happiness and rumination post-hoc contrasts for retrospective recall



Note. $n = 257$. Bars represent mean scores, and error bars indicate + and - 1 standard deviation.

Table 8

Kruskall-Wallis results and pairwise comparisons for positive, accurate and negative retrospective recall error groups

	Kruskall-Wallis test summary			Negative error group	Medians	Pairwise comparisons			
	Statistic	Degrees of freedom	Sig.			Accurate group	Positive error group	Negative vs Accurate	Negative vs Positive
TSWLS - past	70.84	2	< .01	13.00	21.00	22.00	< .01	< .01	1.00
TSWLS – present	48.90	2	< .01	28.00	23.50	16.00	< .01	< .01	< .01
TSWLS – total	6.38	2	.04	63.50	67.50	59.00	.38	1.00	.04
Depression	31.92	2	< .01	8.00	8.00	15.00	1.00	< .01	< .01

Note. $n = 257$. TSWLS = Temporal Satisfaction with Life Scale. Comparisons' significance levels are adjusted with Bonferroni's correction for multiple tests. Bolded results indicate significant difference between groups.

In sum, individuals who made more positive retrospective recall errors, in comparison to individuals who made more negative retrospective recall errors, scored higher on aspects of illbeing, such as rumination and search for meaning in life⁶, and lower on aspects of wellbeing, such as subjective happiness, hope, purpose in life, personal growth and autonomy. These results are not supportive of H2b.

H3a. Optimism of forecasts – proportion highly optimistic, realistic, and lowly optimistic

Optimism scores ranged from -12 to +17.80. Individuals were considered highly optimistic if their average optimism score was above 1, realistic if their average optimism score fell between -1 and +1, and lowly optimistic if it was less than -1. Of the 576 participants, 39.4% were highly optimistic ($n = 227$, mean optimism score = 4.89, $SD = 3.23$), 22% were realistic ($n = 127$, mean optimism score = 0.05, $SD = 0.68$, all between + and - 1), and 38.5% were lowly optimistic ($n = 222$, mean optimism score = -3.76, $SD = 2.21$).

H3b. Optimism of forecasts – links to wellbeing and illbeing

To compare highly optimistic, realistic, and lowly optimistic forecasting styles, means for each participant's optimism tendency were computed for all five times of measure by subtracting present life satisfaction scores from future life satisfaction scores within the same time of measure. Table 2 presented earlier indicates that optimism of forecasts is moderately positively correlated with depressed mood ($r = .40, p < .01$), strongly negatively correlated with present life satisfaction ($r = -.58, p < .01$), and moderately negatively correlated with total life satisfaction scores ($r = -.34, p < .01$), subjective happiness ($r = -.33, p < .01$), self-acceptance ($r = -.31, p < .01$), and environmental mastery ($r = -.31, p < .01$). These results suggest that individuals who had a greater optimistic tendency in their forecasts of life satisfaction had greater negative relationships with wellbeing indicators, and were less satisfied with their present life. They also had greater depressed mood than individuals with lower optimism.

To further examine the differences between individuals with different cognitive styles of forecasting, we investigated 69.3% ($n = 399$) of the total sample comprising of the most optimistic forecasters ($n = 137$: 23.8% of total sample, 81% females; mean age = 36.30, $SD = 13.35$, mean

⁶ In the literature, searching for meaning is related to high illbeing and lower wellbeing.

optimism score = 6.77, $SD = 2.85$, range 3.4 to 17.8), the least optimistic forecasters ($n = 135$: 23.4% of total sample, 86.7% females; mean age = 46.78, $SD = 14.84$, mean optimism score = -4.99, $SD = 2.01$, range -2.8 to -12), and realistic forecasters ($n = 127$: 22.0% of total sample, 82.7% females; mean age = 39.96, $SD = 15.55$, mean optimism score = 0.05, $SD = 0.68$, range -1.00 to 1.00) to perform comparisons. Once again, we chose to perform analyses on this smaller sample to allow more stringent tests between the most and least optimistic individuals. Table 9 below shows descriptive statistics of wellbeing and illbeing indicators for each group.

Table 9

Descriptive statistics of study variables at time 1 of the three optimism sub-groups

	Highly optimistic group		Realistic group		Lowly optimistic group		Skewness	Kurtosis
	M	SD	M	SD	M	SD		
Temporal satisfaction with life scale								
1. Past	16.40	[6.74]	19.87	[7.51]	20.99	[6.94]	.11	-.84
2. Present	16.36	[6.25]	23.77	[6.98]	27.65	[4.47]	-.32	-.77
3. Future	22.84	[5.32]	23.28	[6.57]	22.40	[4.92]	-.21	.20
4. Total Scores	55.60	[14.44]	66.92	[18.74]	71.04	[12.55]	-.05	-.30
Scales of psychological wellbeing								
1. Positive relationships with others	15.15	[3.90]	16.09	[3.88]	17.65	[3.38]	-.70	-.33
2. Self-acceptance	14.89	[3.90]	16.02	[4.13]	18.05	[2.78]	-.82	.20
3. Autonomy	16.15	[3.34]	16.21	[3.48]	16.21	[3.42]	-.74	.25
4. Personal growth	18.55	[2.72]	18.81	[2.66]	19.19	[2.51]	-1.60	2.54
5. Environmental mastery	14.31	[3.87]	15.83	[3.58]	16.77	[2.89]	-.68	.11
6. Purpose in life	16.52	[3.39]	16.83	[3.19]	17.14	[2.94]	-.88	.80
Subjective happiness scale								
7. Subjective happiness	4.30	[1.39]	4.99	[1.26]	5.35	[1.10]	-.43	-.46
Gratitude questionnaire								
8. Gratitude	34.34	[5.98]	35.62	[5.96]	37.89	[4.74]	-1.04	.50
Adult hope scale								
9. Agency	23.28	[5.80]	24.99	[5.22]	26.28	[4.09]	-1.29	1.88
10. Pathway	23.53	[4.94]	24.88	[4.91]	25.11	[4.43]	-.70	.16
11. Total Scores	46.80	[9.51]	49.87	[9.39]	51.39	[7.97]	-.97	.91
Meaning in life questionnaire								
12. Presence	22.40	[7.80]	24.53	[7.45]	26.61	[6.15]	-.68	-.29
13. Search	23.85	[7.91]	19.06	[8.15]	19.25	[8.28]	-.18	-.99
Rumination								
14. Rumination	27.49	[9.39]	23.95	[9.89]	21.16	[8.81]	-.16	-.96
Centre for epidemiological studies depression scale								
15. Depressed mood	18.62	[11.92]	12.47	[10.76]	8.89	[7.59]	1.04	.25

Note. The analysis was conducted on the more stringent sub-sample comprising of 399 individuals. Highly optimistic group $n = 137$, Realistic group $n = 127$, Lowly optimistic group $n = 135$. Skewness standard error = .12. Kurtosis standard error = .24.

Next, a MANOVA was computed between the groups using Bonferroni's correction to assess post-hoc contrasts. Variables that did not meet the analysis' assumptions were treated as non-

parametric. Significant results of the MANOVA are presented in Table 10 below.

Table 10

MANOVA results for highly optimistic, realistic, and lowly optimistic forecasting

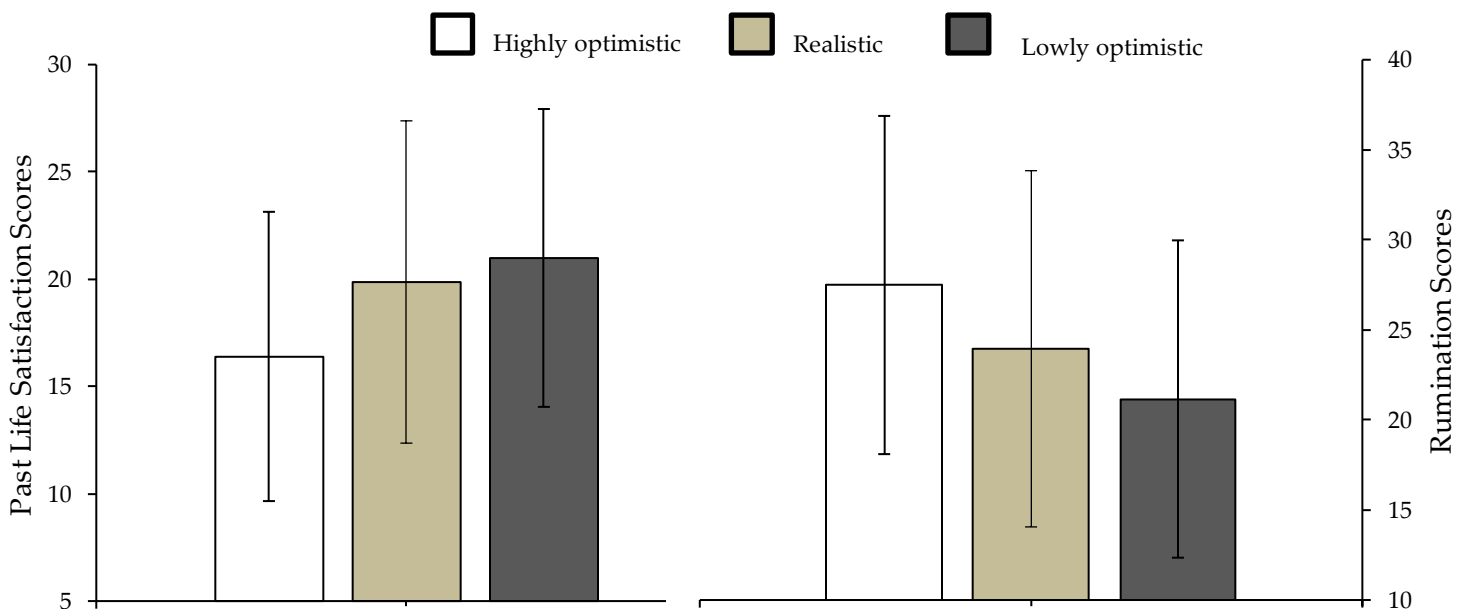
Variable	Highly optimistic		Realistic		Lowly optimistic		df	F ratio	η^2	p
	M	SD	M	SD	M	SD				
TSWLS – past	16.40	[6.74]	19.87	[7.51]	20.99	[6.94]	2, 396	15.63	0.07	< .01
Rumination	27.49	[9.39]	23.95	[9.89]	21.16	[8.81]	2, 396	15.60	0.07	< .01
MLQ – search	23.85	[7.91]	19.06	[8.15]	19.25	[8.28]	2, 396	15.07	0.07	< .01
Hope – pathway	23.53	[4.94]	24.88	[4.91]	25.11	[4.43]	2, 396	4.39	0.02	= .01

Note. Ranked by F ratio. TSWLS = Temporal Satisfaction with Life Scale. MLQ = Meaning in Life Questionnaire. Highly optimistic group $n = 137$. Realistic group $n = 127$. Lowly optimistic group $n = 135$. Mean of significant post-hoc contrasts are bolded.

As indicated in Table 10, individuals with highly optimistic, realistic, and lowly optimistic cognitive styles of forecasting differed significantly on past life satisfaction, rumination, the search for meaning in life, and pathways to hope.

Figure 10

Visual Representation of Past Life Satisfaction and Rumination Post-Hoc Contrasts



Note. $n = 399$. Bars represent mean scores, and error bars indicate + and - 1 standard deviation.

In terms of past life satisfaction, and as displayed in Figure 10 below, individuals from the highly optimistic group scored significantly lower on past life satisfaction than realistic individuals (mean difference = -3.47, $p < .01$) and than lowly optimistic individuals (mean difference = -4.59, $p < .01$). Regarding rumination, highly optimistic individuals were found to have significantly higher scores than realistic individuals (mean difference = 3.54, $p < .01$) and than lowly optimistic individuals (mean difference = 6.33, $p < .01$). Realistic individuals were also found to have higher

scores of rumination than lowly optimistic individuals (mean difference = 2.79, $p < .05$).

The remaining results in Table 10 can also be interpreted in a similar way in that the highly optimistic group reported lower wellbeing and higher illbeing compared to realistic and lowly optimistic groups.

As mentioned above, variables that did not meet the MANOVA's assumptions were treated as non-parametric. Within our stringent subgroup for optimism of forecasts, the following variables did not meet the equality of variance postulate: present, future and total life satisfaction as well as positive relationships, self-acceptance, environmental mastery, subjective happiness, gratitude, the presence of meaning in life, depressed mood, total hope score and the agency subscale of hope. Results of Levene's test of equality of variances are available at Table 15 in Appendix C. Therefore, these variables were tested using Kruskal-Wallis one factor ANOVA. Results are presented in Table 11 below.

Table 11

Kruskall-Wallis results and pairwise comparisons for highly optimistic, realistic and lowly optimistic groups

	Kruskall-Wallis test summary			Medians			Pairwise comparisons		
	Statistic	Degrees of freedom	Sig.	Lowly optimistic group	Realistic group	Highly optimistic group	Lowly vs Realistic	Lowly vs Highly	Realistic vs Highly
TSWLS – present	153.87	2	< .01	28.00	24.00	16.00	< .01	< .01	< .01
TSWLS – future	2.46	2	.29	22.00	24.00	23.00	X	X	X
TSWLS – total	68.12	2	< .01	70.00	67.00	55.00	.06	< .01	< .01
SPWB – positive relationships	32.77	2	< .01	19.00	17.00	15.00	< .01	< .01	.13
SPWB – self-acceptance	49.26	2	< .01	19.00	16.00	15.00	< .01	< .01	.02
SPWB – environmental mastery	29.29	2	< .01	17.00	16.00	15.00	.16	< .01	< .01
Subjective happiness	40.20	2	< .01	5.50	5.25	4.25	.08	< .01	< .01
Gratitude	30.27	2	< .01	39.00	38.00	35.00	< .01	< .01	.13
MLQ - presence	20.34	2	< .01	27.00	26.00	24.00	.12	< .01	.06
Hope - agency	23.39	2	< .01	27.00	27.00	24.00	.30	< .01	.01
Hope - total	18.31	2	< .01	53.00	52.00	47.00	1.00	< .01	.01
Depressed mood	54.02	2	< .01	7.00	9.00	15.00	.04	< .01	< .01

Note. $n = 399$. TSWLS = Temporal Satisfaction with Life Scale. SPWB = Scales of Psychological Wellbeing. MLQ = Meaning in Life Questionnaire. Comparisons' significance levels are adjusted with Bonferroni's correction for multiple tests. X represent unavailable data as pairwise comparisons were not computed for future life satisfaction variable since the general test was found nonsignificant. Bolded results indicate significant difference between groups.

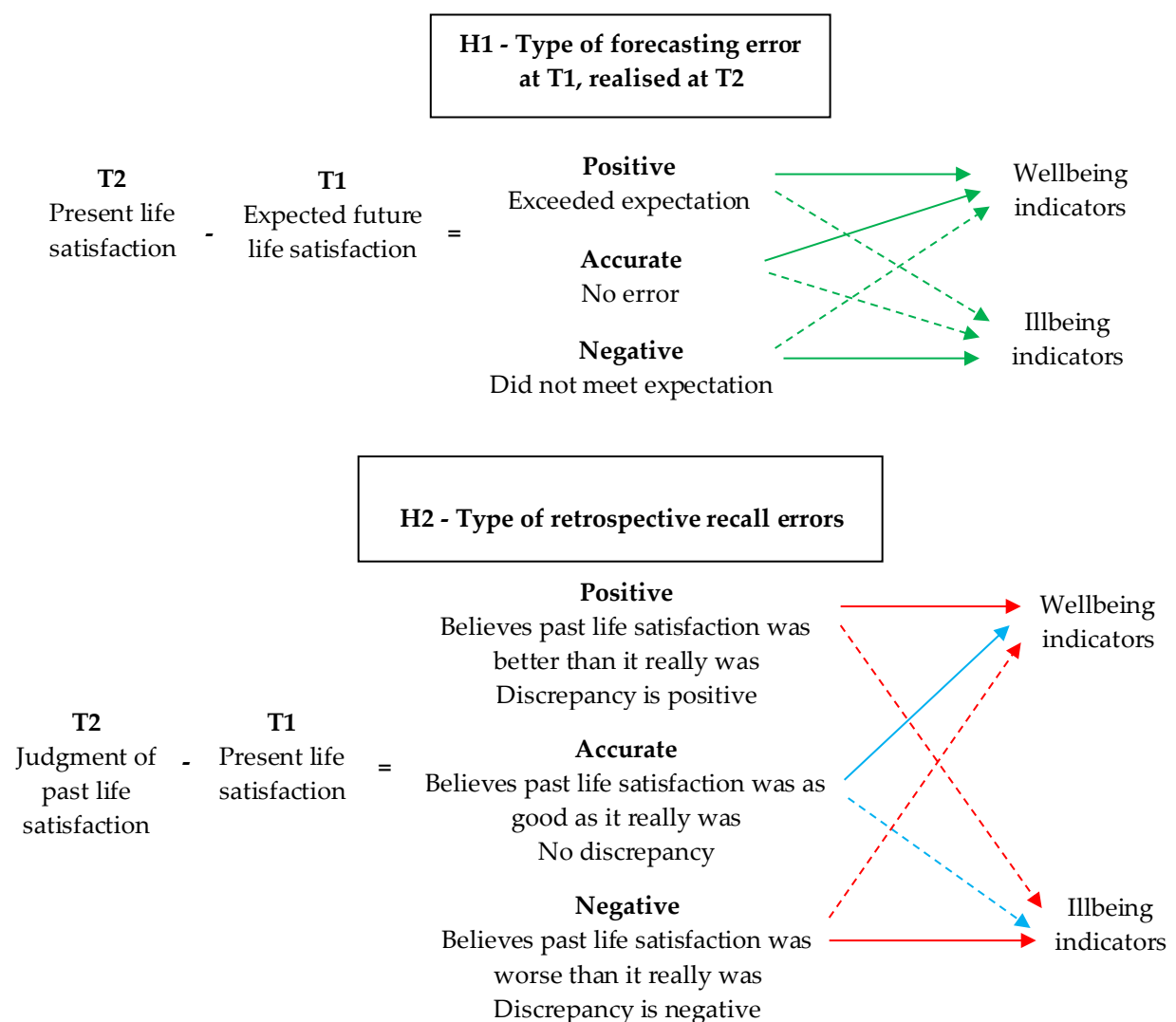
In sum, individuals in the highly optimistic group, in comparison to the lowly optimistic group, scored higher on aspects of illbeing, such as rumination and the search for meaning in life, and lower on aspects of wellbeing, such as past life satisfaction and pathways to hope. Therefore, H3b was not supported.

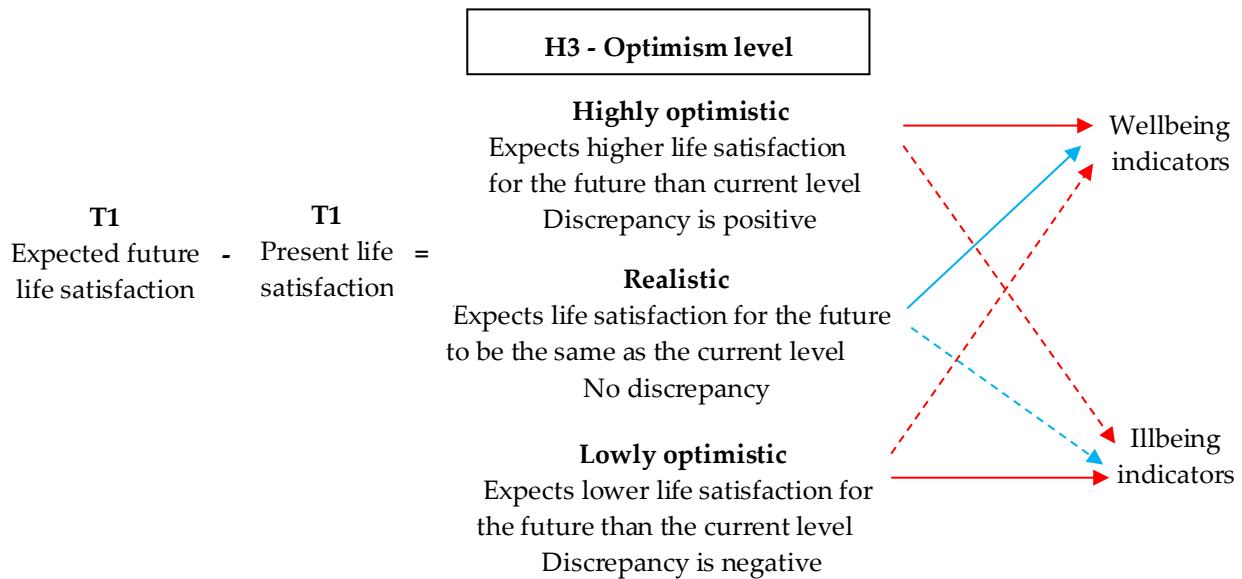
4.2 Results Overview

Figure 11 below displays the results in line with the specific hypothesis; H1 then H2 then H3. A green arrow indicates that the hypothesis was supported, a blue arrow that there was mixed evidence, and a red arrow that the hypothesis was not supported.

Figure 11

Representation of H1b, H2b, and H3b results





5. Discussion

The current research investigated relationships between a specific type of prospection, cognitive forecasting of life satisfaction, and various wellbeing and illbeing indicators. More specifically, we investigated individuals' accuracy at cognitive forecasting, their accuracy at retrospective recall of life satisfaction, and the optimism of their life satisfaction forecasts in relation to wellbeing and illbeing indicators. We discuss results in this above order.

5.1 Accuracy at cognitive forecasting

Regarding the accuracy of cognitive forecasts, results supported hypothesis H1a, that individuals are generally poor at cognitive forecasting, with only 21% of participants reporting accurate forecasts of their future life satisfaction. Furthermore, results supported H1b, that accuracy of forecasts and positive forecasting errors are related positively to wellbeing indicators and negatively to illbeing indicators, while negative forecasting errors have the opposite relationships with wellbeing and illbeing. These results are in line with Bertoni and Corazzini (2018) results that exceeded expectations (making a positive forecasting error) does not bring advantages in terms of wellbeing over being accurate, but not meeting your expectations (making a negative forecasting error) has negative impacts on wellbeing.

5.2 Accuracy at retrospective recall

Results confirmed hypothesis H2a that individuals would be poor at retrospective recall of their life satisfaction with only 18.4% of participants found to be accurate, and we are additionally unsure why inaccurate individuals were more than twice as likely to make a negative error than a positive error (55.6% negatively inaccurate vs 26.0% positive inaccurate). Furthermore, results disconfirmed hypothesis H2b that individuals who rate their past life satisfaction as better than it was (making a positive error) have more positive relationships to wellbeing and less relationships to illbeing (and vice-versa for individuals who made a negative error). Instead, results showed that individuals who made a negative retrospective error (who believed their past life satisfaction was worse than in reality) and accurate individuals scored higher on measures of wellbeing and lower on measures of illbeing than individuals who made a positive retrospective error. There were some differences regarding the links with wellbeing indicators between

accurate individuals and individuals who made negative errors (e.g., scores of present life satisfaction) where individuals in the negative error group scored higher on wellbeing measures than the accurate individuals. It is possible that these results may be interpreted in line with the Relative Standard Model (Diener & Lucas, 2000; Parducci, 1995), which stipulates that satisfaction (including life satisfaction) is determined not by objective conditions, but by the comparisons of one's own standing (e.g., in terms of life satisfaction in the present) to relevant standards (e.g., one's past life satisfaction, perceptions of family or friends' life satisfaction, etc.; Campbell et al., 1976; Diener & Lucas, 2000; Michalos, 1985). The discrepancy between one's own standing and their standard can affect the experienced satisfaction level in the present (e.g., present life satisfaction). As Diener and Lucas (2000, p. 47) mentioned, "a discrepancy that entails an upward comparison (when the comparison standard is higher) should generate lower satisfaction, whereas a downward comparison should lead to higher satisfaction". Individuals who recalled their past life satisfaction as better than reality give themselves an unrealistically high standard which entails an upward comparison, therefore bringing lower present life satisfaction, as well as more negative impacts on wellbeing. On the other hand, individuals who recalled their past life satisfaction as worse than reality create for themselves a standard that is low and entails a downward comparison, resulting in better wellbeing and higher present life satisfaction.

5.3 Optimism of life satisfaction forecasts

Regarding optimism of forecasts, we were unable to make a prediction regarding the proportion of individuals who might be highly optimistic, realistic, and lowly optimistic, as our study was the first one to assess data in that way. Our results showed that 39.4% of individuals in our sample were highly optimistic, 22% were realistic and 38.5% were lowly optimistic towards their future life satisfaction. Regarding H3b, that highly optimistic forecasts would report more wellbeing and less illbeing (and vice-versa for lowly optimistic forecasts), our hypothesis was disconfirmed. Results showed that, in general, highly optimistic individuals scored lower on wellbeing measures and higher on illbeing measures in comparison to lowly optimistic individuals and secondly to realistic individuals. Furthermore, individuals with a realistic style of forecasting also scored higher on certain illbeing measures (such as rumination and depressed mood) and lower on certain wellbeing measures (such as present life satisfaction, positive relationships, self-acceptance, and gratitude) than individuals with a lowly optimistic style of forecasting. Therefore, in terms of optimism towards future life satisfaction, there could be an advantage to being lowly optimistic in comparison to being realistic, or highly optimistic. These results may also be interpreted in light of the Relative Standard Model. Individuals who are highly optimistic have a standard for the future that is, by definition here, very high, therefore entailing an upward comparison that lowers wellbeing and their present life satisfaction, while lowly optimistic individuals' standards entail downward comparison, leading to higher wellbeing and life satisfaction in the present.

6. Limitations, future studies, and summary

Like all studies, ours is subject to several limitations. Firstly, the sample constituted mostly of women and individuals from western cultures. Secondly, all questionnaires were subjective self-reports measures. Thirdly, we used a time interval between judgments of approximately three months – others have used different intervals (e.g., Bertoni & Corazzini (2018) used 5 years), which may lead to different results. Lastly, how we determined cut-values (e.g., -1 to +1 for "accurate"), or the constitution of our more stringent groups, may also impact results.

Future studies may address such sample and methodological issues (e.g., use objective

measures such as the Day Reconstruction Method to assess retrospective recall), and also consider if there are developmental or age differences across the lifespan in such judgments.

In summary, replicating previous research (Bertoni & Corazzini, 2018), the above analysis indicated strong links between accuracy of cognitive forecasting and greater wellbeing and lesser illbeing. However, the results related to accuracy of retrospective recall, and to the optimism of life satisfaction forecasts, and their links to wellbeing and illbeing, may necessitate a re-orientation in our thinking if they can be replicated. The results indicated that both high optimism for future life satisfaction and positive errors in the recall of life satisfaction are related in varying degrees to higher illbeing and lesser wellbeing. This knowledge offers a distinctive and fruitful contribution to our understanding of these phenomena, and a potential path for the utility of prospection.

Conflict of interest statement

The authors report no conflicts of interest.

Authors

Joline Guitard
University of Moncton

Aaron Jarden
The University of Melbourne
aaron.jarden@unimelb.edu.au

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Appendix A

Nine measures were used for analysis and included 1) the Temporal Satisfaction with Life Scale (explained above in methods section), 2) the Scales of Psychological Wellbeing – 18-item version, 3) the Subjective Happiness Scale, 4) the Adult Hope Scale, 5) the Gratitude Questionnaire-6, 6) the Meaning in Life Questionnaire, 7) the Rumination Scale, and 8) the Centre for Epidemiological Studies Depression Scale.

Scales of Psychological Wellbeing

The Scales of Psychological Wellbeing – Short Version (SPWB; Ryff & Keyes, 1995) is an 18-item measure of six more eudemonic dimensions of wellbeing (three items per dimension): autonomy, environmental mastery, personal growth, positive relationships with others, purpose in life, and self-acceptance. Items are answered on a seven-point Likert type scale ranging from 1 - *strongly disagree* to 7 - *strongly agree*. An example item is: “I am good at managing the responsibilities of daily life”. In the current study, internal consistency for the SPWB was $\alpha = .82$ and alphas for the subscales ranged from $\alpha = .34$ to $\alpha = .71$; purpose in life $\alpha = .34$, autonomy $\alpha = .61$, personal growth $\alpha = .62$, positive relationships $\alpha = .62$, environmental mastery $\alpha = .63$, self-acceptance $\alpha = .71$.

Subjective Happiness Scale

Global subjective happiness was assessed with the *Subjective Happiness Scale* (SHS; Lyubomirsky & Lepper, 1999). The 4-item SHS uses 7-point Likert scales which differ across the 4 items, to assess how happy individuals consider themselves. An example item is: “Some people are generally very happy. They enjoy life regardless of what is going on, getting the most out of everything. To what extent does this characterization describe you?”. In the current study, the SHS’s alpha was $\alpha = .87$.

Adult Hope Scale

The 12-item *Adult Hope Scale* (AHS; Snyder et al., 1991) measures two dimensions of hope: agency and pathways. There are four agency items which measure successful goal-directed determination (e.g., “I’ve been pretty successful in life”). Within these four agency items, one focuses on the past, two on the present, and one on the future. The pathways dimension also consists of four items with regards to one’s ability to find ways of surmounting obstacles (e.g., “I can think of many ways to get out of a jam”). Four additional items are fillers and are not related to hope (e.g., “I am easily downed in an argument”). Items are answered with an 8-point Likert-type scales ranging from 1 - *Definitely false* to 8 - *Definitely true*. As well as agency and pathway factors, the AHS produces a global hope score for all eight hope related items. In the current study, the AHS global score had an alpha of $\alpha = .88$, the agency subscale’s was $\alpha = .84$, and the pathway subscale was $\alpha = .81$.

Gratitude Questionnaire-6

The disposition towards gratitude was measured with the *Gratitude Questionnaire-6* (GQ-6; McCullough et al., 2002). The GQ-6 is a unidimensional measure that assess how grateful individuals are in general (e.g., “I have so much in life to be thankful for”). The items are answered on 7-point Likert scales ranging from 1 - *Strongly disagree* to 7 - *Strongly agree*. In the current study, the GQ-6 had an alpha of $\alpha = 0.84$.

Meaning in Life Questionnaire

The *Meaning in Life Questionnaire* (MLQ; Steger et al., 2006) assesses the presence of, and the search for, meaning in life with ten items; five for each subscale. The presence subscale assesses the extent to which individuals feel they live a life full of meaning (e.g., “I understand my life’s meaning”), and the search subscale assesses individuals’ motivation and engagement towards finding or deepening their understanding of meaning in their lives (e.g., “I am seeking a purpose or mission for my life”). Items are answered on a 7-point Likert scale ranging from 1 - *Absolutely untrue* to 7 - *Absolutely true*. In the current study, both the presence and the search subscales had good internal consistency both with alphas of $\alpha = .92$.

Rumination Scale

The 6-item Rumination Scale, a new short form created for the International Wellbeing Study from the 22-item Ruminative Response Style subscale of the Response Styles Questionnaire⁷, assesses responses to depressive symptoms that focus on their meanings, causes, and consequences (Nolen-Hoeksema, 1991). Participants were prompted with, “In the past 3 months would you say you . . .?” and responded to six items using this stem. Two items came from the Brooding factor, or moody and self-critical pondering (e.g., “Thought: ‘Why can’t I handle things better?’”), and four from the Depression-Related factor, thought to directly tap into depression symptoms themselves (e.g., “Thought: ‘Why can’t I get going?’”: Treynor et al., 2003). Participants responded to items on a 7-point Likert scale from 1 - *strongly disagree* to 7 - *strongly agree*. In the current study the alpha was $\alpha = .84$.

Depression Centre for Epidemiological Studies Depression Scale

The presence of depressive symptoms (with a focus on the affective component) over the past week was assessed using the *Centre for Epidemiological Studies Depression Scale* (CES-D; Radloff, 1977). The well-known 20-item CES-DS is unidimensional (e.g., “I felt tearful”) with respondents answering on a four-point scale ranging from 0 = *Rarely or none of the time (less than 1 day)*, to 3 = *Most or all of the time (5-7 days)*. In the current study, the CES-D had good internal consistency with an alpha of $\alpha = 0.92$.

⁷ Credit for this scale development is for Professor Paul Jose.

Appendix B

Table 12

Descriptive statistics and correlations between study variables at time 1

Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Temporal satisfaction with life scale																					
1. Past	19.28	7.35	1																		
2. Present	22.78	7.42	.52**	1																	
3. Future	22.98	5.70	.45**	.61**	1																
4. Total	65.03	16.97	.81**	.87**	.80**	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Scales of psychological wellbeing																					
5. Positive relationships with others	16.35	3.84	.34**	.39**	.30**	.42**	1														
6. Self-acceptance	16.46	3.85	.50**	.62**	.48**	.65**	.51**	1													
7. Environmental mastery	15.71	3.57	.36**	.55**	.40**	.53**	.37**	.59**	1												
8. Autonomy	16.17	3.38	.05**	.18**	.23**	.17**	.14**	.25**	.32**	1											
9. Personal growth	18.89	2.51	.21**	.36**	.36**	.37**	.36**	.40**	.34**	.29**	1										
10. Purpose in life	16.95	3.14	.13**	.24**	.26**	.25**	.30**	.35**	.24**	.17**	.40**	1									
Subjective happiness scale																					
11. Subjective happiness	4.91	1.32	.46**	.64**	.51**	.65**	.48**	.65**	.63**	.29**	.42**	.26**	1								
Gratitude questionnaire																					
12. Gratitude	36.22	5.96	.37**	.50**	.42**	.52**	.45**	.49**	.38**	.16**	.46**	.29**	.57**	1							
Adult hope scale																					
13. Agency	25.09	4.97	.42**	.56**	.50**	.59**	.42**	.70**	.56**	.32**	.52**	.47**	.60**	.52**	1						
14. Pathway	24.65	4.65	.26**	.39**	.41**	.42**	.30**	.49**	.45**	.37**	.44**	.24**	.52**	.40**	.67**	1					
15. Total	49.74	8.78	.38**	.52**	.49**	.56**	.40**	.64**	.56**	.37**	.52**	.39**	.62**	.51**	.92**	.91**	1				
Meaning in life questionnaire																					
16. Presence	24.79	7.05	.21**	.46**	.37**	.41**	.32**	.47**	.39**	.38**	.44**	.38**	.49**	.51**	.54**	.43**	.54**	1			
17. Search	20.74	8.25	-.12**	-.22**	-.06	-.17**	-.13**	-.22**	-.23**	-.13**	.02	-.08*	-.26**	-.12**	-.09*	-.10*	-.10*	-.16**	1		
Rumination																					
18. Rumination	23.78	9.48	-.28**	-.42**	-.25**	-.39**	-.33**	-.47**	-.55**	-.37**	-.2**	-.19**	-.54**	-.31**	-.42**	-.33**	-.41**	-.33**	.31**	1	
Centre for Epidemiological Studies depression scale																					
19. Depressed mood	12.62	10.46	-.37**	-.60**	-.37**	-.54**	-.42**	-.58**	-.63**	-.25**	-.31**	-.27**	-.63**	-.48**	-.51**	-.40**	-.50**	-.43**	.30**	.57**	1

Note. $n = 576$. * $p < .05$, ** $p < .01$. Light grey: correlation of .30 or greater. Dark grey: correlation of .50 or greater. Square box correlations with the specific measure.

Appendix C

The following three tables present the results of Levene’s test of equality of variances for the three MANOVAs computed in the results section.

Table 13

Levene’s test results for the MANOVA computed on positive, accurate and negative forecasting error groups

	Levene’s statistic	Degree of freedom 1	Degree of freedom 2	Sig.
TSWLS – past	0.81	2	231	.445
TSWLS – present	10.02	2	231	.000
TSWLS – future	4.45	2	231	.013
TSWLS – total	9.21	2	231	.000
SPWB – positive relationships	3.21	2	231	.042
SPWB – self-acceptance	8.57	2	231	.000
SPWB – autonomy	2.61	2	231	.076
SPWB – personal growth	0.25	2	231	.780
SPWB – environmental mastery	1.30	2	231	.274
SPWB – purpose in life	0.37	2	231	.690
Subjective happiness	1.97	2	231	.142
Gratitude	4.61	2	231	.011
Hope – agency	4.37	2	231	.014
Hope – pathway	0.37	2	231	.692
Hope - total	0.54	2	231	.584
MLQ – presence	3.07	2	231	.049
MLQ - search	1.61	2	231	.202
Rumination	2.44	2	231	.089
Depressed mood	17.79	2	231	.000

Note. TSWLS = Temporal Satisfaction with Life Scale. SPWB = Scales of Psychological Wellbeing. MLQ = Meaning in Life Questionnaire. The results presented are the Levene’s test based on the mean. Bolded results indicate the test was significant, therefore the null hypothesis that variances are equal is rejected indicating the need for nonparametric tests.

Table 14

Levene's test results for the MANOVA computed on positive, accurate and negative retrospective recall error groups

	Levene's statistic	Degree of freedom 1	Degree of freedom 2	Sig.
TSWLS – past	4.24	2	254	.015
TSWLS – present	4.08	2	254	.018
TSWLS – future	0.12	2	254	.891
TSWLS – total	5.67	2	254	.004
SPWB – positive relationships	1.35	2	254	.260
SPWB – self-acceptance	0.21	2	254	.814
SPWB – autonomy	0.33	2	254	.723
SPWB – personal growth	1.45	2	254	.238
SPWB – environmental mastery	0.74	2	254	.478
SPWB – purpose in life	0.50	2	254	.606
Subjective happiness	1.80	2	254	.167
Gratitude	0.91	2	254	.404
Hope – agency	1.34	2	254	.263
Hope – pathway	2.00	2	254	.138
Hope - total	1.78	2	254	.171
MLQ – presence	2.78	2	254	.064
MLQ - search	0.90	2	254	.408
Rumination	0.09	2	254	.915
Depressed mood	7.40	2	254	.001

Note. TSWLS = Temporal Satisfaction with Life Scale. SPWB = Scales of Psychological Wellbeing. MLQ = Meaning in Life Questionnaire. The results presented are the Levene's test based on the mean. Bolded results indicate the test was significant, therefore the null hypothesis that variances are equal is rejected indicating the need for nonparametric tests.

Table 15

Levene's test results for the MANOVA computed on highly optimistic, realistic and lowly optimistic groups

	Levene's statistic	Degree of freedom 1	Degree of freedom 2	Sig.
TSWLS – past	1.61	2	396	.202
TSWLS – present	14.34	2	396	.000
TSWLS – future	7.40	2	396	.001
TSWLS – total	13.83	2	396	.000
SPWB – positive relationships	3.03	2	396	.049
SPWB – self-acceptance	10.22	2	396	.000
SPWB – autonomy	0.32	2	396	.725
SPWB – personal growth	2.62	2	396	.074
SPWB – environmental mastery	3.90	2	396	.021
SPWB – purpose in life	1.56	2	396	.212
Subjective happiness	4.92	2	396	.008
Gratitude	8.17	2	396	.000
Hope – agency	6.27	2	396	.002
Hope – pathway	1.86	2	396	.157
Hope - total	3.59	2	396	.029
MLQ – presence	5.80	2	396	.003
MLQ - search	0.63	2	396	.533
Rumination	0.99	2	396	.373
Depressed mood	22.68	2	396	.000

Note. TSWLS = Temporal Satisfaction with Life Scale. SPWB = Scales of Psychological Wellbeing. MLQ = Meaning in Life Questionnaire. The results presented are the Levene's test based on the mean. Bolded results indicate the test was significant, therefore the null hypothesis that variances are equal is rejected indicating the need for nonparametric test.