RESEARCH PAPER

Raise of Happiness Following Raised Awareness of How Happy One Feels: A Follow-Up of Repeated Users of the Happiness Indicator Website

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The Happiness Indicator (https://www.happinessindicator.com) is an online tool designed to make people more aware of their own happiness. The theory behind the website is that a keener awareness of one's own happiness helps one find an optimal lifestyle and consequently promotes happiness among users of the website. In this paper, we describe this tool and explore its effectiveness. Users periodically record how happy they feel on the present day and how happy they have felt over the past month, using the Happiness Comparer. They also have the option of indicating in the Happiness Diary how happy they felt during the various activities of the previous day. Users receive instant feedback in the form of a comparison with their earlier scores and with the average scores of similar users. The website has been online since January 2011; 5411 participants have participated at least twice, and 64% of them used the Happiness Diary one or more times. These numbers are now high enough to permit a first check to see whether repeated use of the Happiness Indicator is followed by the expected rise of the participants' happiness. We found that the use of the Happiness Comparer was followed by a small non-significant increase in happiness, while using the Happiness Diary was followed by a greater increase and statistically significant upturn. Using the Happiness Diary 10 times, was followed by an average increase in happiness of 1,5%. In addition, we found that the relationship between diary use and rise of happiness was particularly strong for those who felt less happy when they first used the Happiness Indicator.

Keywords Happiness · Hedonic level of affect · Life satisfaction · Mood awareness · Self-help · E-help · Life style · Day reconstruction method DRM

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1 Introduction

1.1 In Search of Greater Happiness

It is in our nature to prefer feeling good over feeling bad (Grinde 2002) and this tendency extends to a universal quest for a satisfying life, commonly called 'happiness' (Veenhoven 2011). Currently we pursue happiness probably more than in the past. One reason for this greater weight given to happiness is that our chances of living a satisfying life have increased considerably in modern society; a related reason is that in our modern multiple-choice society our happiness is more in our own hands (Veenhoven 2015).

Feeling happy is not only more pleasant than feeling unhappy; it also has positive side effects. Happiness typically makes people more productive (Oswald et al. 2015), as well as social, active, and engaged (Lyubomirsky et al. 2005). Therefore, happy people are generally better citizens (Guven 2009). Happiness also makes people less susceptible to disease, and as a result, happy people live considerably longer than unhappy people do (Lyubomirsky et al. 2005; Veenhoven 2008). These positive effects fit the theory that happiness is part of our affective orientation system and that feeling good tends to accompany functioning well (Grinde 2002; Johnston 2003).

In the light of the above findings especially, there is increasing support for the ideology that we should seek greater happiness for a greater number of people (e.g. Layard 2006; Veenhoven 2011; Diener and Biswas-Diener 2018). One way to promote happiness is to create situations in which most people will enjoy their life, such as providing for material comfort and safety. Though quite successful, this approach involves the danger of paternalism, which may backfire on happiness (Omerod and Johns 2007). Another approach is to help people find happiness by themselves. In this paper, we follow this pathway and present tools that people can use to get a better view on their happiness and adjust their way of life accordingly.

1.2 Methods for Becoming Happier

Our happiness depends in part on genetic predisposition and on circumstances that are difficult to change, however, we can control a considerable part of our happiness.[1] Therefore, many people ask themselves how they could improve their happiness.

This question has led to the development of a growing range of happiness-help products, such as advisory books (e.g. Lyubomirsky 2008), training courses (e.g. Fordyce 1977) and life-coaching services (e.g. Spence and Grant 2007). These products use different techniques, such as training social skills, increasing personal insight, reducing stress and promoting positive thinking, for example, encouraging people to see a glass as half full instead of half empty. The majority of these techniques originates from psychology; in recent years they have drawn mainly from a particular strand in

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[1] Some researchers estimated that about 40% of differences in happiness between people can be explained by how we arrange our lives (e.g. Sheldon and Lyubomirsky 2007). This statistic has been criticized as an overestimation, since it also covers unexplained variance and measurement error. However, there is no doubt that life-choices make a difference, such as in the case of marriage (e.g. Stutzer and Frey 2006) and migration (e.g. Hendriks 2018).

psychology, known as 'Positive Psychology'. Other methods that aim to increase happiness draw on esoteric practices such as Buddhist meditation and yoga.

The focus of these 'happiness trainings' is typically on 'eudaimonic happiness'; a fashionable name for 'positive mental health'. Positive mental health is a syndrome of mental traits deemed to be beneficial (healthy), such as autonomy, self-esteem and a sense of meaning. This idea was first described in 1958 by Marie Jahoda and is currently to be found at the core of positive psychology movement. Though related, 'positive mental health' is not the same as 'happiness' in the sense of the subjective enjoyment of life, which in contrast to 'eudaimonic happiness' is referred to as 'hedonic happiness'. This focus on mental health manifests in the outcome measures used in effect studies,[2] which typically deal with the mental traits trained, such as self-esteem, rather than with life satisfaction.

However, a substantial number of psychological interventions presented as a 'happiness training' aims at fostering enjoyment of life in the first place and this focus appears in the inclusion of measures of hedonic happiness in effect studies of these interventions. An overview of these particular trainings is available in the World Database of Happiness, the Bibliography of which listed some 200 publications in its subject section 'Happiness Trainings'[3] by November 2019.

1.2.1 Approaches in Happiness Trainings

The 'happiness trainings' described in this literature are meant for mentally healthy people and consist of psycho-education and exercises, presented in books, websites or personal instruction, either individually or in classes. The following approaches have been used to raise hedonic happiness in users of such training:

- Enjoyment training; e.g. mindfulness, savoring
- Goals setting
- Humor therapy; e.g. laughter yoga
- Life-review
- Positive thinking; e.g. gratitude, hope
- Relaxation; e.g. meditation
- Self-awareness; e.g. of character strengths
- Self-development; e.g. self-affirmation
- Self-management; e.g. time-management
- Sociability; e.g. acts of kindness exercise

For a recent overview, see Diener and Biswas-Diener (2018).

1.3 Aims of this Paper

Our first aim is to present a new self-help website, based on a different approach. This 'Happiness Indicator' is designed to help users find a way of life that fits them, by 1)

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[2] Reviewed by e.g. Sin and Lyubomirsky (2009), Bolier et al. (2013) and Weiss et al. (2016),
[3] Go to: https://worlddatabaseofhappiness.eur.nl/hap_bib/dis_class.php#1263 (Pursuit of Happiness) and look for 'Happiness trainings' and sub-categories.

sharpening the awareness of how happy they feel in general and during particular activities and 2) providing instant comparison with how happy other users of the website feel. We expect that this will give them clues on a) whether greater happiness is realistically possible for them and b) which changes in their way of life might advance their level of happiness. Our second aim is to test that latter expectation in a longitudinal study among the first users of the Happiness Indicator.

1.4 Plan of this Paper

We describe this Happiness Indicator in more detail, in section 2. The tools it contains, are described in sub-section 2.1, the reasons why we expect that the use of these will add to one's happiness are given in sub-section 2.2, related self-monitoring techniques are mentioned in sub-section 2.3 and some differences with common approaches in positive psychology are discussed in sub-section 2.4. Next, we inspect whether use of the Happiness Indicator tools tends to be followed by a rise in happiness. We present descriptive statistics and our method of analysis in section 3 and report the results in section 4. We found that use of the Happiness Indicator was associated with an increase of happiness and that this happiness increase was largest among the initially least happy users. We discuss these results and explore indications for a causal effect in section 5. Conclusions are provided in section 6.

2 The Happiness Indicator

In collaboration with the health insurance company VGZ, a new online method was developed at the Erasmus University Rotterdam[4] aimed at providing people with greater insight into their own happiness. Self-selected participants were asked to monitor how well they feel in general and during specific daily activities and are informed of how similar people feel, both in general and during the same activities. The method is based on the expectation that a better awareness of one's own happiness helps individuals find a personally optimal life style, which will subsequently lead to increased happiness for that individual.

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2.1 Tools in the Happiness Indicator

The website is presented as 'A tool for working on your happiness' and is available free of charge on www.happinessindicator.com.[5] Upon visiting the website for the first time, the participants create an account and complete a profile questionnaire. They receive an e-mail every month with a link to the website, where they can complete the 'Happiness

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[4] The first version of the Happiness Indicator was developed for a study among third-age students at the School f or Higher Education for Elderly People (HOVO) at Erasmus University Rotterdam in the Netherlands by Ruut Veenhoven in collaboration with Lyanda Vermeulen (Van Herpen and Vermeulen-Kerstens 2008). Ruut Veenhoven also involved in the development of the current version. The software for both versions was developed by Peter Hermus
[5] The version in Dutch: www.gelukswijzer.nl

Comparer' and, if desired, also the 'Happiness Diary'. At the end of each calendar year, they are also asked to specify what has changed in their lives.

2.1.1 Happiness Comparer

The participants' first task is to answer two questions: first, how happy they feel that day, and next, how happy they have felt over the past month. The answers are rated using a visual faces scale, ranging from zero (very unhappy) to 10 (very happy). See Fig. 1. In asking the participants first how they feel that day, we focus the participants' attention on the affective component of happiness[6] and minimize the influence of their current mood on their answer to the second question on their happiness over the past month. After answering the two questions, the participants receive instant feedback in the following two ways: comparison with others and comparison over time.

Comparison with Others The program compares the participant's answers to the two questions with the average score of all participants and with the average score of participants with the same profile; e.g. those in same age category, with same gender and with a similar level of education. A screenshot of this feedback is shown in Fig. 2. This feedback is meant to provide the participants with insight about the likelihood of becoming happier than they are at present.[7]

Comparison over Time If the participant has previously used the Happiness Comparer, the program generates a trend line. See Fig. 3. This trend line shows participants whether they have made progress in their happiness and whether they have fared better or worse than similar participants have.

2.1.2 Happiness Diary

The Happiness Diary comprises an internet application of the Day Reconstruction Method (DRM) developed by Kahneman et al. (2004).[8] Participants are first asked to record everything they did the day before, such as eating, completing household tasks, working and resting. They also state how much time they spent on each activity, where the activity was carried out (e.g., at home or at work) and with whom (e.g., alone, with a partner, with family, or with colleagues). See Fig. 4. Happiness during the activities is indicated on a scale ranging from 0 (very unhappy) to 10 (very happy), identical to that shown in Fig. 1. Participants can use this scale to indicate how happy they felt during each activity. See Fig. 5.

This diary provides participants with instant feedback in the following ways: 1) how much time they have spent on their daily activities, 2) how well they have felt during

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[6] How well one feels most of the time. This concept and its difference with the cognitive component is described in Veenhoven (1984) and 2009)

[7] Users see with what kind of people they compare. In the present (later) version of the Happiness Indicator users can also change comparison profiles.

[8] For a recent review of this method, see Diener and Tay (2014). Others studies that have applied DRM to the study of happiness include Kahneman et al. (2006), Oishi et al. (2009), Knabe et al. (2010), and Hendriks et al. (2014).

Fig. 1 Questions about how happy the participant feels

these activities and 3) to what degree their time use and enjoyment had differed from other users of the Happiness Indicator.

Feelings during each Activity The program generates an at-a-glance overview that shows the activities during which the participant felt the least and most comfortable. See Fig. 6. This overview can help participants allocate their time optimally.
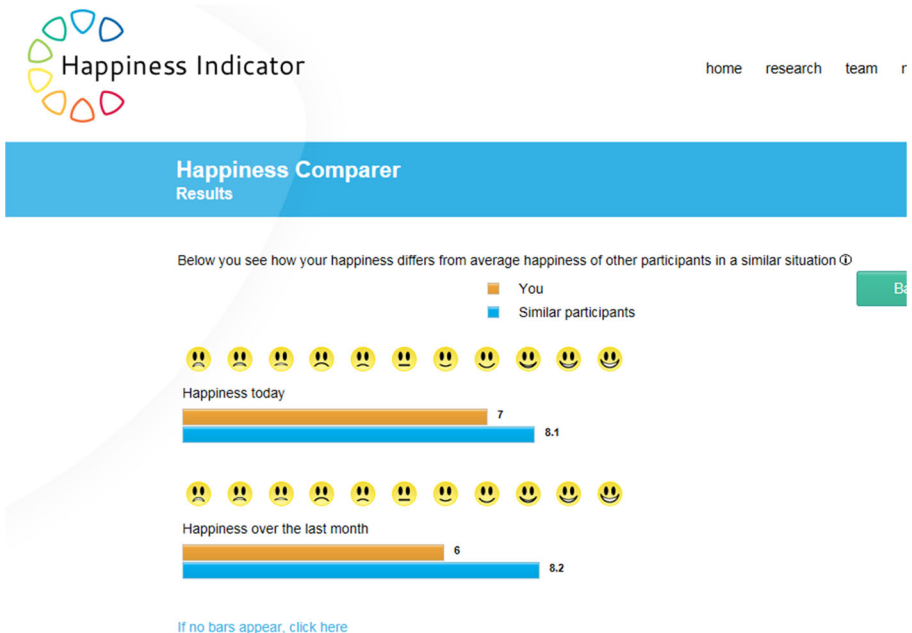
Fig. 2 The participant's happiness compared with the happiness of other participants
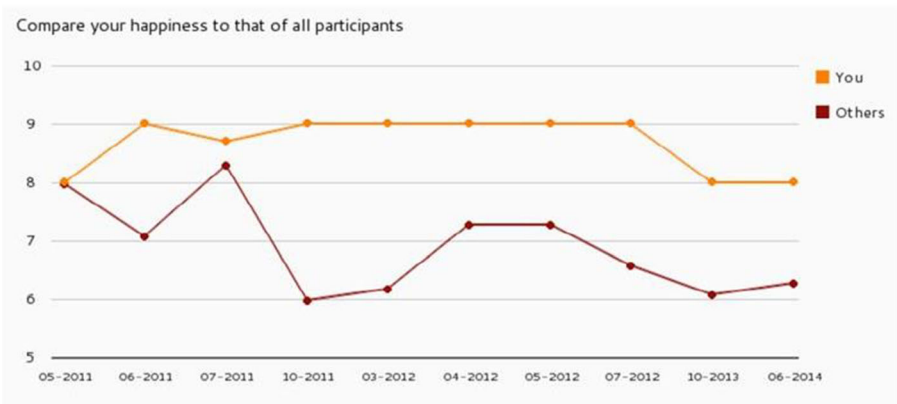
Fig. 3 Example of a comparison over time

Comparison with Other Participants This part of the program also provides instant comparison with other participants with similar life situations. See again Fig. 6. This comparison can help when the participant is making choices, for example when deciding whether to look for a new job. The fact that a person does not feel great at work is in itself not a reason to change jobs, because most people feel one point less happy at work than at home. However, if your difference between work-happiness and home-happiness is greater than that of similar participants, it is most likely worthwhile to try to improve your work conditions or look for a job that fits you better.

Feelings throughout the Total Activity Pattern The average happiness level of the day is calculated based on the time spent on each activity. This helps participants to assess
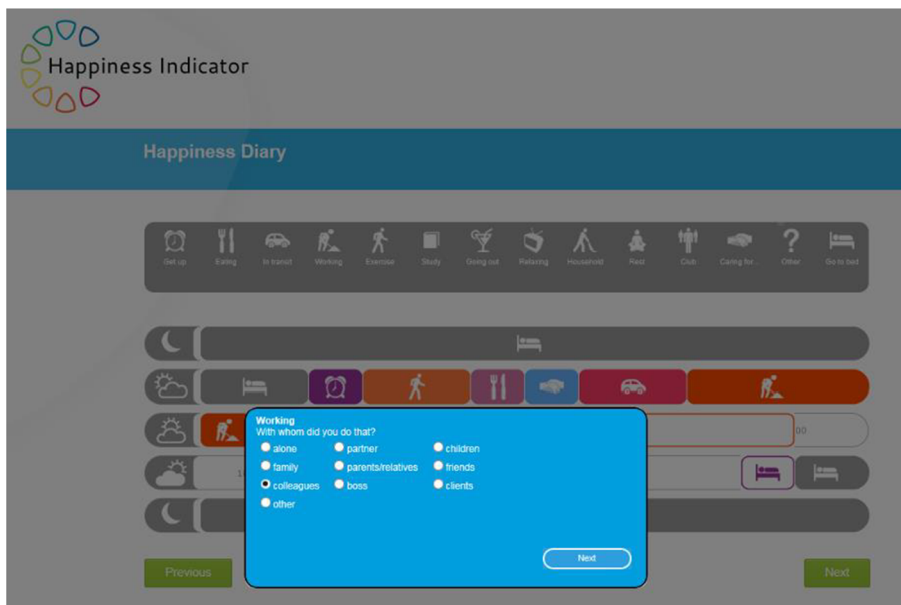
Fig. 4 Example of a happiness diary

Fig. 5 Rating of how happy the participant felt during each activity

Fig. 6 Example of a comparison of an individual's happiness profile with that of similar people

more accurately their own happiness level; if the daily averages obtained with the Happiness Diary differ substantially from the global estimates made on the Happiness Comparer, the latter estimates may be biased.

2.1.3 Other Tools to Work on Happiness

The Happiness Indicator contains two more tools that are designed to provide participants with more insight into their situation: a personality test and a 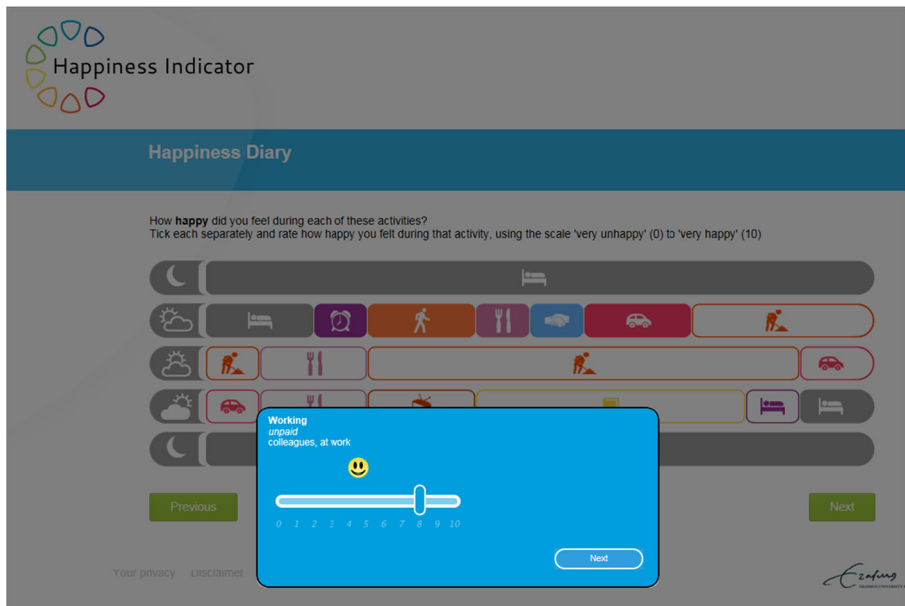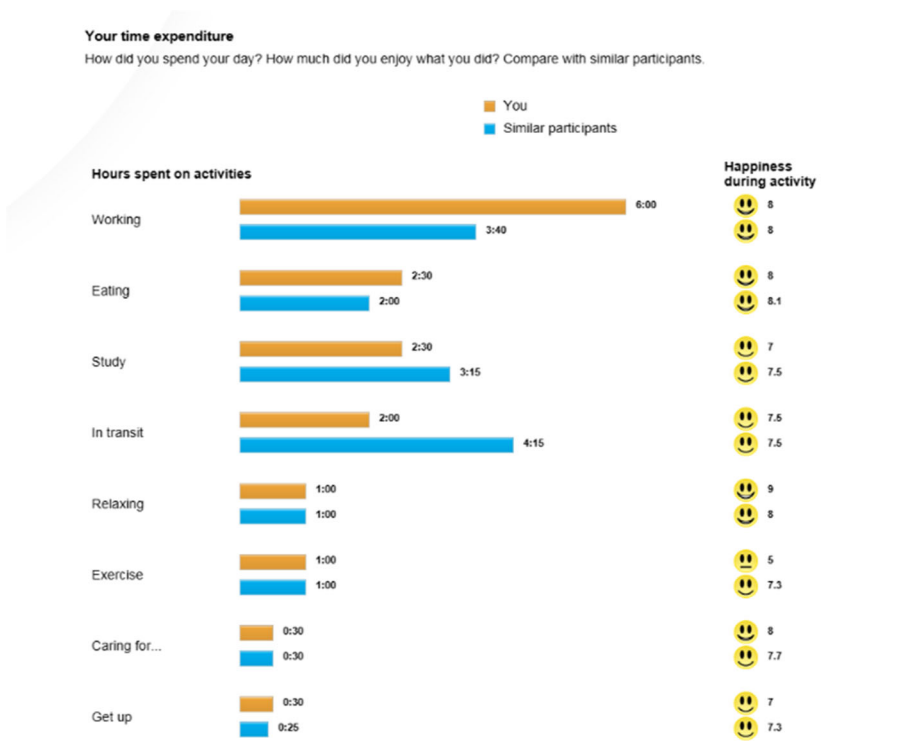diagnostic questionnaire addressing how they experience their job. Both these tools allow a comparison with the average population in the Netherlands, but not (yet) with users of the Happiness Indicator with a similar profile. About 7% of the participants has used one of these additional tools at least once. More of such tools will be added in the future and automatic referrals to tools that seem suitable for particular participants is planned.

2.2 Why the Use of these Tools Is Expected to Raise one's Happiness

Above, we presented this Happiness Indicator as a new kind of happiness training, designed to enhance awareness of one's own happiness, which we expect to help individuals find a personally optimal life style and subsequently raise their happiness. Below, we describe several psychological processes we assume to be involved.

Information Function of Affective Experience Our feelings have a signaling function (e.g. Schwarz 2012), and feeling happy basically indicates that our way of life matches our nature (Grinde 2002). In this perspective, it is functional to be well aware of how happy you feel, at least when there are opportunities to improve your situation. Locked in hell, it is probably better to reduce one's awareness of one's feelings as far as possible, if one cannot change the situation while the signal hurts. Awareness of happiness is also not functional in cases of affective disorder, as we will see in section 5.1.

Inaccurate View on how Happy One Typically Feels Memories of how happy we felt in the past are often distorted and may feed us with false information. Several sources of bias in affective recall have been identified. One is that salient memories of ups and downs limit our perception of the average experience (Wilson et al. 2003). Another source of memory bias is found in 'cognitive framing'; the longer ago the affective experience, the more its afterglow is adapted to existing views on the world and the more we are blinded to divergent information (Kahneman and Krueger 2006).

A related insight is that we are bad at predicting how our choices will affect our future happiness (Gilbert 2005). We tend to project our biased memories of past affective experience on the future, typically neglecting uncertainties and differences in conditions and being susceptible to suggestion (e.g. Wilson et al. 2000). For this reason, we frequently make misinformed choices, such as accepting a better paying job at a longer distance, which in the end makes us less happy because better pay does not compensate the happiness lost in commuting (Frey and Stutzer 2004).

In this respect, it is plausible that the view on our affective experience will be less biased if we monitor it systematically and can retrieve in writing how well we have felt in the past and how well we typically feel during specific activities. It is also plausible

that this will subsequently result in better informed choices when it comes to decisions in which happiness is at stake and that a better view on one's happiness will therefore tend to result in a higher level of happiness in the long term.

Limited View on how Happy one Could Be, Given one's Situation Next to a better view on how happy one feels personally, we can profit from more accurate information on how our own happiness compares to the happiness of other people, similar people in particular. If these other people are typically unhappy, there is apparently little chance for you to be happy and you would do better not to sink energy into the pursuit of happiness; at least not in a real-world context. Pursuing happiness makes more sense if a satisfying life appears to be possible in your situation.

It is not easy to assess how much happiness is realistically possible for you. We are bombarded with misleading information in the media, in advertisement in particular. Information based on scientific happiness research is less abundant and concerns mostly the general population, while what you need to know is how happy people like you typically are. Good talks with intimates may provide you with information on this, but there are limits to openness and to the size of one's circle of intimates. Anonymous reports of a greater number of similar people are therefore helpful.

A further, more common-sense, insight underlying the Happiness Indicator is that we can learn from each other and typically do. If you appear to be less happy than otherwise comparable people are, and want to improve, it is worth knowing what these people do differently. One of the most palpable things in that context is how these people usually spend their time, such as how much of the day they spend with others or alone, how long they commute and how many hours they sleep. It is also of interest to know how otherwise comparable people feel during particular activities. If they feel less miserable when the alarm clock goes off or if they enjoy diner more than you do, this provides you with clues in your search for a more satisfying way of life.

Limited View on Effects of Behavioral Change Bias in affective recall makes it difficult to grasp the effect of behavioral changes on one's happiness. For instance, when you go to a gym, you are probably well aware of how you feel right after leaving the gym, but may have little awareness of how daily exercise has affected your average mood in the last month. Systematic mood monitoring makes such small and delayed effects more visible.

The idea behind the Happiness Indicator is that accurate and tailored information will be helpful in the pursuit of happiness. As such, it fits a wider plea for 'informed pursuit of happiness' (Veenhoven 2015). The emphasis is more on *fact finding* than on *soul searching*. Contrary to mainstream happiness advice, the Happiness Indicator does not give generic recipes, such as 'count your blessings', but aims to help you find what works for you in particular. This approach will not fit everybody, since it requires an ability to digest complex information, think at how this applies to you and to behave accordingly.

2.3 Related Self-Monitoring Techniques

Self-*monitoring* is a common psychological process, which can be facilitated using modern electronic self-*tracking* techniques. E-tracking techniques are now often used

in health care, for example for controlling weight and drinking and in clinical psychology (e.g. Faurholt-Jepsen et al. 2016). Electronic self-tracking is part of the 'Quantified Self' movement[9] (e.g. Neff and Natus 2016) also called 'life-logging'. The aim is mostly to help people achieve particular behavioral changes, whereas the Happiness Indicator rather helps people to find out *what* to change. The use of these techniques has increased considerably since self-tracking tools became available on mobile phones and other wearable electronic devices. Though mostly welcomed, these practices are also criticized (e.g. Lipton 2016).

An example of self-monitoring techniques used for raising happiness is the forecasting system 'Emotical', which uses past mood data to model and visualize future user moods with the aim of improving mood control (Hollis et al. 2017).

2.4 Difference with Other Approaches in Positive Psychology

As noted above in sub-section 1.3.2, the focus of the Happiness Indicator is on how happy one feels most of the time. As earlier noted in section 1.2, this is called 'hedonic happiness' in Positive Psychology and distinguished from 'eudaimonic happiness', which is the more central concept in this tradition.

Focus on Feeling The Happiness Indicator addresses how happy one feels, in other words, how pleasant or unpleasant one's mood is most of the time. In the academic literature on subjective well-being, this is referred to as the 'affective component' of happiness and is distinguished from the 'cognitive component', the more rational assessment of the extent to which life brings what one wants it to bring (Veenhoven 1984: Section 2.2). This difference is not is not always made in Positive Psychology and several interventions focus implicitly in the cognitive component, such as in the case of cognitive reframing. Research has shown that the affective component dominates in the overall evaluation of life (Kainulainen et al. 2018) and that the effect of happiness on health mainly takes place via the affective component (Veenhoven 2009). This is one of the reasons, why the Happiness Indicator focusses on the affective component of happiness.

Focus on Facts As well as having a difference in *object* from common practice in Positive Psychology, the Happiness Indicator uses a different *approach* to advancing an individual's happiness. The Happiness Indicator is aimed specifically at providing a better view on the facts of one's happiness, assuming that this will enable more informed life-choices. Positive Psychology interventions cover a much broader range of mental changes, such taking another view on one's self and practicing new behaviors.

2.5 Long-Term Objectives of the Happiness Indicator

In the long-term, the Happiness Indicator is expected to generate information that will be used in happiness education.

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[9] https://en.wikipedia.org/wiki/Quantified_Self

One such kind of information is how changes in daily behavior have worked out on the happiness of its users, for instance, whether doing more physical exercise has added to the happiness of the average participants and to what extent that effect differed across kinds of participants. Information of this kind will be published on the website. Likewise, the Happiness Indicator will generate information about long-term effects on happiness of major life choices, such as having children or early retirement. Often, individuals do not know how these life choices will turn out; consequently, it is helpful to know how similar people who have made a similar choice in the past have fared. Gathering this information requires that a large number of people continue to use the Happiness Indicator at least once a year. Of course, the willingness of participants to do so depends on the effect of participation in the short run.

Information about effects on happiness of life-style and of life-style change will be fed back to the participants, using e-mail messages and short reports on the website. The information will also be presented to public media, the life-style press in particular. Part of the information is expected to find its way into health education.

Still another application of the Happiness Indicator is to use it to assess the effects on happiness of interventions, such as medical or psychological treatment and organizational change. Follow-up is easy and control groups can be selected from the larger pool of participants. As we will see in section 5, using the Happiness Indicator is likely to be associated with an increase in happiness by itself, and this effect must be subtracted from the effect of the intervention evaluated. It is for this reason also worth knowing whether participants have become happier, and if so, by how much.

3 Method

3.1 Participants

Users of the Happiness Indicator were, and continue to be, recruited using various channels, including different types of customer communications from the health insurer VGZ, social media, i.e. Facebook, LinkedIn, Twitter and Dutch popular magazines, including 'Libelle' a women's magazine and the 'Psychologie Magazine' a popular science journal. Since its start in January 2011, the Happiness Indicator has attracted 40,495 participants all of whom completed a profile and the Happiness Comparer at least one time. Of these 40,495 participants, 9091 (22%) subsequently filled out the Happiness Diary at least once.

The average happiness of these visitors at the first time of participation was a 6.32 on scale 0–10, which is well below average life satisfaction scores reported in Dutch surveys[10]; 9 out of 20 people gave his or her monthly happiness a 6 or lower. This indicates that the Happiness Indicator particularly attracts individuals who are less happy than the average citizen is and probably for this reason they would like to work on their happiness.

Most of these individuals (86%) only participated once; therefore, we could not ascertain whether these users became happier because of using the Happiness Indicator.

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[10] Average response to the question "How happy would you say you are?" was 7,9 in the Dutch sample of the European Social Survey in 2014.

Consequently, we limited this study to examining the change in happiness for people who used the Happiness Indicator twice or more. A total of 5411 participants met this criterion. Those individuals used the Happiness Indicator for an average of 233 days, measured as the difference between the first day and last day of use, where there were on average 3 months between participations.

When comparing the one-time and returning participants, it appears that the returning participants were slightly less happy on their first visit (6.24 vs. 6.34), more likely to be female (78.0% vs. 73.7%) and older (e.g. of the returning participants 51.4% was between 40 and 60 years old vs. 43.4% for the one-time users. In addition, returning participants were more likely to have a chronic disease (32.8% in vs. 26.4%), to be richer (e.g. of the returning participants 38.4% had an income of more than 5000 euros per month compared to 30.7% of the one-time users), and higher-educated (e.g. of the returning participants 54.2% had a higher-vocational or university degree compared to 38.4% of the one-time users).

Frequency of Participation The participants in our sample completed the Happiness Comparer 2 to 35 times.[11] Each time, they had to indicate how happy they had felt over the past month. See Section 1.4.1. In addition, over 64% of the participants in our sample completed the Happiness Diary at least once. See Section 1.4.2. It is possible that the participants also used other tools on the website, such as the personality test or the questionnaire about how they experienced their jobs; however, the use of these tools was not taken into account in this analysis, given the limited number of participants that filled out these tests.

Personal Characteristics The average age of the participants was 45 years (SD = 14), and 78% of the participants were women. Regarding employment, 68% of the participants had a job, and the participants worked an average of 4 days (SD = 1.26) or 29 h a week (SD = 11.86). Over a quarter of the participants (28.9%) worked in health care institutions and welfare institutions, 13.8% worked in the business or financial sector, 13.4% worked in education, 9.5% worked for the government, 6.1% worked in retail, 4.9% worked in the cultural sector, 4.1% worked in the catering industry, 2.2% worked in the transportation sector, and 17.1% worked in other sectors. The participants' level of education varied: 34.1% of the participants had a higher vocational education (HBO in the Dutch school system), 23.0% had a university degree, 6.1% had a pre-university secondary education (VWO), 19% had a senior secondary vocational education (MBO), 11.7% had a preparatory secondary vocational education (VMBO), 7.5% had senior general secondary education (HAVO), and 2.7% had only attended a basic school. In terms of household income, 27.1% of the participants had a relatively low family income (€ 0–2499 per month), 34.5% had an average family income (€ 2500–4499 per month), and 38.4% had a relatively high family income on average (>€ 5000 per month). The participants' living situations also varied: 43.2% were single or divorced with no children living in the household, 27.9% of the participants cohabited with their partner and no children, 10.4% cohabited with their partner and had children,

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[11] Individuals falling within the top 1% for the number of times of participation (35 or more) were considered outliers and were excluded from our analysis.

2.7% were single parents with children, and 15.8% had some other living situation (e.g., a communal group, living with parents or student group housing).

It should be noted, that data collected online has some well-known limitations, one of which is representativeness of the sampling. However, given the goal of the Happiness Indicator, representativeness is not really a problem. The Happiness Indicator gathers information *on* particular people *for* particular people, in this case mainly *on* and *for* well-educated women, interested in getting happier than they are. Representativeness for the general population is therefore not necessary. This point is discussed in more detail in section 5.8.

3.2 Descriptive Statistics

The means, standard deviations and inter-correlations of the variables used in this study are presented on Table 1. These descriptive statistics are based on 13.320 data-points provided by 5.411 participants.

Inspection of the means shows that average happiness 'today' (6.89) is somewhat higher than retrospective happiness over the last month (6.61). This may mean that participants are more inclined to use the Happiness Indicator on good days and/or that they underestimated their happiness over the last month. A possible reason for such under-estimation is that memories of affective experience fade, making way to more evaluative cues.

3.3 Analysis

In this study, we focused on the feeling of happiness in the past month, as measured using the second question shown in Fig. 1. The research question was whether happiness in the past month is related to the repeated use of the Happiness Comparer and the Happiness Diary. As a first test, we assessed whether a participant's happiness had changed between their first and their last use of the Happiness Indicator, and, if so, by how many points to the positive or negative. As a next step, we utilized a dynamic panel data model taken from econometrics, which allowed a better estimate of the size and significance of the changes. The statistical techniques used will be unfamiliar for many readers of this journal but we deem the advantages worthwhile and interested

Table 1 Descriptive statistics and correlation matrix of most important variables in the analysis

	Mean	SD	1	2	3	4	5	6	7
1. Happiness Last Month	6.61	1.68	1.00						
2. Happiness Today	6.89	1.64	0.64	1.00					
3. Times Comparer Used	4.29	5.44	0.10	0.07	1.00				
4. Times Diary Used	2.91	5.60	0.11	0.07	0.68	1.00			
5. Number of Days Participating	93.31	198.3	0.04	0.04	0.24	0.01	1.00		
6. Days since Last Participation	90.24	177.4	−0.01	0.01	−0.15	−0.14	0.68	1.00	
7. Change Happiness Last Month	0.09	1.48	0.41	0.20	−0.03	−0.02	−0.03	−0.01	1.00

readers can consult the references we provide. In its most elementary form, the model can be considered a linear regression in which we have multiple observations per individual over time and to which we add participant dummy variables and time dummy variables. The following happiness model was estimated (see also DiTella et al. 2003; Arampatzi et al. 2015):

$$H_{it} = a_0 + a_1 H_{i(t-1)} + a_2 P_{i(t-1)} + a_3 X_{i(t)} + \mu_i + \varphi_t + \varepsilon_{it},$$

where H is the self-reported happiness over the past month, at participation time t; P is a set of variables capturing the number of times the participant has used the Happiness Comparer and the Happiness Diary[12]; X is a set of control variables capturing happiness that day, the number of days the participant has already used the Happiness Indicator, and the number of days since the last use; μ_i is a vector of participant fixed effects to control for time-invariant participant characteristics, such as gender, marital status, income, and level of education; and φ_t is a vector of month and year dummies to capture time-related circumstances, such as the weather and economic situation. The lagged dependent variable $H_{i(t-1)}$ is included to allow for adjustment dynamics and to partly tackle serial correlation and decrease the likelihood of omitted variable bias.

In our model, we acknowledged that there is interdependence between the Happiness Comparer use and Happiness Diary use variables. To measure how large these influences might be, three versions of the model were estimated: version (i) only included the use of the Happiness Comparer variable; version (ii) only included the use of the Happiness Diary variable; and version (iii) included both variables. We prefer the third specification, because it allowed us to capture the "direct" associations of the Happiness Comparer and Happiness Diary use variables with happiness.

Please note that we use a *within-person* design; where we look at variation in happiness within persons across days the Happiness Indicator was used and not between persons. By focusing on within-person differences we avoid the limitations inherent to common analysis of between-person differences, such as differences in set points between people (Lykken and Tellegen 1996) and differences in unobserved personality traits (Lucas and Fujita 2000).

Although we attempt to deal with endogeneity using lagged dependent variables, the serial correlation present in the data prevents us from drawing causal inferences and our results should be interpreted as conditional associations, rather than causal relationships.

4 Results

An overview of the observed changes in last-month happiness following use of the Happiness Diary is presented in Fig. 7.

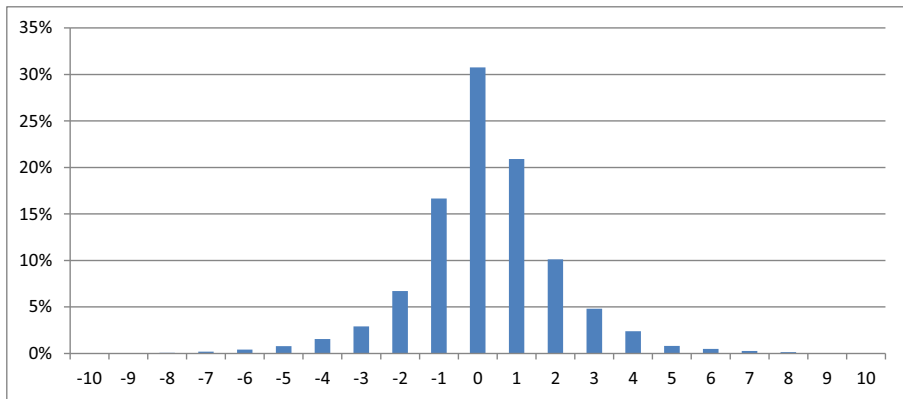[12] Please note that our Happiness Diary variable is Winsorized at the 1% level.

Fig. 7 Change in Happiness Last Month between First and Last Use of the Happiness Diary

Table 2 Determinants of Happiness Last Month – Fixed Effects Estimation

	(1) Only Control Variables	(2) + Happiness Comparer	(3) + Happiness Diary	(4) Full Model	(5) + No diary use Effect
Times Happiness Comparer Used $_{t-1}$		0.008		−0.001	0.001
		(0.005)		(0.007)	(0.008)
Times Happiness Comparer Used $_{t-1}$ x No Diary Used					−0.010
					(0.012)
Times Happiness Diary Used $_{t-1}$			0.013***	0.014**	0.012*
			(0.005)	(0.007)	(0.007)
Happiness Last Month $_{t-1}$	0.024	0.023	0.022	0.022	0.022
	(0.020)	(0.020)	(0.019)	(0.020)	(0.020)
Days Using Happiness Indicator (×100)	0.156	0.126	0.119	0.121	0.123
	(0.146)	(0.149)	(0.148)	(0.150)	(0.149)
Days Since Last Use (×100)	−0.020	−0.012	−0.012	−0.013	−0.014
	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)
Happiness Today	0.314***	0.314***	0.314***	0.314***	0.314***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Respondent FE	Yes	Yes	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	13,320	13,320	13,320	13,320	13,320
Number of Respondents	5411	5411	5411	5411	5411
Within R-Square	0.15	0.15	0.15	0.15	0.15
Between R-Square	0.26	0.29	0.30	0.29	0.29
Overall R-Square	0.27	0.29	0.30	0.29	0.29

Cluster-robust standard errors in parentheses ***$p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

4.1 Happiness Is Changeable

First, we examined whether individual happiness fluctuates over time. This was found to be the case. From Fig. 7, it can be seen that among the users of the Happiness Diary, only some 30% remained evenly happy and some 20% experience changes of 2 points or more. The average monthly change was 0.09 point on scale 0–10, that is, about 1% of the possible range.

At first sight, this small change supports the 'set point' theory, which holds that happiness is a stable 'trait' (e.g. Cummins 2010). Yet, cumulated over time such minor monthly changes can result in substantial alterations of happiness, such as these demonstrated in long-term follow-up studies, see for example Headey (2008).

4.2 Happiness Increases Following Repeated Use of the Happiness Indicator

We considered whether individuals experienced an increase in monthly happiness following the use of the Happiness Indicator. As we can see from Fig. 7, there was more change to the positive than to the negative. This is confirmed using the econometric analysis reported in Table 2. In that analysis, all models were estimated using fixed-effects estimators and cluster robust standard errors. Of the control variables included in the model (Table 1, Column 1), only happiness that day was statistically significant ($b = 0.314$, $SE = 0.016$, $p < 0.01$). Surprisingly, we did not find an effect of monthly happiness in the previous period (t-1) on happiness of last month in the current time period. It should be noted, however, that this effect might be confounded by individual fixed effects and the Nickell bias induced by fixed-effects estimation. This is further explored below.

4.2.1 No Significant Increase after Use of the Happiness Comparer

We examined whether there was an association between repeated use of the Happiness Comparer and an increase in monthly happiness over time. We observed a positive but non-significant relationship ($b = 0.008$, $SE = 0.005$, $p = 0.113$; Table 2, Column 2).

4.2.2 Significant Increase Following Use of the Happiness Diary

We found a significant positive relationship between Happiness Diary use and happiness ($b = 0.013$, $SE = 0.005$, $p < 0.01$; Table 1, Column 3), even when controlling for use of the Happiness Comparer ($b = 0.014$, $SE = 0.007$, $p < 0.05$; Table 2, Column 4).

How large is this effect? Using the Happiness Diary ten times is associated with a monthly happiness of approximately 0.14 points on a 0 to 10 scale when all other factors are held constant. However, less than 4% of the respondents completed the diary 10 times or more, and the average use was only 2.4 times.

In addition, we found that the Happiness Comparer and Happiness Diary cannot be considered as substitutes in terms of their contribution to well-being. The participants who only used the Happiness Comparer and not the Happiness Diary did not profit more from the Happiness Comparer than the participants who used both tools (Table 2, Column 5).

Table 3 Determinants of Happiness Last Month – Fixed Effects Estimation – Squared Terms

	(1) Squared Term Happiness Comparer	(2) Squared Term Happiness Diary	(3) Full Specification
Times Happiness Comparer Used $_{t-1}$	0.026**	0.000	0.021*
	(0.012)	(0.007)	(0.013)
Times Happiness Comparer Used $_{t-1}$ Squared	−0.001***		−0.001***
	(0.000)		(0.000)
Times Happiness Diary Used $_{t-1}$	0.011*	0.033***	0.020
	(0.006)	(0.011)	(0.013)
Times Happiness Diary Used $_{t-1}$ Squared		−0.001**	−0.000
		(0.000)	(0.000)
Happiness Last Month $_{t-1}$	0.019	0.020	0.019
	(0.019)	(0.019)	(0.019)
Days Using Happiness Indicator (×100)	0.101	0.108	0.100
	(0.149)	(0.149)	(0.149)
Days Since Last Use (×100)	−0.009	−0.010	−0.008
	(0.015)	(0.015)	(0.015)
Happiness Today	0.313***	0.314***	0.313***
	(0.016)	(0.016)	(0.016)
Respondent FE	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes
Observations	13,320	13,320	13,320
Number of Respondents	5411	5411	5411
Within R-Square	0.15	0.15	0.15
Between R-Square	0.31	0.30	0.31
Overall R-Square	0.30	0.30	0.30

Cluster-robust standard errors in parentheses ***$p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

We found decreasing marginal benefits of using the Happiness Comparer and Happiness Diary. In other words, the increase in happiness associated with the use of the Happiness Indicator decreases slightly with increasing uses. These interaction effects are shown in Table 3. When participants first begin to use the Happiness Indicator, one additional use of the Happiness Comparer is associated with an increase in happiness in the last month by 0.025; however, after using the Happiness Comparer 20 times, the marginal benefits of use become negligible. See Table 3, Column 1.[13] Given that most of the participants only used the Happiness Comparer a few times, it can be tentatively concluded that happiness increased for participants who repeatedly used the Happiness Comparer, but typically by less than 1%. A similar observation can be made regarding the Happiness Diary (Table 3, Column 2), although the squared term becomes

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[13] Our results do not change when we exclude the variable 'Happiness Today', which reflect current mood. These results are available upon request.

insignificant when the squared terms of both the Happiness Comparer and Happiness Diary variables are entered into our model (Table 3, Column 3).

4.2.3 Nickell Bias, Reverse Causality and Selection Bias

One potential problem with the fixed-effects estimation presented above is that the presence of a lagged[14] endogenous variable in the model induces autocorrelation. Nickell (1981) has indicated that in this context, fixed-effects estimates tend to be downward biased, and the use of this technique typically results in an underestimation of the coefficient of the lagged dependent variable. If the other independent variables in the model are correlated with the lagged dependent variable, their coefficients may also be biased. The Nickell bias is particularly pertinent when the time dimension of a panel is short and the number of individuals is large. Given that our sample is generally characterized by a large N (many individuals), a small T (limited number of time points), and a very small coefficient for our lagged dependent variable, the results described in the previous section might be biased.

We used the system 'Generalized Method of Moments' (GMM) developed by Arellano and Bover (1995) and Blundell and Bond (2000) to address this problem. The GMM addresses the issue by instrumenting the variables in the regressions with their lagged levels and lagged first differences.[15]

System GMM estimation has two additional advantages. First, using the lagged levels and lagged first differences of the variables as internally generated instruments, system GMM addresses the issue of reverse causality, in which individuals who have the idea that the Happiness Indicator tool works for them are more likely to use the Happiness Indicator. In other words, differences in the change in average monthly happiness, measured as the change in happiness between first and last use of the Happiness Indicator, between frequent and infrequent users can be contingent on characteristics that affected whether or not an individual used the Happiness Indicator frequently. In this regard, Jiménez-Martín et al. (2014) have shown that results obtained from System GMM estimators are robust to this form of sample selection bias and often no bias correction is necessary. Second, the time-invariant individual characteristics in the fixed-effects estimation can be correlated with the other independent variables; GMM models address this problem by using a first-difference estimation.

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[14] Here, the lagged value of a variable is the value of a variable at the previous measurement point.

[15] Another solution would be to estimate the model using the first-differenced generalized method of moments (difference GMM), a technique developed by Arellano and Bond (1991). However, Bond et al. (2001) note that in many empirical applications, the performance of difference GMM is disappointing, and the estimates of difference GMM are often implausible because the lagged levels are often poor instruments for first differences. Hence, this technique was not used in this study.

Table 4. Determinants of Happiness Last Month – System GMM Estimation

	(1) Baseline Specification	(2) Squared Term Happiness Comparer	(3) Squared Term Happiness Diary	(4) Full Specification
Times Happiness Comparer Used $_{t-1}$	0.002	0.001	0.004	0.003
	(0.006)	(0.006)	(0.005)	(0.005)
Times Happiness Comparer Used $_{t-1}$ Squared		−0.000		−0.000
		(0.000)		(0.000)
Times Happiness Diary Used $_{t-1}$	0.015**	0.015**	0.017***	0.015**
	(0.007)	(0.007)	(0.006)	(0.006)
Times Happiness Diary Used $_{t-1}$ Squared			−0.001*	−0.000
			(0.000)	(0.000)
Happiness Last Month $_{t-1}$	0.140***	0.138***	0.142***	0.142***
	(0.024)	(0.024)	(0.024)	(0.024)
Days Using Happiness Indicator (×100)	0.029	0.024	0.005	0.009
	(0.022)	(0.023)	(0.023)	(0.023)
Days Since Last Use (×100)	−0.023	−0.017	−0.019	−0.016
	(0.020)	(0.021)	(0.020)	(0.021)
Happiness Today	0.454***	0.444***	0.440***	0.437***
	(0.048)	(0.048)	(0.046)	(0.047)
Respondent FE	Yes	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes	Yes
Observations	13,320	13,320	13,320	13,320
Number of Respondents	5411	5411	5411	5411
AR (2) test (*p* value)	0.07	0.07	0.06	0.06
Sargan test (p value)	0.54	0.52	0.88	0.87
Difference-in-Sargan test (*p* value)	1.00	1.00	1.00	1.00

Cluster-robust standard errors in parentheses ***p < 0.01, ** p < 0.05, * p < 0.10.

The results of our GMM estimation[16] are shown in Table 4 for the baseline specifications in Tables 2 and 3. System GMM use did not lead to different conclusions regarding the change in happiness following repeated Happiness Comparer and Happiness Diary.[17] Two differences regarding our fixed-effects estimations stand out. First, our fixed-effects estimation was subject to Nickell

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[16] In this estimation, we also allowed the independent variables to be endogenous.

[17] Please note that system GMM assumes that the internally generated instruments are exogenous (tested with the Sargan test) and that the error term was not serially correlated (tested with the AR2 test). In addition, there should be no correlation between the unobserved individual fixed effects and the instruments, a factor that can be tested with the difference-in-Sargan test. The test statistics, provided in Table 3, show that there were no problems.

bias in that the coefficient of the lagged endogenous variable became positive and significant. Second, the size of the main effect for Happiness Comparer use became much smaller, and we did not find evidence of decreasing marginal returns for the use of the Happiness Comparer. Hence, we concluded that only use of the Happiness Diary is substantially related to increases in happiness.

4.3 Larger Increase among those Who Initially Were the Least Happy

Further analysis of the use of the Happiness Diary indicated that the relationship between usage and happiness increase was larger for the participants who were less happy at the first use of the Happiness Indicator. This analysis is shown in Table 5. The participants who were initially the happiest experienced lower increases compared with the participants who were initially the least happy. Using the Happiness Comparer or the Happiness Diary 10 times was associated with a 0.3-point increase the happiness of the people who scored 4 on their first use, whereas on average, no relationship was found for people who were relatively happy (7 or higher) at the start. The coefficient of the interaction effect between the number of times the Happiness Diary was used and happiness at first use became insignificant when both interaction effects were entered into our model. Here, it should be noted that the zero-order correlations between happiness at the start and the number of times that the Happiness Comparer and Happiness Diary were used were very low (0.02). These results were confirmed when the models were re-estimated using system GMM.[18]

4.4 No Differences in Happiness Increases across Participant Types

We examined whether the increase in monthly happiness with repeated participation differed according to participant's background (with respect to differences in age, gender, income level, and education level). We found no evidence of heterogeneity across groups in the change in happiness following use of the Happiness Comparer or Happiness Diary.

5 Discussion

This first exploration of the changes in happiness following use of the Happiness Indicator confirmed our expectation that increased awareness of one's own happiness contributes to the likelihood of one finding a more satisfying way of life. This fits the results of three other studies on the effect of mood-tracking on, as we will show below in section 5.1.

   The observed rise in happiness can have other reasons than greater awareness of one's happiness. We will consider some alternative explanations for the gain in happiness in the sections 5.2 to 5.4. Since none of these appear to be very likely, we

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[18] Only 16% of the respondents filled out 2 or more diaries in the same month. We tested whether the effect of diary usage was dependent on the number of days between the diary usage, but did not find a statistically significant effect. These results are available upon request.

Table 5 Determinants of Happiness Last Month Fixed Effects and System GMM Estimation - Effect for Unhappy vs. Happy People at Start

	Fixed Effects			System GMM		
	(1) Interaction Term Happiness Comparer	(2) Interaction Term Happiness Diary	(3) Full Specification	(1) Interaction Term Happiness Comparer	(2) Interaction Term Happiness Diary	(3) Full Specification
Times Happiness Comparer Used $_{t-1}$	0.099***	0.000	0.090***	0.068***	0.004	0.081***
	(0.022)	(0.007)	(0.031)	(0.010)	(0.004)	(0.020)
Times Happiness Comparer Used $_{t-1}$ * Happiness Last Month at Start	−0.016*** (0.003)		−0.014*** (0.005)	−0.010*** (0.001)		−0.013*** (0.002)
Times Happiness Diary Used $_{t-1}$	0.016**	0.096***	0.028	0.013**	0.063***	0.001
	(0.007)	(0.019)	(0.028)	(0.005)	(0.011)	(0.028)
Times Happiness Diary Used $_{t-1}$ * Happiness Last Month at Start		−0.013*** (0.003)	−0.002 (0.004)		−0.009*** (0.002)	−0.002 (0.003)
Happiness Last Month $_{t-1}$	0.001	0.008	0.001	0.180***	0.209***	0.190
	(0.019)	(0.019)	(0.019)	(0.022)	(0.022)	(0.022)
Days Using Happiness Ind.(×100)	0.141	0.135	0.142	0.003	0.007	0.004
	(0.150)	(0.151)	(0.150)	(0.021)	(0.020)	(0.020)
Days Since Last Use (×100)	−0.013	−0.014	−0.013	−0.009	−0.006	−0.012
	(0.014)	(0.014)	(0.014)	(0.020)	(0.020)	(0.020)
Happiness Today	0.310***	0.311***	0.310***	0.712***	0.692***	0.675***
	(0.016)	(0.016)	(0.016)	(0.048)	(0.044)	(0.046)
Respondent FE	Yes	Yes	Yes	Yes	Yes	Yes
Month-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,320	13,320	13,320	13,320	13,320	13,320
Number of Respondents	5411	5411	5411	5411	5411	5411
Within R-Square	0.16	0.15	0.16			
Between R-Square	0.19	0.23	0.19			
Overall R-Square	0.18	0.22	0.18			
AR (2) test (p value)				0.12	0.06	0.08
Sargan test (p value)				0.24	0.05	0.09
Difference Sargan test (p value)				1.00	1.00	1.00

Cluster-robust standard errors in parentheses ***$p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

deem a causal effect of using the Happiness Indicator probable, though not definitively proven.

Next, we will consider the size of the observed gain in happiness among users of the Happiness Indicator. Is that size big or small, absolutely and relatively? (section 5.5). Will it appear to be larger in the long-run? (section 5.6). Does it differ among sub-groups of users? (section 5.7).

Then, we discuss further use of the Happiness Indicator. Is self-selection of participants a problem for utilization of this of instrument in the pursuit of happiness? (section 5.8). Can we do without the Happiness Comparer? (section 5.9). How can colleague investigators join the project? (section 5.10).

We close with some lines for further research in section 5.11.

5.1 Fit with Other Mood-Tracking Studies

Three other mood-tracking interventions have been tried, the results of which fit our findings fairly well.

The most alike is a study among university students in Germany by Ludwigs et al. (2018), which used a variant of our Happiness Indicator in a mobile phone application. Change in happiness before and after a 4-week daily mood-tracking was assessed and compared with change of happiness in a control group that only rated their happiness twice on several measures. Rises in happiness of 1 to 4% were found in both, but no difference between the experimental and the control group. The former finding fits ours, the latter not, but the non-difference in gain of happiness between the experimental group and the control group may be due to the awareness raised in the control group by the baseline administration of 5 questionnaires on happiness, which involved the answering of 27 questions.

Moodscope (2019) is an online mood-tracking system on which users record their daily mood. Scores are automatically tracked on a graph, and, with the users' agreement, e-mailed each day to one or more trusted friends who have agreed to keep an eye on the user. Follow-ups over 90 and 180 days of frequent users (5 days or more per week) showed a gain in happiness of about 20%. This rise in happiness was only slightly higher among users who had their trusted friends e-mailed, so the main driver of the change seems to be in the mood-tracking, which fits our results.

Conner and Reid (2012) did a mood-tracking experiment among young people who recorded their mood 1 to 6 times a day during 2 weeks. They found a rise in happiness following frequent mood-recording (6 times a day) among participants low in depression and neuroticism and a similar sized decline among participants high in depression and neuroticism, the size of the changes being 2 to 3% of the scale range. No such effects appeared among participants who recorded their mood only once a day. These results fit our finding of a greater gain in happiness among the most frequent users of the Happiness Indicator and our idea that this tool requires good mental health (cf. section 2.2).

5.2 Causal Effect?

Our data do not fit strict requirements for causal inference: no randomization and no control group. Hence, we cannot conclude that the observed gain in happiness among uses of the Happiness Indicator was caused by their participation, and neither that increased awareness of one's happiness was the mediator. If not caused by use of the Happiness Indicator, the observed gain in happiness must have other reasons, some of which we will check below.

5.2.1 Spontaneous Recovery from a Temporary Dip?

Happiness Indicator participants are probably occupied with their own happiness to an above-average degree. Would these people have become happier without using the Happiness Indicator? We are familiar with the 'waiting room effect' described in psychotherapy.[19] A part of that effect is seen in spontaneous healing and another part in sharper problem awareness, i.e. there is something wrong with me, and consequent coping. In our case, the problem lies not in sharper awareness, because that is what the Happiness Indicator aims to promote, but in spontaneous recovery, in this case, overcoming a dip in happiness, one that one would have overcome anyway.

Difference with Observed Increases in Control Groups in Effect Studies of Happiness Trainings In effect studies, this possibility of spontaneous improvement is commonly handled using 'control groups', typically randomly assigning a part of the applicants to a waiting list or a placebo treatment. The Happiness Indicator does not have such a control group, but we can learn from other studies.

We looked for earlier studies among self-selected participants in wellbeing trainings that involved a control group in which change in happiness was assessed and we subjected these findings to a mini meta-analysis. We used the Bibliography of Happiness,[20] which lists some 90 studies on the effects on happiness of individual level interventions on wellbeing, of which 10 were among self-selected participants and had a control group.[21] The observed changes in happiness among these controls are reported in Table 6.

The changes are typically small and mostly negative, the average decline of happiness in these control groups is 3,8% of the possible scale ranges. An explanation is that through panel conditioning people report lower happiness scores the longer they participate in a panel (Van Landeghem 2014; see also section 5.2.2). An alternative explanation is that no treatment results in a further decline in happiness of people who need it; if spontaneous recovery exists at all, it is apparently an exception rather than the rule.

This indicates that the observed rise in happiness following use of the Happiness Indicator is underestimated. Above in Table 2, we have seen that each use of the Happiness Diary was associated with a 0,14% raise in happiness, which with an average use of 2,4 times gives a mean gain of 0,34%, but when accounting for the prevented decline in happiness of 3,8%, the actual increase was about 4%.

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[19] Waiting for treatment often appears to be conducive to spontaneous healing.

[20] Bibliography of Happiness, section 'Pursuit of Happiness', subsection 'Interventions at the Individual level', sub-sub-section 'Happiness trainings. The selection of studies included in the Bibliography of Happiness is explained in the Introductory Text on that website.

[21] We did not consider studies that rewarded participants with money or course credits

Table 6 Observed changes in happiness in the control group of studies among self-selected participants in trainings for greater wellbeing

Intervention	Control condition	Measure of happiness	Change happiness in % possible range	Time	Study
Acts of kindness	No intervention	SWLS	–1,2%	10 days	Buchanan and Bardi 2010:236
Positive event recall	Randomly assigned to neutral	SHS	–14.3%	10 weeks	Chancellor et al. 2015:881
Well-being training	Waiting list	Single questions: 'How happy are you right now?'	–13,5%	11 weeks	Feicht et al. 2013: 7
		'How satisfied are you right now?'	–7,6%		
Meditation training	Waiting list	mDES	–3,7%	6 weeks	Fredrickson et al. 2008: 27
Strengths training	Placebo exercise	AHI	+3,2%	6 months	Gander et al. 2013: Table 2
Irrational beliefs discussion	Waiting list	Affectometer 1	0,0%	6 weeks	Lichter et al. 1980: 60
Well-being website	Placebo treatment	PWI-A	–1,8%	3 months	Mitchell et al. 2009: 752
		SWLS	+1,6%		
		PANAS	–0,0%		
		OTH-Pleasure	–2,0%		
Employee wellbeing	No intervention	SWB	–13,2%	6 weeks	Page and Vella-Brodrick 2013: 1017
Strengths training	Waiting list	SWLS	0,0%	10–14 weeks	Proyer et al. 2013: 283
Mindfulness training	Waiting list	SWLS	–0,3%	8 weeks	Shapiro et al. 2005: 171
Average			**–3,8%**		

Difference in Increases between Participants Who Used and Did Not Use Happiness Diary Another way to assess whether the observed gain in happiness was caused by greater awareness of one's happiness, is to compare the increases made by participants who used only the Happiness Comparer with the increases in happiness made by participants who also used the Happiness Diary. The latter group spend more time monitoring their happiness and are thus likely to become more aware of how well they feel. Indeed, we found use of the Happiness Diary affected happiness more, than use of the Happiness Comparer did (cf. section 4.2) and we also found a stronger increase in happiness, the more often the Happiness Diary was used (cf. Table 3).

5.2.2 Response Shift?

It is conceivable that repeated use of the Happiness Indicator has led the participants to score themselves higher on the happiness scale, even though their happiness remained unchanged. In the literature, this is known as a 'response shift'. Previous longitudinal research into happiness has shown a reverse pattern; happiness was estimated to be lower at the second measurement, apparently because respondents had formed a clearer picture of what happiness is for them (e.g. Van Landeghem 2014). Thus, if response shift is involved at all, it is more likely to repress the happiness rating and thus under-estimate the change in happiness following use of the Happiness Indicator rather than over-estimate it.

5.2.3 Placebo Effect?

Still another possibility is that use of the Happiness Indicator has boosted happiness by having mere belief in its effectiveness and possibly also by the idea of taking control of one's life. If so, this should apply both to the use of the Happiness Comparer and the Happiness Diary and could at best explain the small non-significant gain in happiness using the Happiness Comparer, but not the greater significant gain following use of the Happiness Diary. Another reason, to doubt that the observed gain in happiness following use of the Happiness Indicator is a mere placebo effect, is found in the results of studies on the effect of other happiness trainings that did involve a control group. In their review of 57 such studies Bergsma et al. (2020) found typically greater gains in happiness in experimental groups than in control-group, the average difference being 3,9% of the scale ranges.

5.2.4 Self-Selection Bias?

This study was done among returning visitors to the Happiness Indicator website, not among a representative sample of the general population in The Netherlands. So, we deal with change in happiness among self-selected users of this self-help website. Above in section 5.2.1, we discussed the possibility that these people would have become happier anyway because of spontaneous recovery, which appeared be unlikely.

A related issue is that participants can freely select into further participation, where participants who expect that the Happiness Indicator treatment will be

ineffective in the longer run are more likely to quit earlier. Following this line of argumentation, we might expect a positivity bias. Above in section 4.3 we dealt with this issue by estimating a System GMM estimator, which also accounts for reverse causality and try to isolate the relationship that runs from participation to happiness.[22] As Jiménez-Martín et al. (2014) have shown that estimates obtained from this method are relatively robust to this form of sample selection bias, we do not see this a major problem for our study.

An alternative study design to examine the effect of the Happiness Indicator is to first collect a first round of happiness data and then randomly assign half the sample to treatment (i.e. to use the Happiness Indicator), while keeping the other half as control. This is on our list for future research (cf. section 5.11).

5.3 Causal Paths

As noted in Section 1.3, we assume that a clearer view of their own happiness helps individuals find a more suitable lifestyle, which subsequently results in increased happiness. In this analysis, we cannot show that the observed effect followed the path of daily lifestyle adjustment. Further analysis of shifts in time allocation (see e.g. Knabe et al., 2013; Hendriks et al. 2014 for similar approaches) will provide more insight into this effect.

It is possible that other causal mechanisms are involved, such as greater acceptance of their current way of life by participants who see that they are better off than people in similar situations are.

5.4 Negative Effects?

It is claimed that the pursuit of happiness can be self-defeating, e.g. by Mauss et al. (2011) and Schooler et al. (2003). The use of the Happiness Indicator for this purpose can therefore result in a loss of happiness. If so, such losses will have lowered the observed average gain in happiness.

The question is whether this happened among our participants. Inspection of the data does show cases of declining happiness. For our complete sample, we saw that for 29% of the participants there was a decline in happiness between the first and last use of the Happiness Indicator. At the same time, we observed no change in happiness for 31% of the participants and an increase in happiness for 40%. See Fig. 7. Negative effects did occur in this selection of repeated users, but those affected negatively are outnumbered by the respondents who gained happiness in the period of using the Happiness Indicator. Possibly, some one-time users became less happy after use and discontinued use for that reason.

The existence of negative effects on happiness is not surprising, it will be unpleasant to realize than one feels unhappy most of the time, in particular if shown that comparable people take more pleasure in their lives. Though this may be a bitter pill

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[22] However, ultimately, this model cannot determine causality, so the results should be interpreted as conditional associations, not causal relationships

to swallow in the beginning, it is likely to make one feel better later. This long-term effect is another point to consider.

5.5 Sleeper Effect?

In this study, the average difference between the first and the last use of the Happiness Indicator was 233 days, which means that we have observed the short-term effects of using this self-help tool. The long-term effects on happiness could be greater, in particular if gains a greater awareness of one's happiness leads to major life-choices, such as taking another job or divorcing. Such decisions come with considerable delay, and so do the effects on happiness, which often are negative in the beginning.

The Happiness Indicator is an ongoing project, and we hope to learn more about this topic in future analyses.

5.6 Variation in Effect

In section 3.3, we reported that the gain in happiness following use of the Happiness Indicator does not differ greatly according to socio-demographic background, however, this does not mean that there are no differences at all.

It is possible that the effect differs according to psychological characteristics, such as personality. Above in section 5.1 we saw a decline in happiness among frequent users in poor mental health. Likewise, previous diary research in the work context shows that (a) extraverted participants become (even) happier on a daily basis when they spend time on social and rewarding activities (Oerlemans and Bakker 2013, 2014a, b); (b) participants who score high on burnout become happier daily as a result of social activities and relaxation (Oerlemans et al. 2014), and (c) participants who score high on work addiction become more vital and recover better when they exercise (Bakker et al. 2013).

As noted in section 3.3, relatively unhappy participants, i.e. participants with an average score below 7, benefit more from repeated participation in the Happiness Indicator compared with participants with a relatively high initial score for monthly happiness, i.e. participants that a 7 or higher. An evident explanation is that unhappy people are more motivated to change their way of life. However, when unhappiness is due to poor mental health this medicine may be worse than the disease.

5.7 Size of the Gain in Happiness

The observed gain in happiness following use of the Happiness Indicator can be considered from two perspectives, the absolute size of the gain and the size relative to observed effects of other happiness trainings.

5.7.1 Absolute Size Compared to Other Determinants of Happiness

The observed increase in happiness following use the Happiness Diary ranged between 0.14% and 1,4% depending on the number of times used, which with an average of 2,4 uses,

gives a mean gain of 0,34%. As noted above in section 5.2.1, use of the Happiness Indicator may have prevented a bigger decline of happiness in this group of people seeking to improve their happiness of 3,8%. Likewise, we noted in section 5.2.2 that a negative response shift may have underestimated the gain in happiness. Together, this means that the actual gain in happiness will be somewhere between 1% and 5%. Is this a lot or a little?

One way to answer this question is to calculate how much additional income is required to achieve the same happiness benefit. The use of a new method developed by Fujiwara et al. (2014) indicates that a 1% increase in happiness equals an increase in annual income of € 297,[23] so the 2% gain in happiness due to repeated use of the Happiness Diary is equivalent to an annual income increase of about € 600.

Another way of estimating the size of the gain is to compare with changes in happiness following real-life events. To that end, we scanned the research literature for observed changes in happiness following major life events over periods of about a year. The best comparable findings are presented in Fig. 8. The gain in happiness following use of the Happiness Diary appears to be stronger than the, surprisingly small, effect of winning a lottery and about a third of having one's first child. The size of the positive change after using the Happiness Diary appears to be similar to the size of the negative effect of getting injured in a traffic accident. In this comparative view, the advantage of using the Happiness Diary is substantial.

Although the effect of using the Happiness Indicator can still be considered modest, it is a relatively easy road to take in the pursuit of happiness.

5.7.2 Relative Size Compared to Effects of Other Happiness Trainings

Bergsma et al. (2020) did a research synthesis of 57 studies on the effect of using happiness trainings on hedonic happiness. The average rise in happiness at follow-up was 7,2%, which is higher than the 1 to 3% rise of happiness observed in this study, and even higher than the possible 5% gain when prevented decline of happiness and negative response shift are taken into account. Does this mean that the Happiness Indicator is less effective than its competitors? Not necessarily, since Bergsma et al. acknowledge that publication bias is likely to have inflated the result of their research synthesis.

As noted above in section 5.2.3, Bergsma et al. found an average difference with gains in control groups of 3,9%, which is in the range of our estimate of the gain in happiness following use of the Happiness Indicator for the Happiness Indicator between 1 and 5%.

5.8 Is Self-Selection a Problem for Application of the Happiness Indicator?

Users of the happiness Indicator participated voluntary and are likely to be predisposed to consider the use of self-help websites, because they are less happy or because of their attitude towards psychological trainings. The observed gain in happiness can therefore not be generalized to everybody.

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[23] The effect of extra income on happiness was assessed on the basis of a study of lottery winners in the UK, where a comparison was made between the increase in happiness of winners of small and medium-sized prizes. This calculation assumed the average income in the Netherlands.
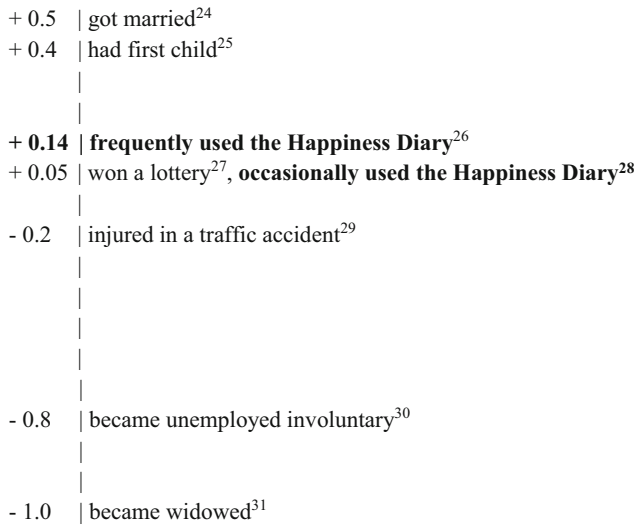
+ 0.5 | got married[24]
+ 0.4 | had first child[25]

         |

         |

+ 0.14 | frequently used the Happiness Diary[26]
+ 0.05 | won a lottery[27], **occasionally used the Happiness Diary[28]**

         |
- 0.2 | injured in a traffic accident[29]

         |

         |

         |

         |

         |
- 0.8 | became unemployed involuntary[30]

         |

         |
- 1.0 | became widowed[31]

Fig. 8 Changes in happiness following use of the Happiness Indicator and specific life events: Happiness, measured using a 0–10 scale

We do not see this form of self-selection as a problem. We do not aim to develop a tool that will make everybody happy. We aim to serve a particular public, that is, people interested in raising their happiness and intellectually able to handle this tool. As noted in section 2.1, frequent users of the Happiness Indicator were predominantly higher educated women. These people have much in common with members of a consumer association, who read a product test before buying that product. Like any medicine, the Happiness Indicator should not be prescribed for everybody. Possibly, there are more groups for which the Happiness Indicator will work and it is a task for future research to identify these kinds of people. See the last recommendation for further research below in section 5.11.

5.9 Implications for Further Application of the Happiness Indicator

The Happiness Indicator encompasses two main tools: The Happiness Comparer and the Happiness Diary (cf. Section 1.4). Our analysis has shown that the use of the Happiness Comparer was not followed by a significant increase of on happiness, but the use of the Happiness Diary was followed by a significant gain. Should we therefore omit the Happiness Comparer?

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[24] One year before vs. one year after. Stutzer and Frey (2006)

[25] One year before vs. one year after. Stutzer and Frey (2006)

[26] This study

[27] Winning vs. non-winning players. Kuhn et al. (2011)

[28] This study

[29] Victim in last 2 years vs. the average population. Brorsson et al. (1993)

[30] Lost job in the last year, due to plant closure or dismissal. Hetschko (2014)

[31] Lost spouse in the last year (women), Williams (2003)

It is possible that doing so would not harm the short-term aim of the project, namely, increasing the participants' happiness. However, eliminating the Happiness Comparer would interfere with the project's long-term aim of monitoring the effects of major life choices on happiness. Although it may not substantially contribute to the participants' happiness, the Happiness Comparer is still a useful tool for follow-up. It may also function as a stepping-stone to the use of the Happiness Diary.

5.10 Use of the Happiness Indicator by Colleagues

We welcome use of the Happiness Indicator technique by colleague researchers and practitioners. Now that the system has been developed, large-scale applications are possible at low cost. 'Satellite-projects' will run on the same server at Erasmus University. Variants tailored to specific interest can be made, provided that a set of core variables is maintained. Data will be added to a common pool, which all projects can use, among other things for comparison. For further information, please go to http://www.happinessindicator.com and click 'project' in the header.

5.11 Lines for Further Research

Availability of more cases over longer periods will allow a better view on the *causal mechanisms* behind the gain in happiness following use of the Happiness Indicator.

One of the things to be checked is whether a sleeper effect exists or not (cf. section 5.5). As the yearly reports of life-change become available, we can also get a view on the links of these changes with patterns in earlier reports on the Happiness Indicator and effects of these changes in happiness. Next to such indirect inference of the causal effects, we can analyze the reasons participants have provided for the reported changes in their way of life.

Another option to get a view on the causal process is to test whether use of the Happiness Indicator is indeed followed by greater awareness of one's happiness. One more thing to check is whether use of the additional tools, mentioned in section 2.1.3, were associated with an increase in the user's happiness. Last but not least, we can assess the effect experimentally, using a placebo control. A problem in that context is that the placebo must be credible and that we may deny the control group an effective treatment (cf. section 5.2.1).

Another line for further research is to chart *contingencies*; in what situations for what kinds of people is use of the Happiness Indicator most effective? We did not see much difference among the participants considered in this study, but more difference may appear when more data become available from other publics and in different nations.

Lastly, it is worth exploring the *negative effects* of using the Happiness Indicator. A first to do in that context is to take a closer look at the 29% users who became less happy.

6 Conclusions

Repeated use of the Happiness Comparer was followed by a gain in happiness that did not reach statistical significance, while use of the Happiness Dairy was followed by a significant rise of happiness, the size of which was 0,34% of the

scale range with an average use of 2.4 times, but could actually be about 5%. These observations fit our expectation that raising awareness of how happy one feels tends to raise happiness. Though this causal effect is likely to be involved, it is not yet definitively proven.

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