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# Social Indicators Research

## French adaptation of the Orientation To Happiness Scale and the impact of Quality of Life in French Students --Manuscript Draft--

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<b>Abstract:</b>	<p>Happiness is the current hot topic whether in television, press or research. For some, it is immeasurable; for others it is quantifiable and thus has numerous measurement tools. After having defined happiness, the aim of the four studies presented below is to propose a valid French adaptation of the three-dimensional Orientation To Happiness questionnaire (OTH; Peterson, Park, &amp; Seligman, 2005). In Study 1, successive PCA and CFA revealed that there exists a three factor structure conforming to its theoretical framework. Study 2 was used to test different models to confirm this factor structure. We found two models that proved to be adequate. The results of Study 3 demonstrate satisfactory test-retest stability for each of the three subscales. Study 4 was undertaken to test the convergent validity of the scale. Moreover, this study showed the relationship between variables linked to quality of life and their impact on happiness. To summarize, the four studies together demonstrate satisfactory psychometric qualities of the scale that is now called "Échelle Francophone d'Inclinaison au Bonheur" (EFIB), and show how happiness is impacted by different variables linked to quality of life.</p>

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French Students

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## French adaptation of the Orientation To Happiness scale and the impact of Quality of Life in French Students

“I decided to be happy because it's good for health!” (Voltaire), is the beginning of a paragraph from *Happiness* (Diener & Biswas-Diener, 2008, p. 19). It turns out, he was not wrong. Being happy is a beneficial, and not merely a pleasant state or peaceful feeling. According to the authors, being happy “is more of a resource to be used rather than just being joyful” (p. 19). With happiness as a resource, two central issues need to be explored. The first one concerns the concept of happiness itself: What is happiness and how do we understand it? The second question refers to the effects of happiness: What are its short-term and enduring benefits?

Happiness: A concept to define.

Happiness can have different meanings such as wellness or subjective wellbeing. Their definitions and measures have different implications. Happiness can be conceptualized as an element of “subjective well-being” in order to take into account all subjective assessments of life including life satisfaction, a high positive affect and low levels of negative affect (Diener, 1984). It is both a cognitive and/or emotional assessment of life. However, well-being represents what people consider as happiness. In English, happiness is usually translated by positive emotions such as joy, as suggested by Diener (1984). Still, the definition of this term can be different. The term well-being is used in order to integrate a larger reality than the mere experience of positive emotions. This goes beyond simply feeling good and includes other attributes such as being mentally healthy or profiting from good social relations as postulated by Ryff and Singer (1998). It can also be seen as an immediate pleasure as suggested by the hedonist approach. The eudemonic approach, on the other hand, is about maximising pleasure and minimising suffering.

According to the theoretical framework underlying the “Orientation To Happiness” (OTH; Peterson, Park, & Seligman, 2005), happiness can also be seen as a mix between pleasure, meaning and engagement. Pleasure refers to the hedonism that was formulated several thousand years ago by the Greek philosopher Aristotle (435-360 BC) and is the basis for a fulfilling life. According to Park, Peterson and Ruch (2009) hedonism remains relevant in contemporary psychology, especially the development of the “psychology of hedonism” (e.g., Kahneman, Diener, & Schwarz, 1999). It is operationalized through the way we appreciate our pleasurable experiences (Bryant & Veroff, 2006). However, only referring to pleasure is insufficient to account for the complexity of happiness, given the fact that it fluctuates by nature, and that man has a tendency to adapt (Brickman & Campbell, 1971; Lyubomirsky, Martin-Krumm, & Nelson, 2012). This is why the hedonic approach of happiness was supplemented by two other factors: meaning and engagement, representing different facets of eudemonia-

**Meaning:** A meaningful life is a life in which the person feels connected to something larger than him or herself. According to this point of view, happiness integrates the values of the person, the fact that it helps to develop and live in harmony with them (eudemonic vision – Aristotle, 2000). Corresponding studies seek to explore the relationships between happiness, character strengths and virtues and satisfaction (e.g., Peterson, Ruch, Beermann, Park, & Seligman, 2007).

**Engagement:** The dimension “engagement” complements both the hedonic and eudemonic visions of happiness. This dimension concerns the feeling of a total involvement in one’s undertakings. When a person has a high score on this dimension, his/her time flies, his/her attention is focused on the activity itself, and he/she feels completely absorbed (Park et al 2009). This is what Csikszentmihalyi (1990) calls a “flow state”. This state provides

energy, and people describe it as being strongly and intrinsically enjoyable (see Bassi & Delle Fave, 2011, for a review).

It appears, therefore, that the framework adopted by OTH scale is a synthesis of different conceptions of happiness, to be precise, hedonism and eudemonia. However, it is necessary to go a step further to define happiness.

The relationship between happiness and different types of variables has been identified at an individual level, and also more broadly. For example, it is possible to classify nations according to their level of happiness (Veenhoven, 2011). On the other hand, in order to compare happiness level between nations it is necessary, first of all, to have a consensual definition of happiness, and second of all, to agree on the measurement tools. Indeed, the very definition of happiness varies across studies. It is therefore important to take into account the definition adopted in the assessment of happiness. The strength of the self-report measure developed by Peterson et al. (2005) is in its' breath, as it has been designed to measure three distinct factors corresponding to hedonistic happiness/pleasure, meaning and engagement. The level of hedonic pleasure is measured with items formulated as follows "*life is too short to postpone the pleasures it can provide*". The meaning of life in a broad sense is measured with items such as "*My life serves higher purpose*". The engagement (i.e. the flow state) is measured with items such as "*Regardless of what I am doing, time passes very quickly*". Vella-Brodrick, Park and Peterson (2009) compared the orientation to happiness of US and Australian respondents. US respondents scored higher on an orientation to meaning than did Australian respondents, perhaps reflecting (again) national differences in religiousness. Park, Peterson and Ruch (2009) extended this line of work by looking at similarities and differences in the three orientations to happiness across respondents from 27 nations. Participants could fill the questionnaire in on a website. It was presented in English and only 37 French participants have contributed, so it is difficult to make any conclusive observations about

differences between the French and people from other nations. A French version of a questionnaire, based on this definition of happiness, could be a way to solicit more participants. We presume that the three dimensions of happiness maybe a way to measure happiness among the French, but the way to assess them may have to be adapted according to the French culture.

The objective of the four studies presented involving more than 1,100 participants, is, to first of all, adapt the scale developed by Peterson et al. (2005) in French, in accordance with the theoretical framework on which it is based, and second of all to analyse the relationships between happiness, quality of life, and satisfaction with one's academic results and orientation among university students. Students' transcultural validation procedure developed by Vallerand (1989) has been met. The first study was designed to test the structural validity of the scale using exploratory factor analysis. In the second study, the aim was to test the structural validity of the scale using confirmatory factor analysis. Here, the internal consistency was also verified. The purpose of the third study was to test the temporal stability with a test-retest procedure three weeks apart. The convergent validity of the scale was tested. Finally, the fourth study was conducted to measure the impact of different variables on happiness. The scale was first translated into French.

#### Translation

The three studies that follow represent the initial validation of the scale Orientation To Happiness (OTH) in French. The original scale is comprised of 18 items, six for each of the three dimensions: hedonism / pleasure, engagement and meaning of life (Peterson et al., 2005). The response mode is a five point Likert scale ranging from (1) "*very much unlike me*" to (5) "*very much like me*". The content of the 12 items on the dimensions of meaning of life and pleasure are in line with the hedonic versus eudemonic conceptions of happiness observed in previous research (Peterson et al, 2005; King & Napa, 1998; McGregor & Little,

1998). The remaining six items measuring engagement are based on the work of Csikszentmihalyi (1990) and characterize the “flow” state of absorption in the task. Two English teachers conducted a reverse translation procedure adopted to achieve the experimental version of OTH in French. One of them translated the scale from English to French, and the other from French to English. A third teacher, expert in the field, assessed the concordance of the two versions. To ensure the clarity of each item, 10 students, five females and five males of the first academic year, were then sought. They completed the questionnaire and an interview with each of them helped validate the translation. The results showed that item 12 was not clear and two translations have been proposed. The following analysis should then be used to decide on the most appropriate version of translation. This first experimental version was thus composed of 19 items.

## **Study 1: Structural validity of the experimental French version of the OTH**

### **Method**

#### **Participants and procedure**

Paper version of the questionnaire was administered during a university lecture to 271 young adults who participated voluntarily, 153 females (56.5%) and 118 males (43.5%), between the ages of 17 to 20 years ( $M = 18.54$ ,  $SD = 0.51$ ). The rules and regulations of the ethics committee of the department of Psychology and Educational Sciences, Paris Ouest Nanterre La Défense University were followed.

#### **Results and discussion**

Initially we wanted to perform a principal component analysis (PCA) with varimax rotation to follow Peterson et al. (2005) validation methodology. However, we considered that does not constitute a sound solution. Actually, Peterson et al.’s results showed correlations



between the three constructs defining happiness. Accordingly, an oblimin rotation was computed instead of a varimax one.

The results revealed an accurate KMO index of .80. It indicates satisfactory correlations between items. Furthermore, the results of the Bartlett's test of sphericity are significant ( $p < .001$ ). Therefore not all the correlations are equal to zero. We decided to proceed with the analyses. Different procedure can allow us to determine the number of factors to retain (for a review, see Fabrigar, Wegener, MacCallum, & Straban, 1999). To diminish the risk of "over-extraction" from the methods of scree test and Kaiser- Guttman criterion - more than one eigenvalue - it was decided to use the Horn's (1965) parallel analysis (PA) method. The analysis was performed using the Monte Carlo PCA for Parallel Analysis 2.0.3 software using calculation algorithms proposed by Watkins (2002) for random eigenvalues and 19.0TM SPSS software for PCA, as proposed by Peterson et al. (2005). A three-component solution with eigenvalues exceeded the own random value generated by the PA was extracted (Table 1). The first two factors account for 22.8 % and 9 % of the variance respectively. The third factor explained 7.2 % of the variance.

-----INSERT TABLE 1 APPROXIMATELY HERE -----

This exploratory factorial analysis (EFA) with oblimin rotation ( $\delta = 0$ ) identifies the original three-dimensional structure of the OTH (engagement, pleasure and meaning), according to the Peterson et al.'s (2005) model, but does not have the exact same composition. From this analysis, in order to obtain a more satisfactory multifactorial version, according to Tabachnick and Fidell (2007), items that did not reach a minimum weight of .40 on one factor were removed (items 1 and 8).

The results also reveal that item 9 appears to load on the dimensions of engagement and meaning, however in Peterson's model, it loads on the engagement dimension. This item will not be included in the final French scale measure of happiness. Item 16 loads on two

dimensions (meaning and pleasure). Accordingly, it has been deleted too. Furthermore, item 2 (see table 1), which loads in the original model on the dimension “meaning” loaded on the dimension of “engagement” in our analysis. Item 4 (see table 1) loaded on the pleasure dimension in our study, but on the engagement dimension in Peterson et al.’s analysis. However, we have kept the two last items, considering that these results could be justified by cultural differences. Indeed, Hofstede (1993) or McCrae and Costa (2006) have previously shown such differences among cultures. For example, Hofstede (1993) shows that there are differences in the fundamental dimensions called Competence (or assertiveness) and Warmth (or communality). “It is the degree to which tough values like assertiveness, performance, success and competition, which in nearly all societies are associated with the role of men, prevail over tender values like the quality of life, maintaining warm personal relationships, service, care for the weak, and solidarity, which in nearly all societies are more associated with women's roles. Women's roles differ from men's roles in all countries; but in tough societies, the differences are larger than in tender ones” (p. 91). More specifically concerning the differences between USA and France, Hofstede (1993) shows that with the dimensions “individualism” and “masculinity”, the USA is much more individualistic and chauvinistic than France. French society appears to rather define personal challenge as a notion of progress than competition or social comparison. On the other hand, US society appears to be more focused on competition and social comparison, and this may explain why these items didn't load on the same dimensions than in Peterson et al.’s study.

However, it is essential not to replicate the original questionnaire “item by item”, but to reproduce the theoretical tri-partite construction of the original OTH (Peterson et al., 2005).

The remaining 14 items are divided into three factors as follows: Items 15, 3, 18, 13, and 4 loaded on the pleasure dimension. Items 10, 6, 7 and 2 loaded on the “life engagement”. Finally the last five items, 12, 11, 5, 14, and 17 loaded on the dimension called “meaningful

life” of OTH. Compared to the version of Peterson et al. (2005), we find that the EFA can highlight the same dimensions, but some differences are worth noting with regard to the loading of some of the items on the three dimensions. These differences could arise from cultural differences between the American and French populations in the conception of happiness. In previous research some differences have already been highlighted, as for example for the German version of the OTH (Ruch, Harzer, Proyer, Park, & Peterson, 2010) in which a four-factor solution appeared to show a better fit to the data. Actually, the meaning factor was split into two factors even if according to Bollen (1989), the 3-factor solution was favored. However, as mentioned by the authors, the German version of the OTH was an adaptation of the English version of the OTH (Ruch et al., 2010, p. 2). As mentioned for the French version of the OTH, Ruch et al. (2010) observed differences in the loadings as for example item 9 which didn’t load on the expected factor, pleasure instead of engagement (p. 4), and item 4 and 10 showed low loading on the engagement factor, and factor 5 on the meaning dimension. “In the German and in the American version, four items had secondary loadings on other factors than intended, especially the item 9 (life of engagement). In the German OTH this item loaded higher on Pleasure than on Engagement. Nevertheless, we decided to maintain this item in order to keep the German version identical to the US version. Nevertheless, this effect should be taken into account when interpreting the results (e.g., scale intercorrelations, factor structure)” (Ruch et al. 2010, p. 7). This may show some differences in the conception of happiness between the Americans and Germans, as it is the case with the Frenchs. But here it was preferred to take the results of the analysis into account and to propose a shorter version of the questionnaire, even if it was necessary to shorten it further due to the results of the next study. Further studies are needed to confirm or reject this hypothesis. To resume, the EFA with oblimin rotation highlighted a three factors and 14 items solution. This result allows for the emergence of different models, which have to be tested.

## **Study 2: Analysis of the hierarchical factor structure and the fidelity of the OTH**

The objective of this study was to test the structural validity of OTH. Several models were tested using confirmatory factor analysis (CFA) performed with LISREL 8.7 software (Jöreskog & Sörbom, 1993). The first model tested is the null model in which no relationship is assumed with the 18 items of the experimental version of OTH (M0). Then the original structure of OTH was tested (M1 - 18 items, three factors as proposed by Peterson et al, 2005). The following models are subsequently tested in ascending order of the number of constraints to be imposed on the basis of models from EFA with oblimin rotation. Thus, the model 2 (M2) is composed by 14 items that load on the three dimensions. In model 3 (M3), we used the model 2 but removed the items 2 and 4, which do not load on the same dimensions as the original model. Thus we offer a shorter version of OTH. Model 4 (M4) is based on M3, proposing a second order hierarchical structure. In the second step, the internal consistency of each factor will be evaluated, as well as the temporal stability with an interval of three weeks with a test-retest procedure.

### **Method**

#### **Participants and procedures**

The paper version was administered to 222 students volunteers enrolled in a training school for teachers (University Institute of Teacher Training-IUFMs) Rennes (France). The sample consisted of 186 women (83.8%) and 36 men (16.2%). These proportions are in accordance with the overall proportion of male and female in this type of higher education establishment. 160 students were enrolled in school teaching (72.1%, including 44.6% in first year primary schools) and 62 students in High School and College Professorship. The distribution between men and women is the overall distribution within the School of the Teaching and Education of Rennes. These students have an average age of 30.27 years ( $M = 24.10$  years,  $SD = 5.36$ ). The rules and regulations of the ethics committee of the University

of Rennes were followed.

## **Results and discussion**

### **Confirmatory Factor Analysis**

The data were screened for nonnormality, and no problematic trend was detected. To ensure univariate normality, Kline (1998) suggested cut-off of absolute values of 3.0 and 8.0 for skewness and kurtosis, respectively. Univariate skewness ranged from  $-1.36$  to  $0.16$ , and univariate kurtosis ranged from  $-0.76$  to  $1.81$ , indicating that the responses were relatively normally distributed. In addition, relative multivariate kurtosis as reported by the output from LISREL 8.7 (Jöreskog & Sörbom, 1993) equalled  $1.14$ . Whereas there is no standard cut-off for this index, Bentler (1998) recommended that multivariate normality can be assumed if this value is less than 3. So, the distribution of variables being normal a matrix of product-moment correlations was generated to evaluate the models using the Maximum Robust - Likelihood method (ML -Robust). To assess the validity of the proposed models, several fit indices were used: the Chi-square ( $\chi^2$ , Jöreskog & Sörbom, 1993), the Goodness -of -Fit -Index (GFI, Jöreskog & Sörbom, 1993) the Comparative Fit Index (CFI, Bentler, 1990), the Tucker-Lewis Index (TLI, McDonald & Marsh, 1990), the Root Mean Square Error of Approximation (RMSEA), and the Root Mean Square Residual (RMSR). The  $\chi^2$ , which is an indicator of the level of correspondence between the proposed factor structure and the data collected should be used more as an index adjustment than as a test of the null hypothesis, because its sensitivity to the number of observed variables and the number of subjects is now permitted (Marsh, Balla, & McDonald, 1988). Although there is no test of the null hypothesis GFI, CFI and TLI, a commonly accepted rule of thumb is to consider the model as correct when these indexes are greater than or equal to  $.90$ . RMSEA can observe the residuals of the model and gives an indication of the degree of fit between the theoretical model and the empirical data. According to MacCallum, Browne and Sugawara (1996) a RMSEA of the

value of .01, .05 and .08 indicate fit indices as excellent, good and poor respectively. Finally, RMSR is a measure of the average residual variances and covariances. It is therefore preferable that it be low. Here again, the norms are empirical. According to Rupp and Segal (1989), a value between .05 and .10 is correct. Hu and Bentler (1998) suggest that these indices are among those that are most relevant to assessing the inadequacy of a model.

The main goal of the first CFA was to test the null model – M0 (18 items which saturate only one factor). Results presented in Table 3, show that this model doesn't fit with the data. Two other models have been tested. First, M1 according to Peterson et al. (2005), has been tested, and then a third one taking into account the results of the EFA with Oblimin rotation (M2). Both fit suitably to data, confirming the multidimensionality of the OTH. M2 fits slightly better to the data than does M1 (see table 2).

-----INSERT TABLE 2 APPROXIMATELY HERE -----

Model 3 (M3), suggested by the EFA (Oblimin rotation) and Peterson et al., by removing firstly the two items that load on two dimensions (items 9 and 16 ), secondly the two items that do not load on any dimension (items 1 and 8), and finally items that do not load on the same dimension as in the Peterson's model (items 2 and 4) was then tested. The fit indexes of M3 indicate a good fit of the latter with the data (TLI = .90 , CFI = .93, GFI = .94 , RMSEA = .05 , RMR = 0.06;  $\chi^2 = 84.1, p < .001, \chi^2 / df = 1.65$  ). The difference between  $\chi^2$  of model 2 and 3 is significant ( $\Delta \chi^2 = 45.1.84, \Delta df = 23, p = .004$  ).

Finally, with all three factors correlated with each other (see Table 2) a model with a second-order factor was tested (M4). The fit indices are close to the model 4 (TLI = .90, CFI = .93, GFI = .94, RMSEA = .05,  $\chi^2 = 84.1, p < .001, \chi^2 / df = 1.65$ ). Following the recommendations of Marsh (1987), a hierarchical model must be chosen when the fit indices of the hierarchical model are identical to those of the first order model itself. Therefore, the

results confirm the hierarchical organization of the dimensions of the adapted version of the OTH called “*Échelle Francophone d’Inclinaison au Bonheur*” (EFIB, see Figure 1).

-----INSERT FIGURE 1 APPROXIMATELY HERE-----

Thus, it is possible to consider the calculation of an overall score by adding the scores of the three subscales. This result is unique, as Peterson et al. (2005) advocated a model with three independent dimensions. However, their results and those obtained here revealed significant correlations between dimensions pleasure and engagement ( $r = .31$  for the English version, and  $r = .20$  in the French version,  $p < .01$ ), between pleasure and meaning ( $r = .18$  and  $.26$  in the French version,  $p < .01$ ), and finally between engagement and meaning ( $r = .46$  and  $r = .34$  in the French version,  $p < .01$ ). These correlations could let us deduce the hierarchical organization that has been demonstrated here. So far, as the CFA was not conducted by Peterson et al. (2005), this hypothesis can neither be confirmed nor denied. Thus, as defined by Peterson et al. (2005), happiness is actually made up of three dimensions, but also retorts to a hierarchical organization as we have just demonstrated. The results also revealed that the overall alpha of .72. So actually, this scale allows us to calculate four scores, one for each dimension and an overall score.

### **Reliability of the scale**

The reliability of the scale was assessed using Cronbach's Alpha in accordance with standard procedures and from selected items for models 4 and 5. According to Gliem and Gliem (2003), the results on the whole revealed acceptable consistency ( $\alpha = .60, .65, .65$  and  $.72$  respectively for the subscales of engagement, pleasure, meaning and overall score). These values, however, are lower than those reported for the validation of the tool in its original version (the  $\alpha$  were respectively  $.72, .82$  and  $.82$  with 18 to over 65 participants, and 28% men to 72% women, Peterson et al, 2005).

### **Study 3: Temporal stability and convergent validity**

The first objective of this study is to test the temporal stability of the scale. In accordance with the theoretical framework, each dimension of happiness is supposed to be closer to a trait than a state. They are assumed to be stable over time. The second objective is to test the convergent validity of the scale. Scores on happiness scale are presumed to be correlated with optimism and burnout.

#### **Method**

##### **Participants and procedure**

The paper version was administered twice at a university to unpaid and voluntary students who signed a consent form. They were 199 at time 1, and the re-test performed three weeks apart had to match 112 students between time 1 and time 2. At time 2, our sample consisted of 95 women and 17 men ( $M = 21.24$ ,  $SD = 3.2$ ). The remaining students did not wish to participate in the second phase of the study. The rules and regulations of the ethics committee of the department of psychology and education of Paris Ouest Nanterre La Défense University were followed. In addition to this questionnaire, at time 1, students completed a questionnaire on optimism (LOT-R, Trottier, Mageau, Trudel, & Halliwell, 2008) and burnout (Gauthier, Oger, Guillet, & Martin-Krumm, 2010). Thus, we also present the correlations between these constructs.

##### **Results and discussion**

Taken together, the results showed good correlations for the test - retest reliability ( $.60 \leq r \leq .82$ ,  $p < .001$ ). According to Cohen (1988), these correlations ensure moderate to high relation. They are consistent with the expected stability of the different dimensions of the happiness scale. Cronbach's alpha of the scale at time 1 is .55 while at time 2, it is .69.



Secondly, there is significant and negative relationship between EFIB and exhaustion, as well as the total score of burnout. Specifically, the lower the scores of the EFIB, the more prone an individual will be to burnout. However, we note that only one dimension of burnout, namely emotional exhaustion is significantly and negatively correlated with the dimension “meaning”. Thus, without knowing the direction; an individual who feels he or she lacks meaning in their life will have high scores on emotional burnout. It is possible to interpret this result in terms of dysfunction of a regulatory cognitive - emotional mechanism, in which patterns of negative thoughts (no meaning to life) are interconnected with unpleasant emotions (Garnefski, Kraaij, & Spinhoven, 2001).

Regarding optimism, we note a significant and positive correlation between the total score of happiness and total score of optimism and its dimensions, and a significant and negative relationship between happiness and pessimism. We observe a significant correlation between the dimension of “pleasure” and optimism and between “meaning” and optimism. We also observe a significant and negative relation between pessimism and pleasure. Finally, we note a significant positive correlation between satisfaction with academic orientation and pleasure. It was decided to continue the validation process by an additional study on the convergent validity between happiness and quality of life, optimism, burnout, vitality, self-esteem and psychopathological dimensions as the anxiety and depression. According to Cohen (1988) recommendations of Cohen (1988), correlation under .10 is “low”, between .10 and .30 is “moderate”, and under .50 is “high”. Table 3 shows the moderate correlations it was possible to observe. To resume, these results ensure adequate convergent validity of the EFIB.

-----INSERT TABLE 3 APPROXIMATELY HERE -----

We conducted a student’s T test (matched sample) to check whether there was a significant difference between time 1 and 2 scores on different dimensions and the total score.

Results show some differences for the dimension “meaning” ( $t = -2.22; p < .05$ ) and the total score ( $t = -3.20; p < .05$ ). These results can be justified by the fact that the retest was carried out during the last class before exams of the second semester. The differences between time one and time two in dimension meaning are relatively high. Thus they may affect the fluctuation in the overall score. The explanation may come from the presence of an adjustment disorder with respect to stress, which is very high amongst the students at this time of the year. On the other hand, we find that the dimensions “engagement” and “pleasure” are perfectly stable.

#### **Study 4: Study of the relationship between variables linked to quality of life and their impact on happiness**

Following Peterson et al. (2005) framework, the objective of this study is to test the interactions between orientation to happiness and academic performance. Indeed, the structural validity and reliability are not sufficient to fully validate a psychometric scale. It is also important to test its relationships with other psychological constructs with which it is presumed to be correlated. For example, the scientific literature indicates the existence of a strong relationship between health and happiness (Schimmel, 2009) and, particularly, between subjective health and happiness (Diener et al., 1999). In this study, correlations between each dimension of happiness and relationships with quality of life, optimism, and burnout will be investigated. Moreover, the benefits of happiness were not highlighted in the field of health behaviors, but with regard to academic success deserve further investigation (Lyubomirsky et al., 2005). So the question of the welfare of individuals arises particularly in its relationship with actual or perceived performance, whether for work, sports, school or university. Is a person happy because he gets good results, he performs well or is it because he is happy in his environment, and it's the feeling of well-being, that in turn makes him more efficient? Even if

this question has long remained unanswered; some studies are now trying to answer it. Lyubomirsky et al. (2005) published an extensive review of literature in which, invariably, whatever the context, show that well-being predicted performance and not the reverse. Therefore, it is crucial to take into account this variable both from the perspective of a humanist vision of education as well as to create conditions for the expression of individual talents (Knoop, 2011). Moreover, happiness seems to allow people to give the best of themselves, increasing their social meaning, making them more able to help others, and to act more ethically. Accordingly, happiness was presumed to be positively correlated with health, academic success, optimism and negatively with burnout.

## **Method**

### **Participants and procedure**

The questionnaire was administered during class to 426 student volunteers, 297 women and 129 men from several universities, enrolled between L1-PhD, aged 18 to 35 years ( $M = 21.68$ ,  $SD = 3.34$ ). The rules and regulations of the ethics committee of the department of psychology and education of Paris Ouest Nanterre La Défense University were followed.

### **Measures**

#### **Dependent variable**

**French version of the Orientation to Happiness Scale:** The 12 items of the experimental French version of the scale were used. Participants were asked to reply on a scale of 1 (not at all me) to 5 (very me). For each dimension, the average was calculated ( $\alpha = .71$ , see the full version of the scale in the appendix).

#### **Independent variables**

**Quality of Life:** Duke Scale, validated in France in a Hospital Clinical Research Program of the Ministry of Health, provides a health profile which allows us to measure the quality of life related to health (Guillemin, Paul-Dauphin, Virion, Bouchet, & Briançon,

1997). It includes 17 items that are grouped into 10 dimensions: physical, mental, social, general perceived health, self-esteem, anxiety, depression, pain, and disability. The responses are scored 0, 1 or 2 according to increasing quality in terms of health (some questions are worded in a negative way, their coding reflects inversion).

Variables were selected to best describe our population. These variables act as control variables (gender, age), and different types of drinks:

**Alcohol (Audit):** Developed by the World Health Organization (WHO) in 1990, this simple tool can identify subjects with alcohol problems, abuse or excessive use of one hand, and dependence on the other. This instrument tracking abuse/alcohol dependence has 10 questions, which successively address the alcohol consumption (first 3 questions), dependency, black holes and the social consequences of alcohol (7 questions).

**Cigarette use (Fageström):** The Short Tobacco Test (STT, short version of the Fageström) was used. It assesses nicotine dependence. The questionnaire consists of six items. The interpretation of the total score is the sum of the scores for two items that reflect a level of dependency.

**Cannabis use:** CAST was used. Principles of scoring and interpretation are as follows: The total score is the sum of the scores for each item. Consumption is said to be at risk when the total score (which corresponds to the negative consequences of use) is greater than or equal to 2 (Legleye, Karila, Beck, & Reynaud, 2007).

**Level of physical activity (PA):** To measure this indicator, the Godin Leisure Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985) was used. This questionnaire focuses on the weekly frequencies of exercise: high, moderate and low exercise lasting at least 15 minutes. People are placed in the context of a typical week. It consists of four items. The first three are used to calculate energy expenditure of Met (i.e., energy expenditure of a person sitting at rest or  $1\text{MET} = 1 \text{ kcal} / \text{kg} / \text{hr} = 3.5 \text{ ml O}_2 / \text{kg} / \text{min}$ ) and the fourth item

allows to know the frequency of the practice. The GLTEQ is a metabolic equivalent or indicator, which lists four questions to measure the level of physical activity (PA) which is correlated with the subject's energy expenditure. This is a reference in psychology, because we cannot afford to make quantitative measurements of energy,  $VO^2$  max or other physiological measures for the size of the population interviewed. More specific questionnaires exist but are too long to administer. This simple questionnaire allows us to have a good estimate of energy expenditure (typically expressed as a Met) in a person during a typical week.

### **Results and discussion**

Students who responded to the questionnaires live mainly with their parents ( $N = 134$ , 31.5 %), 28.9 % ( $N = 123$ ) live with their partner or roommate, 12.2% ( $N = 52$ ) live in university residences. The majority did not have children ( $N = 404$ , 94.8%). All years of study (L1-PhD) are represented in the sample. However, we note that a large proportion is registered Master 1 (30.8 %), while 73 students (17.1 %) were enrolled in L1, 61 (14.3 %) in L2, 63 (14.8 %) in L3 and 94 (22.1 %) in Master 2.

Regarding the students' academic orientation, 89.4 % reported being satisfied with their choice of an orientation. However, only 288 students (67.6 %) were satisfied with their results (vs. 138, 32.4 %) not satisfied. In our population, the vast majority of students do not smoke ( $N = 353$ , 82.9%) and only 4.7 % ( $N = 20$ ) are at risk of nicotine dependency. Alcohol use is more problematic with 94 students (22.1 %) indicating alcohol abuse and 46 (10.8 %) were alcohol dependent according to AUDIT. Finally 269 students do not smoke cannabis; however 61 (14.3 %) are at risk of cannabis dependence. Regarding the bivariate statistics between happiness and the demographic characteristics of students, the results show that there is no difference between men and women on the different scores of happiness ( $-1.20 \leq t \leq 1.57$ ; see table 4).

-----INSERT TABLE 4 APPROXIMATELY HERE -----

We note a significant positive correlation only between the dimension “meaning” of happiness and age ( $r = .10, p < 0.05$ ). Older students tend to have more meaning in life. This seems consistent with respect to one’s choice of an academic pathway, given that one’s studies are usually more general in their youth and specialized thereafter, but also not many life choices are thoughtful, matured for a majority of students. Regarding habits, results show that there is a significant negative correlation between the total score of happiness and alcohol consumption ( $r = -.17; p < .01$ ). The correlation between the score of pleasure and the practice of PA is positive and significant ( $r = .14; p < .05$ ), but moderate according to Cohen (1988). The relationship between alcohol and happiness (engagement) are interesting to observe, and support the idea of a link between the use of alcohol and negative experiences of life ( $r = -.11; p < .01$ ). Two further directions could be worth investigating: firstly, whether the less happy students would drink in order to have pleasant experiences (alcohol as a coping strategy), or whether students who do not have meaning in their lives, drink to avoid negative emotions caused by this lack of meaning (alcohol as a strategy of emotional regulation). Further investigations are needed to understand the links between happiness and different kinds of consumptions.

Existing studies are somewhat controversial, for example, the study by Walter et al. (2011) shows the relationship between alcohol intake and “social” behaviour, also behaviour which is more aggressive in nonverbal communication; with alcohol they feel they are able to reach out more to others, this applies especially to people who have problems with social phobia. However, most studies show that happiness is more correlated with lower levels of alcohol consumption among adults (Murphy, McDevitt – Murphy, & Barnett, 2005; Kelloniemi, Ek, & Laitinen 2005). Other studies such as Kawada, Kuratomi and Kanai (2009) find no link between “unhappiness” and alcohol. In children aged from 10 to 15 years, less

alcohol, tobacco, and drugs consumption is observed if the scores in happiness and family communication are high (Farmer & Hanratty, 2012).

With respect to bivariate statistics between happiness and academic data, there are significant gender differences in terms of satisfaction with academic results. The persons, who are satisfied with their academic orientation, are significantly happier ( $t = -1.96; p < .05$ ) and experience significantly more pleasure ( $t = -2.53; p < .01$ ). Furthermore, a positive and significant, but modest relationship was observed between satisfaction linked to the results and pleasure. T-test revealed that the students, which are satisfied with their results are happier overall ( $t = -3.57; p < .01$ ), obtaining higher scores on the pleasure ( $t = -3.28; p < .01$ ), and meaning dimensions ( $t = -2.93; p < .05$ ).

Regarding the bivariate statistics between happiness and quality of life, the results show significant and positive correlation between total score of happiness, physical and mental health, and the scores on the QOL. Results show moderate correlations with physical, mental, social, general perceived health, self-esteem, anxiety, depression, pain, and disability subscales of the QOL. More precisely, significant and negative correlations were noted for anxiety, depression, pain and disability. We note a significant positive relationship between pleasure and perceived physical health, mental, social, and general self-esteem. Relationships are significant and negative between pleasure and anxiety, depression, pain, disability. The dimensions of meaning and engagement are also correlated with QOL dimensions, but to a lesser extent (Table 5).

-----INSERT TABLE 5 APPROXIMATELY HERE -----

### **General Discussion**

According to the work of Peterson et al. (2005), it is possible to distinguish three different orientations of happiness (Seligman, 2002). In studies that have been done here,

these three dimensions are effectively identified. They are correlated and can be pursued simultaneously by the individual. Each is associated with life satisfaction. However, the results showed that it was quite possible to envisage a hierarchical organization of happiness; a hypothesis that could have been tested by CFA in the validation of the original version, but the authors have not done so at that time (Peterson et al., 2005). It is likely that the results would have been close to those obtained here. Indeed, correlations between dimensions were found to be comparable in both the English version and the version tested here. Anyway, the AFC showed the compatibility of the EFIB and the postulation of a hierarchical organization of happiness. This opens the possibility, in subsequent studies in French to keep the scores for each subscale or perform analysis from a global score.

More than 1,100 participants were involved in the procedure for validating the “*Échelle Francophone d’Inclinaison au Bonheur (EFIB)*”. The results of different studies show good construct validity and reliability of the scale. The test-retest stability was also satisfactory. Overall, the psychometric qualities of the French version of the scale are comparable to the original English version. It is therefore suitable for further studies for Francophone countries. It has been therefore used in the fourth study to show the links between different indices of health and their impact on happiness.

However, certain limitations or concerns should be noted. For example, why are there significant differences between T1 and T2 in the test-retest procedure for the “meaning” dimension? The differences may be due to the contextual disparities that are related to the fact that T1 was held during the second semester and T2 during last week before exams. Does this mean that students arrive at a period of the academic year in which they feel lost and at the end they lose a sense of direction, or do they realize that some of them will need academic re-orientation?



Further studies are now required to test the effects of these different orientations to happiness on emotional, cognitive or behavioural variables in order to understand how they are involved in processes related to well-being, health or performance. Another direction is to study how these orientations to happiness interact with personality variables such as optimism to predict the performance or well-being.

Furthermore, the links between the meaning of life and burnout are particularly interesting. Indeed, two lines of interpretations can be proposed. First, people looking for pleasure, life satisfaction and having a meaningful life live more rewarding experiences (Capri, Ozkendir, Ozkurt, & Karakus, 2012). Meaning of life can be considered as a positive way of experiencing life that includes both cognitive and emotional mechanisms. On the opposite, burnout is comprised of three dimensions: emotional exhaustion, depersonalization and lack of personal accomplishment, being a negative way of experiencing life. Cognitive and emotional mechanisms of meaning in life could act as a protective factor for burnout emotional exhaustion. Consequently, people with high level of meaning of life are less likely to develop a state of burnout than other individuals. Secondly, people who are more heavily involved in their lives lose the ability to regulate their emotions and would present a greater risk of developing a state of burnout. Excessive involvement could be a vulnerability factor for burnout. In fact, burnout could affect happiness because of emotional exhaustion: people with significant levels of emotional exhaustion would not be able to feel happy especially when they would lack sense to their life (an inverse form of the meaning of life). These links between happiness and burnout reinforce the work done on the relationship between burnout and depression (Hakanen & Ahola, 2010; Boudoukha, Hautekeete, Abdellaoui, Groux, & Garay, 2011; Khoo & Tan, 2007; Shirom & Ezrachi, 2003).

In Study 4 we did not find significant differences in the various facets of happiness between men and women or in connection with the achievement. However, the dimension

“meaning” is of particular importance and appears to be subject to external influences (upcoming event here in this case). We also observe this through established relationships where only this dimension (meaning) is correlated with burnout. One hypothesis could be that at the end of the year, students “are sick and tired” to the point of losing any meaning in their work, or maybe they become aware of the changes they would need to make in their professional life.

### **Conclusion**

Additional research is needed to provide some validation or refutation of these hypotheses. One of the aims of future studies could be to explore the temporal stability of the different dimensions of happiness and life satisfaction. The aim was to validate a measurement tool based on the theoretical framework of Peterson al. (2005). In further studies, it will be possible to compare the results between the original English and the French versions, and to study the usefulness of this scale with clinical populations (i.e., patients with mood disorders, addictions, of anxiety disorders). Studying these three orientations to happiness may require other types of methodologies, including a longitudinal plane with repeated measurements. In the same manner, some individuals had low scores on three dimensions. According to Peterson et al. (2005), they may be at risk for developing depression, anxiety disorders, or other types of pain, hence one needs to provide support based on their current happiness scores, given that well-being is a cognitive evaluation process of one’s own life (Berrocal, Ruini, & Fava, 2011). It may be appropriate to combine this quantitative data with a qualitative approach. And it might also be appropriate to focus on those who have particularly high scores on life satisfaction, which could help to identify ways to increase levels of happiness and satisfaction for others (Diener & Seligman, 2002).

**Conflict of interest statement**

There were no actual or potential conflicts of interest, including financial and personal conflicts, or any other relationships with people or organizations within three years of starting the submitted work that could inappropriately influence, or be perceived to influence, this work.

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Figure 1: Hierarchical structure of the “*Échelle Francophone d’Inclinaison au Bonheur*” (EFIB)

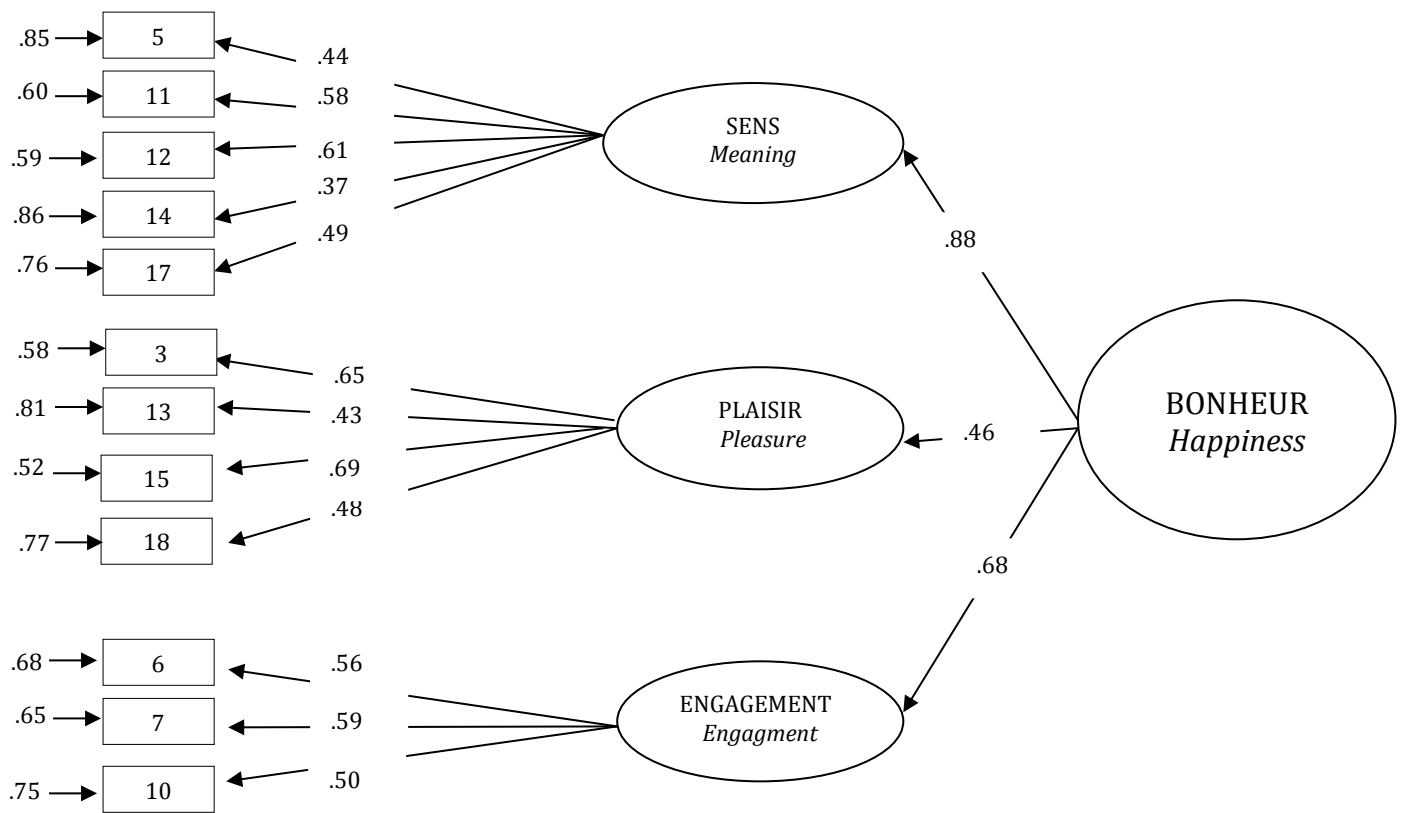


Table 1: EFA with oblimin rotation and descriptive statistics ( $N = 271$ )

Items	Factors			Descriptive statistics			
	Meaning	Pleasure	Engag.	Min	Max	Mean	SD
12. Ma vie a un sens sur le long terme	.567			1	5	2.87	0.91
11. Je pense que j'ai une part de responsabilité pour rendre le monde meilleur	.527			1	5	3.14	1.10
5. Avant de faire quoi que ce soit, je me pose toujours la question de l'intérêt commun	.468			1	5	3.25	1.20
14. Ce que je fais compte pour les autres et donne un sens à ma vie	.455			1	5	3.07	0.92
17. J'ai déjà passé beaucoup de temps à réfléchir sur le sens de la vie et comment je me situe dans la vie	.447			1	5	2.97	1.20
1. Quelle que soit l'activités dans laquelle je suis engagé(e), je ne me rends pas du tout compte du temps qui passe				1	5	3.61	1.06
15. Je suis d'accord avec l'affirmation : "la vie est trop courte, il faut en profiter"		-.718		1	5	4.31	0.97
3. La vie est trop courte pour ne pas en profiter à chaque instant		-.648		1	5	4.01	0.98
16. J'adore les sensations que peut me procurer une activité dans laquelle je m'engage, quelle qu'elle soit	.432	-.523		1	5	3.75	0.98
13. Je choisis toujours des activités qui potentiellement vont m'apporter du plaisir		-.461		1	5	3.69	0.94
18. Pour moi, une bonne vie est une vie de plaisir		-.460		1	5	4.16	0.95
4. J'aime bien me fixer des défis personnels		-.442		1	5	3.67	0.96
10. Je me laisse rarement distraire par ce qui se passe autour de moi			-.632	1	5	2.72	0.99
7. Je suis toujours très absorbé(e) par ce que je fais			-.544	1	5	3.39	0.93
9. Avant de m'engager dans quoi que ce soit, je me demande toujours si je peux m'y engager pleinement	.441		-.505	1	5	3.14	1.07
6. Que ce soit au travail ou lors de mes loisirs, je rentre habituellement dans un état ou je m'oublie			-.501	1	5	2.86	0.93
2. Dans la vie, je sais que je fais du bien autour de moi			-.481	1	5	2.89	0.91
8. Je fais tout pour être euphorique				1	5	3.04	1.11
Parallel Analysis random values	1.47	1.38	1.31				
Eigenvalues	4.32	1.67	1.34				
% explained variance	24.1	9.3	7.5				
$\alpha$ Cronbach (internal consistency)	.92	.67	.61				
Correlations	-						
Pleasure	-.38	-					
Engagement	-.39	.30	-				

Table 2: Confirmatory Factor Analysis tested models ( $N = 222$ )

	Models	Chi <sup>2</sup>	ddl	chi <sup>2</sup> /ddl	<i>p</i>	TLI	CFI	GFI	RMSEA	RMR
M0	Null Model (18 items)	319.3	135	2.37	.00	.87	.88	.86	.07	.07
M1	Peterson et al.'s Model (18 items-3 dimensions)	227.01	132	1.72	.00	.92	.93	.90	.07	.07
M2	Model according EFA (14 items-3 dimensions)	127.12	74	1.72	.00	.91	.93	.92	.06	.07
M3	Model according EFA and Peterson et al. (12 items- 3 dimensions)	84.1	51	1.65	.00	.90	.93	.94	.05	.06
M4	Second Order Model according to EFA and Peterson et al. (12 items- 3 dimensions)	84.1	51	1.65	.00	.90	.93	.94	.05	.06

Table 3: Correlations between Happiness, Optimism, and Burnout

		Meaning	Pleasure	Engagement	EFIB
Burn Out	Exhaustion	-.16*	ns	ns	-.16*
	Devaluation	ns	ns	ns	ns
	Accomplishment	ns	ns	ns	ns
	Total Score	ns	ns	ns	-.17*
Optimism	Optimism	.21**	.26**	ns	.27**
	Pessimism	ns	-.25**	ns	-.19**
	Optimism score	.18*	.28**	ns	.26**
Satisfaction	Satisfaction orientation	ns	.19**	ns	ns
	Satisfaction results	ns	ns	ns	ns

$N = 199$ , \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

Table 4: Scores and descriptive statistics of male and female participants

	Gender	<i>N</i>	Mean	SD	<i>t</i>	ddl	<i>p</i>																																
Happiness Meaning	Male	126	3.40	.76	1.57	417	.12																																
	Female	293	3.52	.72				Happiness Pleasure	Male	126	3.91	.80	.20	417	.84	Female	293	3.93	.74	Happiness Engagement	Male	126	2.98	.71	-1.21	417	.23	Female	293	2.89	.73	Happiness total	Male	126	3.46	.53	.63	417	.53
Happiness Pleasure	Male	126	3.91	.80	.20	417	.84																																
	Female	293	3.93	.74				Happiness Engagement	Male	126	2.98	.71	-1.21	417	.23	Female	293	2.89	.73	Happiness total	Male	126	3.46	.53	.63	417	.53	Female	293	3.50	.52								
Happiness Engagement	Male	126	2.98	.71	-1.21	417	.23																																
	Female	293	2.89	.73				Happiness total	Male	126	3.46	.53	.63	417	.53	Female	293	3.50	.52																				
Happiness total	Male	126	3.46	.53	.63	417	.53																																
	Female	293	3.50	.52																																			



Table 5: Correlations between Happiness and Quality of Life

	Quality of Life									
	PHYS.	MENT.	SOC.	GENERAL	PERCEIVED HEALTH	SELF ESTEEM	ANXIETY	DEPRESSION	PAIN	INCAPACITY
Happiness-Meaning	.14**	.25**	.31**	.29**	.10*	.32**	-.27**	-.27**	-.15**	-.10*
Happiness-Pleasure	ns	.12*	ns	ns	ns	ns	-.13**	-.13**	ns	ns
Happiness-Engagement	.22**	.30**	.42**	.39**	.13**	.38**	-.28**	-.28**	-.18**	-.11*
Happiness-Total	ns	.12*	.19**	.15**	ns	.20**	-.15**	-.15**	ns	ns

$N = 426$ , \*  $p < .05$ ; \*\*  $p < .01$

Attachment to Manuscript

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Dear Editor in Chief,

First of all, we would like to thank the reviewers for their comments. We will answer each one in detail.

Reviewer #1: "French adaptation of the Orientation To Happiness Scale and the impact of Quality of Life in French Students"

The revised paper clarified most of my specific questions. I now realize that my earlier confusion with the results of Study 2 was due to the reported p-values. Basically, the author can say that a model has a good fit when s/he can retain the null (i.e. the proposed model=data). So for the author to retain the null, the p-value should be larger than the level set by the author. In Table 2, the author should list the p-value corresponding to the Chi-sq/df. For instance, for M4, if the author is going by Chi-sq/df of 1.65, the corresponding p-value should be something close to 0.20 (rather than 0.00). The p-values listed in Table 2 are not very useful for the reader.

*We agree with the reviewer's comments. However, we used several indices to assess the model fit (Hu & Bentler, 1999). First, fit of the model to the data was examined using the chi-square test. A non-significant chi-square indicates that the model was able to suitably replicate the sample covariance matrix. However, there are problems with relying solely on the chi-square test because this statistic is sensitive to both correlation size and sample size (see Kline, 2010). Consequently, we used additional well-established fit indices to further assess model fit: one indice of absolute fit, standardized root-mean square residual (SRMR); three indices of comparative fit, the comparative fit indice (CFI), the goodness of fit index (GFI), and the Tucker-Lewis indice (TLI); and a parsimony corrected fit indice, the root-mean-square error of approximation (RMSEA). We used the recommended two-indices strategies to assess fit, with values greater than .95 for CFI and TLI (Bentler, 1990; Hu & Bentler, 1999), and SRMR and RMSEA values less than .08, which suggest adequate fit (Brown & Cudeck, 1989; Hu & Bentler, 1999).*

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, 107(2), 238–246.

Brown, M. W., & Cudeck, R. (1989). Single sample cross-validation indices for covariance structures. *Multivariate Behavioral Research*, 24, 445–455.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1–55.

Kline, R. B. (2010). *Principles and practice of structural equation modeling* (3rd ed.). New York: Guilford Press.

As I said previously, the section on the benefits of happiness should be dropped from the paper I think the author has a major question of adopting Peterson's model to French data. The author should focus on the benefits of happiness in a separate paper.

*According to the reviewer's comment, this section has been deleted.*

My final major comment/request is to elaborate what cultural difference between France and the US may be there to explain some of the author's results. For instance, Item 4 (“J'aime bien me fixer des défis personnels”) loads on engagement in Peterson's study and on pleasure in the author's French study? The author only says this difference may be cultural, but it would be more interesting for the prospective reader if the author could speculate on what sort of cultural difference(s), with some useful references.

*This comment has been taken into account and the following has been added:*

*“However, we have kept the two last items, considering that these results could be justified by cultural differences. Indeed, Hofstede (1993) or McCrae and Costa (2006) have previously shown such differences among cultures. For example, Hofstede (1993) shows that there are differences in the fundamental dimensions called Competence (or assertiveness) and Warmth (or communality). “It is the degree to which tough values like assertiveness, performance, success and competition, which in nearly all societies are associated with the role of men, prevail over tender values like the quality of life, maintaining warm personal relationships, service, care for the weak, and solidarity, which in nearly all societies are more associated with women's roles. Women's roles differ from men's roles in all countries; but in tough societies, the differences are larger than in tender ones” (p. 91). More specifically concerning the differences between USA and France, Hofstede (1993) shows that with the dimensions “individualism” and “masculinity”, the USA is much more individualistic and chauvinistic than France. French society appears to rather define personal challenge as a notion of progress than competition or social comparison. On the other hand, US society appears to be more focused on competition and social comparison, and this may explain why these items didn't load on the same dimensions than in Peterson et al.'s study.*

*However, it is essential not to replicate the original questionnaire “item by item”, but to reproduce the theoretical tri-partite construction of the original OTH (Peterson et al., 2005).”*

Hofstede, G. (1993). Cultural constraints in management theories. *Academy of Management Executive*, 7(1), 81 – 94.

McCrae, R. R., & Costa P. T. (2006). Perspectives de la théorie des cinq facteurs (TCF) : traits et culture - A five-factor theory perspective on traits and culture. *Psychologie Française* 51, 227–244.

My minor comment: The revised manuscript seems to have more French than the previous manuscript. I try to be open-minded, but I would not dream of leaving as many words in my own native language in any of my papers submitted to English language journals!

*According to the reviewer's comment, this section has been deleted.*

Reviewer #2: I thought the authors had done a good job getting the publication to a publishable standard. My initial major comment was that the PCA looked to be very much data driven, and it is now clear that there is some theory behind the variables in the PCA, and the underlying reason for the analysis is clearer. My other comments have also been addressed.

*We would like to thank reviewer two for his very kind feedback.*

A handwritten signature in black ink, appearing to read 'C. Martin-Krumm', is centered on the page. The signature is stylized with a large, sweeping horizontal stroke that extends to the left and underlines the name.

*Dr. Charles Martin-Krumm*