

**Memory-Experience Gap in Adolescents' Happiness Reports**

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## **Abstract**

Studies among adult populations show that estimates of how happy one has felt in the past tend to be more positive than average happiness as assessed using time-sampling techniques. This 'memory-experience gap' is attributed to cognitive biases, among which fading affect bias. In this paper we report a study among 352 pupils of a secondary school in the Netherlands. These youngsters reported subsequently: 1) how happy they had felt yesterday, 2) how happy they had felt during the last month, 3) what they had done the previous day and 4) how they had felt during each of these activities. Unlike earlier studies, the average rating of happiness in the last month appeared to be lower than average happiness of the previous day. In accordance with earlier research, the global rating of happiness during the previous day was higher than the average of reported affect during separate activities during that day. A further multilevel analysis suggest that in estimating how they have felt on the whole yesterday, youngsters overestimated short pleasant episodes and underestimated unpleasant episodes, especially when such episodes lasted long.

*Keywords:* Happiness measurement, Day Reconstruction Method (DRM), Adolescents, Retrospection

### **Research on happiness among adolescents**

Scientific interest in happiness has expanded greatly during the past decade: The World Database of Happiness contains over 6300 publications in its Bibliography of Happiness, to which some 400 titles are added each year (Veenhoven, 2011). Among those publications, the Bibliography of Happiness currently contains 149 publications on happiness of children and adolescents (e.g. Gilman & Huebner, 2003; Huebner, Drane & Valois, 2000; Huebner, Valois, Paxton & Drane, 2006; Lee, 2003).

### **Happiness**

Research has shown that happiness is not only an important indicator of mental health, but also a prerequisite for various positive outcomes, such as academic success, successful social relationships and health (e.g. Cohn, Fredrickson, Brown, Mikels, & Conway, 2009; Fredrickson, 2003; Lyubomirsky, King & Diener, 2005). In this paper, we define happiness as subjective enjoyment of life: The degree to which an individual judges the overall quality of his or her life-as-a-whole favorably (Veenhoven, 1984; 2009).

In order to assess overall quality of their lives, people typically rely on two different types of information: how well they feel most of the time and how well they meet common standards of the good life. Thus, overall happiness draws on two sub-appraisals, which Veenhoven (2009) refers to as 'components' of happiness: an affective component called 'hedonic level of affect', and a cognitive component called 'contentment'. *Hedonic level of affect* is the degree to which positive emotional experience outweighs negative ones. *Contentment* is the degree to which one perceives to get what one want in life and draws heavily on both intraindividual and interindividual comparison (Pavot & Diener, 2008).

This distinction is particularly relevant for children and early adolescents who have not yet developed clear cognitive standards of the good life (Dahl, 2004; Yurgelun-Todd,

2007). Thus, when examining how happy a child or an early adolescent is, we should aim at how he or she feels (Ciarrochi, Heaven, & Supavadeeprasit, 2008). Unfortunately, happiness studies among children most often use cognitive measures (e.g. Gilman, Huebner, & Laughlin, 2000; Huebner, 2004; Zullig, Valois, Huebner, & Drane, 2005).

Although cognitive measures have shown to yield useful information, they are associated with several specific limitations. As Gilman and Huebner (2000) present, existing life satisfaction scales for adolescents meet the standards for research only when less rigid psychometric standards are applied. Moreover, among adolescents, question on global life satisfaction may also be vulnerable for social desirability bias and impression management because of greater conformity to peer group pressure (Gilman & Huebner, 2000).

### **Retrospective and Real-Time Happiness Assessment**

Contentment is typically assessed using global questions such as: "On the whole, my life is close to how I would like it to be. Please rate the degree to which you agree with this sentence ranging from strongly disagree (1) strongly agree (5)". The ability to answer such questions requires retrospection on what one wants and what one has (Pavot & Diener, 2008).

Retrospective types of assessments are the simplest and easiest to conduct; however, previous research on adult population questions their validity to some extent (Kahneman & Krueger, 2006; Robinson & Clore, 2002; Schwartz, Kahneman & Xu, 2009; Stone et al., 2006). Specifically, in order to answer such questions, we need to use complex cognitive activities: evaluation of past and future experiences, as well as the estimation of the average quality of life (Stone et al., 2006; Veenhoven, 2000). In turn, retrospective happiness reports are susceptible to various biases (Kahneman & Krueger, 2006; Krueger & Schkade, 2008; Robinson & Clore, 2002).

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Hedonic level of affect can be measured in two ways. One way is to use global assessments, such as a common question: "On the whole, how do you feel most of the time? Please choose your answer on a scale from bad (1) to good (5)". Answering this question also requires retrospection. Another way is to use real-time multi-moment assessment, such as the experience sampling method or diary methodology, which do not require retrospection, and as such, are less susceptible to various biases (Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004; Scollon, Kim-Prieto & Diener, 2009).

### **Memory-Experience Gap**

Growing research evidence documents incongruence between people's concurrent and retrospective reports of emotional experience (Schwarz, Xu & Kahneman, 2009). For instance, two studies among 1415 adult females showed that the overall daily ratings of affect are significantly higher than those based on episodic multi-moment assessments captured via the day reconstruction method (Miron-Shatz, Stone & Kahneman, 2009). The difference between average of episodic affective states and the retrospective evaluation of affective experience has been recently conceptualized as the memory-experience gap (Miron-Shatz, et al., 2009).

The memory-experience gap has been shown in different aspects of peoples' emotional experiences, such as coping (Todd, Tennen, Carney, & Armeli, 2004;), vacations (Kemp, Burt, & Furneaux, 2008; Wirtz, Kruger, Scollon, & Diener, 2003), and pain (Redelmeier, Katz, & Kahneman, 2003; Stone & Broderick, 2007). Thus, we assume the same pattern of retrospective overestimation of affective experiences will be present in happiness reports among adolescents.

Altogether, it seems that the common global assessment of happiness might not be the best choice of happiness measurement (Kahneman & Krueger, 2006). In contrast, episodic (multi-moment) assessments, such as experience sampling method and the day

reconstruction method, might provide more accurate insights into one's happiness levels. Nevertheless, assessments of happiness among adolescents mostly relied on retrospective assessments. Episodic (multi-moment) assessments of emotions among adolescents have been used in only a few studies (e.g. Larson, Moneta, Richards and Wilson, 2002; Lee, 2003; Silk, Steinberg and Morris, 2003). Hence, the memory-experience gap for happiness reports has not yet been examined for adolescent population as yet and consequently we may overestimate the level of happiness among these youngsters when we use cognitive retrospective measures.

### **The Present Study**

The central aim of this study is to examine the memory-experience gap for happiness reports among early adolescents using the day reconstruction approach (Kahneman, et al., 2004; Miron-Shatz, Stone, & Kahneman, 2009). Specifically, we examine the differences between retrospective overall estimate and episodic multi-moment assessments of happiness linked to specific daily activities adolescents were engaged in during the previous day. Moreover, we also examine the role of duration and the hedonic level of affect of those activities in explaining the memory-experience gap. We present our hypotheses below.

**Hypothesis 1.** There is a memory-experience gap in adolescents' happiness reports: when asked to rate how happy they felt yesterday in the overall, adolescents will give higher ratings than their averaged activity-based happiness report indicates.

Although previous studies show that memory-experience gap typically follows a trend where retrospective evaluation of affective experience is usually more positive than the averaged episodic emotions, there are also exceptions (Miron-Shatz, Stone, & Kahneman, 2009; Walker, Skowronski and Thompson, 2003). In other words, not every retrospective estimate is overestimation; there seem to be many cases of underestimation of

the hedonic affect level. One of the possible explanations of those variations can be found in the *fading affect bias* (Walker, Skowronski & Thompson, 2003).

Affective intensity fades with time; however, intensity of negative affective experiences fades much faster than intensity of positive affective experiences, and that effect is known as the fading affect bias (Suedfeld & Eich, 1995; Walker, Skowronski and Thompson, 2003; Walker, Vogl, & Thompson, 1997). For instance, several studies consistently demonstrate that people tend to perceive autobiographical events as more pleasant than unpleasant (e.g. (Thompson, Skowronski, Larsen, and Betz, 1996; Walker, Vogl & Thompson, 1997). Hence, it seems that our memory system has different strategies for negative and positive affect (Walker, Skowronski and Thompson, 2003).

Therefore, in this study we examine the role of pleasantness of affect (that is, the hedonic valence of affect) for the variations in the size of the memory-experience on a within-person level, using an episodic (multi-moment) happiness assessment-the day reconstruction method (DRM; Kahneman, et al, 2004). Based on previous findings on fading affect bias, we formulate our second hypothesis:

**Hypothesis 2.** The hedonic valence of affect related to each of the activities adolescents listed plays a substantial role in the memory experience gap: The less pleasant an activity is, the bigger the gap between retrospective overall and episodic rating.

Furthermore, previous findings indicate that the duration of affective states seems to play a small role in respondents' evaluations of their prior affective experiences (Ariely, 1998; Fredrickson & Kahneman, 1993; Kahneman et al., 1993). Hence, we also examine the role of the duration of affect related to specific daily activities in order to capture more fine grained processes that might explain the variance in the memory-experience gap, which is illustrated in the third hypothesis:

**Hypothesis 3.** The less time pupils spend on specific activity, the larger the memory-experience gap between the retrospective and episodic ratings of hedonic affect level.

In addition, we also look at whether the impact of the hedonic valence of affect on the memory-experience gap is contingent on the duration of the activities. In other words, we examine whether the duration of the activities moderates the relationship between the hedonic affect valence and memory-experience gap. Based on previous findings and theoretical considerations, we state our fourth and final hypothesis:

**Hypothesis 4.** The activity duration moderates the relationship between hedonic valence of affect experiences during that activity and the memory-experience gap: When the duration of the activity is long, less pleasant activities are related to bigger gap, whereas more pleasant activities are related to lower gap.

### METHOD

#### Participants

Participants were 352 Dutch pupils engaged in the project 'Lessons in Happiness' (Broerrefijn et al, 2008), from 12 secondary schools in The Netherlands. Participants age ranged from 12 to 15 years, with a mean age of 13.44 (SD=0.84). Furthermore, 172 of pupils are boys and 180 are girls. The pupils are ethnically diverse, as it is the case in Dutch society, with most of them (81.5%) reporting Dutch ethnicity, and 18.5% reporting Surinamese, Antilleans', Turkish, Moroccans or other ethnicity. The majority of pupils (77.9%) reported living with both of their parents, whereas 20.3% stated they live with one of their parents, and 1.8% stated other forms of living arrangements.

#### Procedure

All of the pupils filled out the questionnaire on-line on a weekday in classrooms at their school. First, they were asked to give two global ratings of how happy they had felt

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yesterday, and how happy they had felt during the past month. Next, they were asked to fill out an internet application 'Yesterday's Diary' (described in detail below) by Veenhoven (2009), designed especially for this study and based on the 'Day Reconstruction Method' (DRM, Kahneman et al., 2004).

Recent research shows that episodic measures of happiness, such as DRM, successfully tackle retrospective biases and, as such, provide more accurate measures of happiness (Kahneman et al, 2004). The day reconstruction method is specially designed to divide the day in chronologically ordered episodes (activities participants engaged in throughout the day), which fosters accurate recall and reduces retrospective bias. DRM combines elements of time-budget measurement and experience sampling; however, when compared to experience sampling method (ESM), DRM is easier to conduct, but it is still providing an assessment of continuous episodes over the course of the full day, rather than a sampling of moments (Kahneman & Krueger, 2006; Stone, et al., 2006).

### Measures

**Retrospective assessment of hedonic level of affect.** We assessed the hedonic level of affect using two different time frames: First, we asked the "*How happy did you feel during the previous day?*", and then "*How happy did you feel during the past month?*" Both questions were rated on a graphical response scale with faces ranging from 0 (*extremely unhappy*) to 10 (*extremely happy*), as presented in Figure 1. The faces communicate that the focus is on affective experience.

**Episodic (multi-moment) assessment of hedonic level of affect.** In *Yesterdays' Diary*, adolescents systematically reconstructed what they did and experienced during the previous day. Each diary started with "getting up" and ended with "going to bed", and boys and girls were requested to report the type of activities they were engaged in during the preceding day in a chronological order. Thereafter, pupils were directed to a second screen,

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which presented all of the activities they listed in a chronological order. Here, using the same graphical scale with faces as in the retrospective assessments described above, boys and girls rated how happy they felt during each of the reported activities.

**Daily activities.** In current study, we refer to activities as behavioral practices in which boys and girls engage in daily life. They were able to choose various daily activities from a list, and also add the types of activities on their own. The activities listed were: getting up, eating, getting ready, being in school, doing homework, engaging in sport, relaxing with friends, relaxing alone (e.g. watching TV, surfing the Internet, reading a book), being with family, going to a club/church, doing house chores, visiting a doctor, going to bed).

**Activity Duration.** For each listed activity (e.g., studying, being with friends and family), boys and girls also stated the approximate times at which an activity began and ended. The duration in minutes of each activity was calculated from those beginning and ending times information.

**Background variables.** After filling out Yesterdays' diary, adolescents responded to a background questionnaire, consisting of sociodemographic information, namely, sex, age, ethnicity, living arrangements, type of school and class they are attending at the moment.

### **Data Analysis**

In order to address the research questions stated in Hypothesis 1, first we constructed a memory-experience gap variable on a between-person level. Building upon previous studies (Miron-Shatz, et al., 2009), we conceptualized memory-experience gap as the difference score between the retrospective (overall) report of the hedonic level of affect during yesterday and the aggregated episodic (activity-based) hedonic level of affect reports in that same day. We used one-sample t-test because it allows us to test whether a

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sample mean of the memory-experience gap (a normally distributed interval variable) significantly differs from zero.

In order to capture more fine grained processes on a within person-level, we also look at the memory-experience gap on an activity-level, that is, we look at the difference between hedonic level of affect related to each of the activities and the retrospective hedonic level of affect. Because this dataset has a 2-level hierarchical structure with activities nested within pupils, in order to test the Hypotheses 2, 3 and 4, we used hierarchical linear modeling to analyze the data. We used the PASW Statistics Data Editor program for data analysis (Peugh & Enders, 2005).

Moreover, in order to test the moderation effect of the activity duration in the relationship between hedonic valence of the activity and memory-experience gap (Hypothesis 4), we recoded the hedonic valence of the activity and the duration of the activity into dummy variables. The hedonic valence was recoded from the activity-based (episodic) hedonic level of affect. Those activities rated with hedonic level of affect below person-specific median were categorized as low hedonic valence (low pleasantness) and those rated with hedonic level of affect above person-specific median were categorized as high hedonic valence (high pleasantness). Similarly, the duration of the activities was recoded into low and high duration: Those activities with duration below person-specific median were categorized as low, and those rated with duration above person-specific median were categorized as high.

On a between-person level, we statistically controlled for age, sex, happiness during past month, number of activities reported, total time active during the day. On a within-person level, we statistically controlled for measurement occasion (chronological order of the activities).

## **Results**

### **Preliminary Analyses**

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We start by presenting descriptive information of our data to illustrate the nature of our participants' reports. The mean and the standard deviations for happiness indicators are represented in Table 1. As can also be seen in Table 1, reported numbers of activities pupils engaged in the previous day ranged from 5 to 28 ( $M=13.89$ ;  $SD=6.12$ ). The reported hours being active per day ranged from 1 to 24, with 13.14 hours on average ( $SD=4.08$ ).

--Table 1 about here--

As will be discussed in more detail below, we did find a memory-experience gap. Prior to testing of the hypotheses 2, 3 and 4, we examined the variability of that gap across the two levels (Level 2-between-person; and Level 1-within-person). Of the total variance, 33.7% was *between* pupils ( $2.085/(2.085+4.106)$ ), and 66.3% was on the activity (within-pupils) level ( $4.106/(2.085+4.106)$ ), which demonstrated that there is enough variability on each level to conduct multilevel analyses.

### **Hypotheses testing**

To test our hypotheses, we started with a Null model that included the intercept as the only predictor and memory-experience gap on an activity level as the outcome variable. In Model 1, we entered control variables: age, sex, happiness during past month, number of activities reported, and total time active during the day as Level 2 control variables, and measurement occasion as Level 1 control variable.

Results in Model 1 showed that age, sex, number of activities reported or total time spent active were not significantly related to memory-experience gap on an activity level. Happiness during past month related positively to memory-experience gap on an activity level whereas measurement occasion related negatively to the memory-experience gap on an activity level. In Model 2, we added the activity duration and the hedonic valence of activity as predictors. In Model 3, we entered the interaction term between the activity

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duration on the one hand and the hedonic valence of activity on the other hand. Table 2 illustrates the findings for each of the Models.

We tested the improvement of each model over the previous one by computing the differences of the respective log likelihood statistic  $-2 \cdot \log$  and submitting this difference to a Chi<sup>2</sup>-test. Each nested model showed an improved model fit. Model 1 was compared to the Null (intercept only) model ( $\Delta-2\loglik=453.586$ ,  $\Delta df=6$ ,  $p < .001$ ); Model 2 was compared to Model 1 ( $\Delta-2\loglik=4928.073$ ,  $\Delta df=2$ ,  $p < .001$ ); and Model 3 was compared to Model 2 ( $\Delta-2\loglik=8.242$ ,  $\Delta df=1$ ,  $p < .01$ ).

Before testing first hypothesis, the episodic (activity-based) happiness was duration-weighted. More precisely, we calculated average daily happiness by multiplying the happiness ratings in each activity by the proportion of one's waking hours the activity occupied and adding these products together. We computed memory-experience gap score in order to investigate the differences between the reconstructed rating of global happiness during the previous days and averaged ratings of episodic happiness based on daily activities.

In line with our first hypothesis, the one-sample t-test confirmed that the memory-experience gap on a between person-level for happiness ratings is positive and significantly different from zero ( $t=42.986$ ;  $p=0.00$ ). Hence, global estimates of yesterday's affect tend to be somewhat more positive than average real-time assessment of the same day. However, the average difference is small (0.67). Figure 2 presents the distribution of the memory-experience gap according to its size and valence. The histogram in figure 2 shows that the deviation is not only to the positive, but quite often also to the negative.

--Figure 2 about here--

Contrary to Hypothesis 1, retrospective estimate of happiness during past month was not higher than retrospective estimate of yesterday.

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As can be seen in Table 3, Model 2 showed that activity duration was negatively related to the memory-experience gap on an activity level. In other words, the more time pupils spent on specific activities, the smaller the size of the memory-experience gap on an activity level was. That confirms our Hypothesis 2.

In line with the hypothesis 3, Model 2 demonstrated that hedonic valence of the activity was negatively related to the memory-experience gap on an activity level, suggesting that when hedonic level of affect during an activity is rated as below personal average, the size of the memory-experience gap on activity level increases. However, when hedonic level of affect during an activity was rated as above personal average, the size of the memory-experience gap on an activity level decreased.

Hypotheses 4 stated that hedonic valence of the activities moderates the relationship between activity duration and the memory-experience gap on the activity level. Model 3 showed that the interaction pattern between hedonic valence of the activities on the one hand, and activity duration on the other hand, was significant. Moreover, once the interaction term was entered in the equation, the direct effect of activity duration became insignificant. The interaction pattern is graphically displayed in Figure 3.

--Figure 3 about here--

Figure 3 shows that when hedonic level of affect during an activity is rated as less pleasant (below personal median), the size of the memory-experience gap on activity level increases as the time spent in the activity increases. However, when hedonic level of affect during an activity was rated as more pleasant (above personal median), the size of the memory-experience gap on an activity level decreased as the activity duration increased.

### **Discussion**

The broad goal of this study was to get more insight into the happiness measurement issues among adolescents, and in that way our study contributes to the

existing literature in several ways. First, the results obtained indicate that a memory-experience gap for happiness reports exists among adolescents, which illustrates the limitations of commonly used global retrospective happiness measures. Second, we presented a specific episodic multi-moment happiness assessment approach: Yesterdays' Diary-the modified version of the Day Reconstruction Method (DRM). Finally, we also examined the processes that underlie memory-experience gap among early adolescents, and the results showed that the fading affect bias is a useful theoretical framework to explain the memory-experience gap. The findings are discussed in more detail below, together with the strengths and limitations of this study.

### **Memory-experience gap: Are global estimates of happiness too rosy?**

The results of our study reveal that the memory-experience gap for happiness ratings in early adolescents follows similar patterns to those found in adult population (Miron-Shatz, et al., 2009): when asked how they felt yesterday in the overall, pupils tend to overestimate the pleasantness of their affect on the average. In other words, their global yesterdays' happiness reports are higher than their averaged activity-based happiness ratings.

The question is why is that? What contributes to memory-experience gap? There are at least three things we can attribute the memory-experience gap to: the random measurement errors, the retrospective bias, but also the method artifact. The random measurement errors refer to the various factors that influence the happiness reports and are out of our control.

The method artifact is another aspect of the memory-experience gap that should be noted. Specifically, the responses for the global retrospective happiness measures that were available for boys and girls were whole numbers, whereas the average happiness rating

obtained from episodic measures was a decimal number. In that way, method artifact contributes to the memory-experience gap at least to a small extent.

According to previous studies and theoretical considerations, the largest part of the memory-experience gap could be attributed to the retrospective bias. According to the accessibility model of emotion report (Robinson and Clore, 2002), retrospective overall reports of the past happiness are based on semantic memory. For example, when asked how they typically feel during a specific activity, people tend to express their general beliefs about the activity to arrive at an assessment.

The actual experience of happiness is not prominently present in global reports because the experience itself is gone, and people have to reconstruct it from memory, which makes that type of assessment more prone to retrospective biases (Robinson & Clore, 2002). In contrast, when people report on their recently experienced happiness, the affects themselves are more easily accessible because they draw from their episode memory. This, in turn, enables accurate reports on the basis of experiential information.

### **What drives the memory-experience gap? The role of activity duration and hedonic valence of affect during the activities**

In order to examine what factors contribute to the memory-experience gap, in this study we also looked at the within-person fluctuation in the gap. Based on the existing literature, we analyzed the role of the duration of yesterdays' activities and the hedonic level of affect related to those activities for the size of the gap. Results show that longer duration of affect states does not contribute to increased accuracy of retrospective assessment in itself (e.g. Fredrickson & Kahneman, 1993; Izard, Libero, Putnam, & Hayes, 1993; Kahneman et al., 1993). Rather, as our findings suggest, hedonic valence of the affect seems to play a crucial role, with highly pleasant states being better recalled in comparison to less pleasant affect states.

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Moreover, we examined if memory-experience gap can be partially explained with the interaction between the activity duration and the hedonic level of affect valence of the activities on the relationship and the activity-level memory-experience gap. The results confirmed our expectations and showed that in making overall retrospective estimates of their happiness throughout the day, pupils seem to overestimate the impact of the short episodes of pleasant activities, while at the same time they underestimate the impact of longer episodes of unpleasant activities. In that way, shorter pleasurable activities are better recalled, indicating that highly pleasant affect fades less over time as compared to unpleasant affect. These findings fit the concept of the *fading affect bias* (Walker, Skowronski and Thompson, 2003).

Walker, Skowronski and Thompson (2003) emphasize that this fading affect bias might actually be a healthy coping processes. Hence, the memory-experience gap might actually represent much more than retrospective bias. More concretely, they build upon the mobilization-minimization hypothesis (Taylor, 1991), stating that when a person experiences a negative event, mechanisms of minimization and mobilization of resources are activated. People tend to mobilize various resources to cope with the immediate consequences of the event, and at the same time, they also tend to minimize the impact of the event. Such minimization occurs because people are generally motivated to view their life in a relatively positive light (Gilbert, Pinel, Wilson, Blumberg, & Wheatley, 1998; Walker, Skowronski and Thompson, 2003; Wilson, Wheatley, Meyers, Gilbert, & Axson, 2000).

### **Limitations of the study**

It should be noted that this approach has some limitations. In this study, we refer to the episodic assessments of happiness as experienced happiness, while in fact; those are retrospective reports of very recent episodes. However, we justify our approach through

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research evidence which shows that reports obtained through the day reconstruction method are very similar to those obtained in real-time, such as those using the experience sampling method (e.g. Dockray et al, 2010; Kahneman et al, 2004; Stone et al, 2006).

Moreover, the memory-experience gap between reports of how happy one feels (affective component of happiness) and how satisfied one is with his or her life happy one is (cognitive component of happiness) is likely to be even greater. Yet, since this study did not involve a cognitive measure of happiness we cannot demonstrate that.

### **Conclusions and implications**

Altogether, our findings have several important implications for happiness research among adolescents: 1) There is a memory-experience gap in happiness reports of early adolescents: Pupils tend to overestimate their happiness level when asked with a global question, even when the reports refer to how happy one felt. 2) The size of the gap can, in part, be explained with the hedonic level of affect, with pleasant affect tending to be overestimated and negative to be underestimated; 3) Global retrospective estimates may not be optimal choice when the research goal is to get more detailed insight into how happy adolescents feel, rather, episodic multi-moment assessment should be used; and finally, 4) If the research uses the global retrospective happiness self-estimates, it is advisable to subtract about 5% of the scale range.

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Table 1. *Descriptive information for the main variables and one-sample t-test for memory-experience gap*

<b>Variable</b>	<b>Mean (SD)</b>	<b>t</b>	
<b>Number of activities reported</b>	13.89 (6.12)	N/A	
<b>Active hours per day</b>	13.14 (4.08)	N/A	
<b>How happy were you past month?</b>	7.34 (1.79)	N/A	
<b>How happy were you yesterday?</b>	7.43 (1.83)	N/A	
<b>Activity-based (episodic) happiness</b>	6.76 (2.31)	N/A	
<b>Memory-experience gap between-person level</b>	0.79 (1.82)	42.968***	
<b>Memory-experience gap within-person activity level</b>	0.70 (2.48)	19.684***	*
<b>Total N</b>	352	N/A	*

*p*<0.001; N/A not applicable

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Table 2. Multilevel estimates for 2-level models predicting memory-experience gap, N=352












	Null-model			Model 1			Model 2			Model 3	
	Estimate	SE	t	Estimate	SE	t	Estimate	SE	t	Estimate	SE
<b>Constant</b>	0.744	0.084	8.891***	2.043	1.442	1.416	7.755	1.448	5.355***	7.610	1.450
<b>Chronological order</b>				-0.080	0.004	-20.577***	-0.03	0.003	-8.085***	-0.026	0.003
<b>Age</b>				-0.166	0.094	-1.759	-0.276	0.095	-2.902**	-0.276	0.095
<b>Gender</b>				-0.142	0.159	-0.895	-0.075	0.163	-0.463	-0.076	0.162
<b>Happy past month</b>				0.284	0.044	6.494***	0.284	0.045	6.342***	0.285	0.044
<b>Number of activities</b>				0.010	0.015	0.648	-0.031	0.016	-2.007*	-0.032	0.015
<b>Time active</b>				-0.004	0.001	-1.158	0.001	0.001	0.521	0.001	0.001
<b>Activity duration</b>							-0.002	0.001	-6.627***	0.001	0.001
<b>Hedonic valence</b>							-3.066	0.042	-73.256***	-2.976	0.052
<b>Activity duration X Hedonic valence</b>										-0.003	0.001
<b>-2 Log Likelihood</b>		21278.350			20824.764			15896.691			15888.449
<b>Diff-2 Log</b>					453.586***			4928.073***			8.242***
<b>Df</b>					6			2			1
<b>Level 1 variance</b>		4.106 (0.087)			3.752 (0.079199)			1.632 (0.036)			1.629 (0.036)
<b>Level 2 variance</b>		2.085 (0.186)			1.796 (0.161872)			2.008 (0.168)			2.012 (0.168)

\* $p < 0.05$ ;  $p < 0.01$ ; \*\*\* $p < 0.001$












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Figure 1. The three version of the one-item graphical response scale for happiness assessment.

How happy did you feel yesterday?

										
<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>

How happy did you feel during past month?

										
<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>

How happy did you feel during that activity?












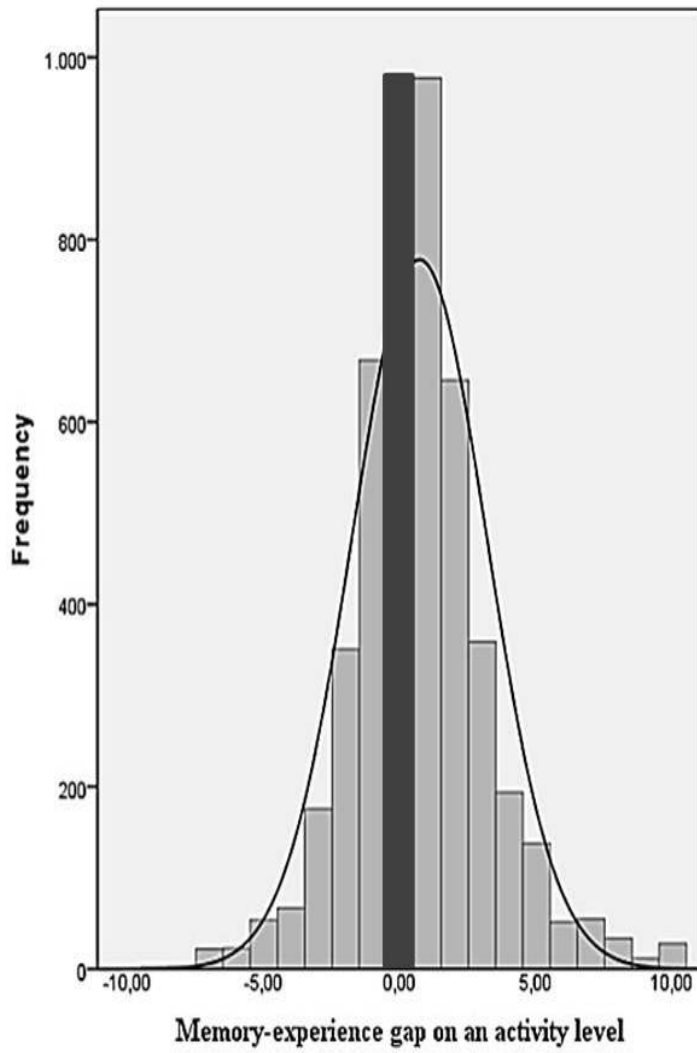
										
<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>

Figure 3. The memory-experience gap distribution.



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Figure 4. Interaction effect of hedonic valence of the activity on the relationship between activity duration and memory-experience gap *Note.* Low = below person-specific median; High=above person-specific median.

