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RESEARCH PAPER

Fatigue as Moderator of the Relationship Between Personality and the Affective Dimensions of Well-Being

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Abstract This study examines the role of fatigue as a possible moderating factor of the relationship between personality and the affective dimensions of well-being: positive affect (PA) and negative affect (NA), as well as affect balance. At the end of their work shift, 218 nursing professionals filled out self-report questionnaires assessing PA, NA, the Big Five personality dimensions and their level of fatigue. A series of moderated multiple regression analyses were conducted to test the study hypotheses. The results showed that fatigue moderates the relationship between neuroticism and NA, and the relationship between extraversion and both PA and affect balance. These findings reported here constitute strong evidence in support of temperamental and instrumental models that attempt to explain why extraversion is consistently related to PA and why neuroticism is consistently related to NA; moreover, in line with these results, it can be postulated that energy level serves as a background in which the relationship between extraversion and both PA and affect balance may become effective.

Keywords Fatigue · Well-being · Big Five · Neuroticism · Extraversion · Positive affect · Negative affect · Affect balance

1 Introduction

In a broad sense, positive affect (PA) and negative affect (NA), represent the most comprehensive conceptualization of overall mood (Watson et al. 1984), and an appropriate

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balance between them is considered one of the most fundamental components of positive mental health (Lamers et al. 2012). Consequently, questions concerning the personal characteristics and contextual factors that predict global and domain-specific subjective well-being are central to this line of research (Staudinger et al. 1999). Among the multiple predictors of well-being (e.g., DeNeve and Cooper 1998), personality has emerged over time as one of the most robust, with neuroticism and extraversion as the most important predictors, respectively, of NA and PA (Costa and McCrae 1980; DeNeve and Cooper 1998; Steel et al. 2008). Results for the other Big Five personality dimensions are more controversial (Hayes and Joseph 2003; Steel et al. 2008). Neuroticism and extraversion have thus been conceived as affect-dispositional dimensions, with extraversion predisposing individuals towards PA, and neuroticism predisposing individuals towards NA (Costa and McCrae 1980; O'Malley and Gillette 1984).

Diverse mechanisms have been proposed for explaining why extraversion is consistently related to PA and neuroticism is systematically related to NA. These have been grouped in two theoretical accounts, which are not mutually exclusive: temperamental models and instrumental models (McCrae and Costa 1991). Temperamental models can be traced back to Gray's (1982, 1991) theory of personality, and posit that there is a direct link between traits and their affective outcomes. One of the most significant temperament models, the affective-reactivity hypothesis, holds that individual differences in affect are the result of differences in the magnitude of reactions to affect-relevant events (Gross et al. 1998; Tellegen 1985). Thus, while people scoring higher in neuroticism react more strongly to punishing or unpleasant stimuli in their environment, extraverts react more intensely to rewarding or pleasant stimuli in their environment (and specifically to their approach, rather than to the enjoyment of them) (Larsen and Ketelaar 1991; Lucas and Baird 2004; Smillie et al. 2012). As a result, while neurotics maintain higher levels of long-term unpleasant affect, extraverts maintain higher long-term unpleasant affect. The other important temperament model is the affect-level model (Gross et al. 1998; Lucas and Baird 2004), which posits that extraverts and neurotics differ in their level of tonic affect (rather than in affective reactivity) in any kind of situation.

Instrumental models postulate that diverse mediation processes take place between the trait and the affective result (McCrae and Costa 1991). Traits indirectly affect outcomes through choice of situations or other intervening processes. For example, extraverts engage more than introverts in diverse types of social activity (Lucas et al. 2008). Extraverts also invest more effort in pursuing incentives and in prolonging their pleasant mood, in some cases through higher expressiveness of positive emotions (Gross and John 1998; Fleeson et al. 2002, 2003; Lischetzke and Eid 2006). In a similar vein, persons scoring high in neuroticism are more likely to attend to internal physical sensations and minor aches (Watson and Pennebaker 1989; Geisser et al. 2000). They are also more likely to notice and remember negative information and to encounter more negative life events and daily stressors (Forgas 1995; Magnus et al. 1993; Suls et al. 1998). Furthermore, neurotics tend to exaggerate the degree of threat posed by undesirable events and to underestimate the level of personal resources available for coping with the problem (Gunthert et al. 1999); in turn, they are more prone to rumination, which leads to negative emotions beyond the event, and they may even develop a sense of helplessness and pessimism as they regularly confront the same problems (Suls and Martin 2005).

As stated above, the different direct (temperamental) and indirect (instrumental) theoretical accounts are not mutually exclusive. Indeed, the association between traits and affect is expected to be determined by multiple factors (Lucas and Baird 2004), which probably reinforce each other (Suls and Martin 2005). In all cases, however, the level of

available energy seems important, so that in some instances it may increase the influence of personality on behaviour, while in others it may reduce it (Gailliot et al. 2008). Thus, fatigue may make it more difficult for extraverts to maintain the effort necessary for engaging in pleasant activities, for pursuing incentives, and for prolonging pleasant mood through their expressive behaviour, this effect being even more evident in the case of introverts (additive effect). The alternative possibility is that, under fatigue conditions, and by comparison with introverts, extraverts may be the only ones capable of sustaining the effort necessary to prolong their pleasant mood and to seek engagement in pleasant activities and incentives (interactive effect).

Similarly, and from the viewpoint of an interactive effect, under fatigue conditions people high in neuroticism may exaggerate even more the degree of threat posed by stressors, and may underestimate still more their resources available for coping with them. Since neurotics are prone to experiencing negative life events and stress more frequently (Suls and Martin 2005; Ormel and Wohlfarth 1991), they may experience, in conditions of fatigue, tense tiredness, a state characterized by low levels of energy and moderate or high levels of tension that underlies the worst types of mood (Clark and Watson 1991; Thayer et al. 1994; Thayer 2001). Furthermore, many signs of fatigue (muscular aches, numbness, stiff joints, etc.) are in fact physical symptoms, so that they are more likely to be noticed by neurotic persons, who are especially self-conscious and introspective in nature (Watson and Pennebaker 1989; Geisser et al. 2000). Once one's attention is focused on signs of fatigue, since neurotics are also more sensitive to punishing or unpleasant stimuli in their environment, they may also show hyper-reactivity to fatigue. In this sense, neuroticism (positively related), together with conscientiousness and extraversion (both of them negatively related), or adjacent constructs such as harm avoidance, self-directedness, strength of excitation and strength of inhibition (De Fruyt et al. 2000; Brebner and Stough 1995), have been found among the personality variables most strongly related to fatigue, both in healthy individuals and in patients with chronic fatigue syndrome (Matthews and Desmond 1998; De Fruyt et al. 2000; De Vries and Van Heck 2002; Michielsen et al. 2003; Jiang et al. 2003; Tanaka et al. 2010; Fukuda et al. 2010; Kangas and Montgomery 2011; Calderwood and Ackerman 2011).

In sum, we can hypothesize that fatigue, as a consequence of work or as a result of other factors, interacts with personality (and especially with extraversion and neuroticism) to impact on affect. In the present study we examine the role of fatigue as a possible moderating factor of the relationship between personality (Big Five personality dimensions) and the affective dimensions of well-being (PA and NA) in a sample of nursing professionals, a population which has frequently been linked to the experience of fatigue (Witt 2012). Specifically, we hypothesize that fatigue will be a significant moderating factor of the relationship between extraversion and PA, and between neuroticism and NA.

2 Method

2.1 Participants and Procedure

Participants were nurses working in eight different departments at seven hospitals in Madrid (Spain), and aged between 20 and 55. A total of 300 nursing professionals were initially involved. Seventy-seven declined to participate and did not return their questionnaires (response rate = 74 %). Responders and non-responders did not significantly differ from each other with respect to age and gender distribution. Five outliers were

excluded for scoring 3.09 standard deviations above the mean in NA (3), neuroticism (1), conscientiousness (1) and agreeableness (1) ($p < 0.01$; two-tailed test). The final sample consisted of 218 nursing professionals (27 men and 191 women). Mean age of responders was 35.66 years (SD = 8.06). Ninety-one (41 %) nurses filled-out the questionnaire at the end of an early-morning/early afternoon work shift, 67 (30 %) at the end of an early-afternoon/early-night work shift, 42 (19 %) at the end of an early-night/early-morning work shift, and 21 (9 %) after a 24-h work shift (in the early morning). All nurses were exposed to a rotating shift schedule, with the exception of those nurses working 24-h shifts.

Participants were required to have worked in the same department for at least 1 year. They were also required to be free from severe psychopathology or severe chronic physical illness. In accordance with procedures approved by the King Juan Carlos University human research ethics committee, participants who agreed to take part in the study were asked to fill out the questionnaire at the end of their work shift, for control purposes. The entire process was overseen by departmental supervisors, who were given 2 weeks to return the questionnaires to the researchers. A telephone follow-up to the departmental supervisors was maintained until the questionnaire process was completed.

2.2 Measures

2.2.1 Big Five Personality Dimensions

The Spanish version of the NEO-FFI (Costa and McCrae 1999) was employed to assess the Big Five personality dimensions (neuroticism, extraversion, openness to experience, agreeableness and conscientiousness). The NEO-FFI (Costa and McCrae 1992) is a 60-item version of the NEO PI-R (form S). Participants indicate on a 5-point scale the extent to which the items describe them. The Spanish version of the NEO-FFI has adequate psychometric properties, with internal consistency ranging from 0.71 to 0.82. The factor structure was also satisfactory (Costa and McCrae 1999; Manga et al. 2004). Cronbach's alpha values in the present sample were 0.73 (agreeableness), 0.76 (openness), 0.77 (conscientiousness), 0.76 (neuroticism) and 0.81 (extraversion).

2.2.2 Subjective Fatigue

As a measure of subjective fatigue after habitual activities characterized by a high degree of exertion, we used the Spanish version of the Swedish Occupational Fatigue Inventory (SOFI; González et al. 2005; Ahsberg 2000). The Spanish version of the SOFI is a 15-item instrument for the evaluation of work-related fatigue in the Spanish language. Participants have to indicate on a 10-point scale the degree to which they usually experience diverse symptoms of fatigue at the end of their work shift "as a consequence of their work". The SOFI permits the evaluation of five dimensions of fatigue: lack of energy (general feelings of diminished strength), physical exertion (whole-body sensations that may be the result of dynamic work and, to a certain extent, the sign of metabolic exhaustion), physical discomfort (local bodily sensations that may result from static or isometric workload), lack of motivation (feelings of not being involved or enthusiastic), and sleepiness. With the exception of lack of energy, each of the other four dimensions comprises three items. Lack of energy, on the other hand, can be estimated on the basis of the three remaining items focused on feelings of tiredness and exhaustion, or on the basis of the aforementioned 12 items corresponding to the other four dimensions, plus these three remaining items. We chose this second option, since it is better suited to the factor structure of the instrument

(Ahsberg 2000; González et al. 2005). Lack of energy thus acts as a general index of global fatigue. The SOFI has demonstrated appropriate score reliability and validity, with internal consistency ranging from 0.55 to 0.91 (González et al. 2005; Boada-Grau et al. 2012). Cronbach's alpha value for lack of energy in this sample was 0.87.

2.2.3 Positive and Negative Affect

Positive affect and NA were assessed by means of Bradburn's Affect Balance Scale (ABS; Bradburn 1969). This scale was derived from Bradburn's theoretical approach to subjective well-being, based on the concept of ''happiness'' defined as a preponderance of PA over NA. Five out of ten items of the instrument refer to questions about positive feelings, and the other five items refer to questions about negative feelings. Thus, the score on each subscale (PA and NA, respectively) ranges from 0 to 5. In addition, a general score on affect balance can be computed as PA minus NA plus a constant of 5 (in order to avoid negative values). The instrument has satisfactory convergent validity, as well as good test–retest correlation (Bradburn 1969; Harding 1982; Lewis et al. 2000), though its internal consistency is less satisfactory. Lewis et al. (2000) reported alpha coefficients of 0.67 for the PA subscale and 0.50 for the NA subscale. In the present study, KR20 values of 0.55 and 0.57 were obtained for the PA and NA subscales, respectively.

2.3 Statistical Analyses

First of all, zero-order correlations among the study variables were calculated. Differences between men and women in the study variables were analyzed using an independent samples t test. Differences between nurses in personality and affectivity dimensions according to the work shift in which they completed the questionnaire were explored using multivariate analysis of variance (MANOVA) to control for inflated Type I error. Similarly, differences in fatigue, according to the work shift in which the nurses completed the questionnaires, were explored using univariate analysis of variance (ANOVA). Next, to examine the hypothesis that fatigue would moderate the relationship between personality and affect, preliminary moderated multiple regression analyses for fatigue were carried out, with PA, NA and affect balance as dependent variables (Baron and Kenny 1986), using the following procedure: background variables (work shift in which the questionnaire was answered, age, and gender) were entered in step 1 to control for their effects; each personality dimension and fatigue were entered in step 2; and the interaction term of each personality dimension with fatigue was entered in the last step (step 3) of the equation. Finally, in order to reduce inflated Type I error rate, three new multiple regression analyses were conducted with PA, NA and affect balance as dependent variables, entering the background variables together with the significant terms from steps 2 and 3 of the previous preliminary analyses. Interaction effects were plotted following the Aiken and West (1991) procedure. Statistical tests were carried out in two-tailed format. Statistical significance was declared at $p < 0.05$. All statistical calculations were performed using the Statistical Package for the Social Sciences (SPSS, Windows version 19.0, SPSS, Chicago, IL, USA). Interaction effects were plotted following the Aiken and West (1991) procedures.

3 Results

3.1 Preliminary Analyses

Means, standard deviations and zero-order correlations among the study variables are shown in Table 1. Fatigue was positively correlated with neuroticism ($r = 0.14$) and NA ($r = 0.26$), and negatively correlated with openness ($r = -0.14$) and affect balance ($r = -0.20$). The personality dimensions were predominantly correlated with PA and affect balance. Only neuroticism ($r = 0.39$) was correlated with NA.

T tests showed no significant differences between men and women in fatigue, affect, extraversion, openness and conscientiousness. However, we found significant differences in neuroticism [$t(216) = -3.01$; $p = 0.00$; $d = -0.62$] and agreeableness [$t(216) = -2.63$; $p = 0.01$; $d = -0.54$], with women scoring higher than men in both variables. A multivariate main effect of the work shift in which the questionnaire was answered was found in personality [$F(15, 580) = 2.84$, $p = 0.00$; $\eta^2 = 0.06$]. Examination of univariate tests revealed significant effects of work shift in neuroticism, openness, and agreeableness, but not in extraversion or conscientiousness. Bonferroni post hoc comparisons showed that nurses filling out the questionnaire at the end of the evening work shift obtained higher scores in neuroticism than nurses answering at the end of the night work shift, and that nurses answering at the end of the 24-h work shift obtained lower scores in both openness and agreeableness than nurses responding at the end of the morning, evening or night work shifts. No multivariate main effect of work shift was found in positive and negative affect [$F(6, 426) = 1.67$, $p = 0.13$; $\eta^2 = 0.02$], and nor was a univariate effect observed in affect balance [$F(3, 214) = 2.45$, $p = 0.06$; $\eta^2 = 0.03$]. Finally, a univariate effect of work shift was found in fatigue [$F(3, 214) = 6.51$, $p = 0.00$; $\eta^2 = 0.08$], with 24-h work shift nurses showing the highest levels of fatigue. Bearing in mind that our objective in the present study was to analyze the moderating role of personality in the relationship between fatigue and well-being, we tried to eliminate the potential effect of any confounding variable linked to them. This was why the work shift in which the questionnaire was answered, age, and gender (which were linked to personality and fatigue, as showed in previous analyses) were used as covariates in the present and subsequent analyses.

3.2 Moderated Multiple Regression Analyses

Results of the moderated multiple regression analyses indicated that PA was initially predicted by age, and by each of the Big Five dimensions. The interaction term between extraversion and fatigue was also significant ($\beta = 0.14$). However, entered together in the final regression model (see Table 2), only extraversion ($\beta = 0.26$), openness ($\beta = 0.24$) and the interaction term between extraversion and fatigue ($\beta = 0.14$) remained significant. Figure 1a shows that nurses with low extraversion experienced lower PA under conditions of high fatigue than nurses with high extraversion. Under conditions of low fatigue there was no difference in PA between nurses high and low in extraversion.

Negative affect was initially predicted by fatigue, neuroticism, and the interaction term between neuroticism and fatigue ($\beta = 0.15$). Entered together in the final regression model, the three terms remained significant: fatigue ($\beta = 0.24$), neuroticism ($\beta = 0.38$) and neuroticism x fatigue ($\beta = 0.15$). Figure 1b shows that high fatigue increased the effect of neuroticism on NA. Nurses with high neuroticism experienced higher NA than nurses with low neuroticism, under both high and low fatigue conditions. However, the effect of neuroticism on NA increased under conditions of high fatigue.

Table 1 Means, standard deviations, and correlations of the study variables

	M	SD	1	2	3	4	5	6	7	8	9
1. Age	35.70	8.10									
2. Fatigue	3.18	1.63	−0.09								
3. Neuroticism	18.23	6.69	−0.06	0.14*							
4. Extraversion	31.71	7.06	−0.21**	−0.09	−0.33**						
5. Openness to experience	28.72	6.91	−0.16*	−0.14*	−0.13	0.44***					
6. Agreeableness	31.41	6.18	−0.05	−0.04	−0.11	0.27***	0.23**				
7. Conscientiousness	33.55	5.87	0.03	−0.07	−0.33**	0.29***	0.23**	0.25***			
8. Positive affect	2.19	1.18	−0.17*	−0.08	−0.22**	0.42***	0.38***	0.19**	0.18**		
9. Negative affect	0.62	0.86	−0.01	0.26***	0.39***	−0.11	0.05	−0.02	−0.01	−0.17*	
10. Affect balance	3.18	1.58	−0.13	−0.20**	−0.38***	0.37***	0.26***	0.15*	0.14*	0.84***	−0.67***

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

Table 2 Results of the final moderated multiple regression analyses for the prediction of PA, NA and affect balance

	B	SE B	95 % CI	β	R^2 cor.
Positive affect					
Background variables					
Gender	0.13	0.23	−0.32, 0.54	0.04	
Age	−0.01	0.01	−0.03, −0.01	−0.07	
Work shift	0.07	0.06	−0.04, 0.18	0.09	
Fatigue	−0.03	0.07	−0.17, 0.12	−0.02	
Big Five dimensions					
Neuroticism	−0.12	0.07	−0.28, 0.05	−0.10	
Extraversion	0.30	0.09	0.13, 0.47	0.26**	
Openness to experience	0.29	0.08	0.12, 0.45	0.24**	
Agreeableness	0.08	0.08	−0.07, 0.23	0.06	
Conscientiousness	0.02	0.08	−0.14, 0.17	0.01	
Extraversion × fatigue	0.15	0.06	0.03, 0.28	0.14*	0.23***
Negative affect					
Background variables					
Gender	−0.26	0.17	−0.59, 0.07	−0.10	
Age	0.01	0.01	−0.01, 0.02	0.03	
Work shift	−0.05	0.04	−0.13, 0.02	−0.09	
Fatigue	0.21	0.05	0.10, 0.31	0.24***	
Neuroticism	0.34	0.06	0.23, 0.45	0.38***	
Neuroticism × fatigue	0.12	0.05	0.02, 0.22	0.15*	0.21***
Affect balance					
Background variables					
Gender	0.38	0.30	−0.21, 0.98	0.08	
Age	−0.01	0.01	−0.04, 0.01	−0.08	
Work shift	0.12	0.07	−0.03, 0.27	0.11	
Fatigue	−0.23	0.10	−0.42, −0.28	−0.14*	
Big Five dimensions					
Neuroticism	−0.50	0.11	−0.72, −0.28	−0.30***	
Extraversion	0.33	0.11	0.10, 0.55	0.21**	
Openness to experience	0.18	0.11	0.03, 0.40	0.12	
Agreeableness	0.09	0.10	−0.11, 0.29	0.06	
Conscientiousness	−0.10	0.10	−0.30, 0.11	−0.06	
Extraversion × fatigue	0.25	0.08	0.08, 0.42	0.17**	0.26***

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

Finally, affect balance was initially predicted by fatigue and by each of the Big Five dimensions. The interaction term between extraversion and fatigue was also significant ($\beta = 0.18$). However, entered together in the final regression model, only fatigue ($\beta = -0.14$), neuroticism ($\beta = -0.30$), extraversion ($\beta = 0.21$), and the interaction term between extraversion and fatigue ($\beta = 0.17$) remained significant. Figure 1c shows that nurses with low extraversion experienced a lower affect balance under conditions of high

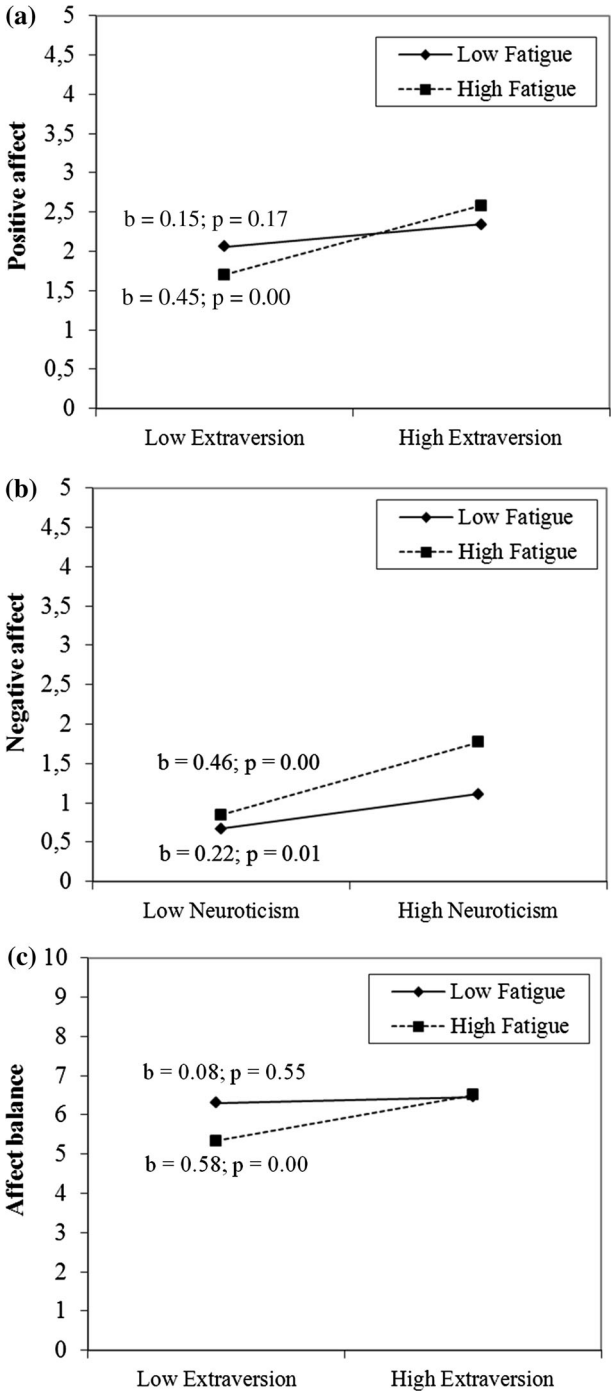

Fig. 1 Significant interaction effects between personality and fatigue on affect. **a** interaction between fatigue and extraversion on PA; **b** interaction between fatigue and neuroticism on NA; **c** interaction between fatigue and extraversion on affect balance

fatigue than nurses with high extraversion. Under conditions of low fatigue there was no difference in affect balance between nurses high and low in extraversion.

4 Discussion

To improve our knowledge of the potential mechanisms explaining the relationship between personality and affect is one of the most important challenges for Psychology (Steel et al. 2008). Fatigue, a common complaint in healthy individuals, and in most cases resulting from people's everyday activities, including work (Sluiter et al. 2003), can be conceived as a potential threat to well-being which, in interaction with personality, can erode affect and happiness.

In line with the initial hypothesis, fatigue interacted with extraversion and neuroticism to impact on affect. On the one hand, fatigue was a significant moderating factor between extraversion and PA. Positive affect has been defined as a sense experience involving pleasurable engagement with the environment to which high energy could make an important contribution (Clark et al. 1989; Lamers et al. 2012). Thus, fatigue might affect PA as an obstacle to the achievement of positive emotions and desirable life events. However, extraverted people, as a direct expression of their predisposition to pursuing incentives and to prolonging their pleasant mood, would not easily succumb to fatigue, maintaining their positive expectancies about an eventual future enjoyment of rewarding or pleasant stimuli (and consequently preserving their sense of approach to them), and their effort in seeking positive events (including social ones) and in prolonging positive emotions, for example by sustaining a higher expressiveness of positive emotions (Gross and John 1998; Fleeson et al. 2002; Lischetzke and Eid 2006; Lucas et al. 2008). The relationship between extraversion and PA would therefore be highly dependent upon the individual's level of energy, which can be seen as clear evidence in favour of temperamental and instrumental models that attempt to explain why extraversion is consistently related to PA (McCrae and Costa 1991).

On the other hand, fatigue was a significant moderating factor between neuroticism and NA. Subjective well-being, from Bradburn's perspective, is defined as a preponderance of PA over NA, NA being mostly dependent on negative emotions and undesirable life events (French et al. 1995). This is the case of fatigue, an aversive subjective state including, as well as lack of energy, experiences of discomfort and lack of motivation commonly perceived as an unpleasant experience quite unlike calm tiredness, especially when occurring at a time when the person cannot relax (Thayer 2001). Thus, people who score higher on neuroticism could also be hyper-reactive to signs of fatigue, as they are more sensitive to signs of punishment. In addition, they tend to be more self-conscious and introspective in nature, and are more likely to attend to internal physical sensations and minor aches (Watson and Clark 1984; Watson and Pennebaker 1989; Geisser et al. 2000), which may include signs of fatigue. People scoring high in neuroticism may, therefore, more often pay attention to signs of fatigue, and perceive them as more intense, their levels of NA being increased.

Apart from these explanations derived from temperamental models that attempt to explain why neuroticism is consistently related to NA, from an instrumental viewpoint there are also other ways in which fatigue and neuroticism may interact to increase people's vulnerability to NA. For example, since neurotics are prone to experiencing negative life events and stress more frequently (Forgas 1995; Magnus et al. 1993; Suls et al. 1998), they are likely, in conditions of fatigue, to experience tense tiredness, a state characterized

by low levels of energy and moderate or high levels of tension that underlies the worst types of mood (Clark and Watson 1991; Thayer 2001). Furthermore, Gunthert et al. (1999) proposed that neurotic persons both exaggerate the degree of threat posed by undesirable events (primary appraisal) and underestimate their level of personal resources (secondary appraisal) for coping with the problem. Accordingly, fatigue may even further alter neurotic individuals' appraisal of problems, because when energy drops, people lose confidence in their capacity to cope with stressors, and everything seems overwhelming for them (Thayer 1987, 2001). At the same time, as well as underestimating their capacity to cope with stressors, under fatigue people in general seem to undervalue their capacity for using other strategies of emotion regulation, such as the use of pleasant distractions (Lyubomirsky and Nolen-Hoeksema 1993). This could be especially significant for neurotics, given the well-known major presence of stress in their lives (Bolger and Zuckerman 1995; Ormel and Wohlfarth 1991).

In conclusion, while fatigue (or level of perceived energy) may strengthen the relationship between neuroticism and NA, it can also create the background against which the relationship between extraversion and PA may become effective. This latter effect of fatigue seems especially significant for the relationship between extraversion and affect balance, the general measure of well-being or happiness in the context of Bradburn's theoretical approach to subjective well-being (Bradburn 1969). All of these results have important practical implications, as they highlight the need to consider fatigue as a risk factor for well-being. This is especially significant for introverted and neurotic individuals, for whom it is crucial to guarantee correct processes of recovery (Frankenhaeuser 1978; Meijman and Mulder 1998; Kallus 2002; Sonnentag and Zijlstra 2006), with a view to increasing well-being and, in turn, preventing the development of affective disorders. Diverse strategies can be employed in this regard, including, to name but a few, frequent respites at work, moderate exercise, a nutritious diet, adequate sleep, enjoyment of recreational activities and social relationships or relaxation techniques, and adequate vacation activities and experiences (Thayer 2001; De Bloom et al. 2013).

The present study had some limitations. First, there is a need for caution in the interpretation of the findings, given the cross-sectional nature of the study. Thus, diverse alternative interpretations are also possible. For example, fatigue, studied as a moderator of the relationship between personality and affective well-being, may also be a consequence of affect. Indeed, we might expect a circular process in which fatigue can affect well-being, which in turn influences subjective fatigue state (Calderwood and Ackerman 2011). Longitudinal studies are essential for examining the predictive values and specific influence of each variable on the others over time. Second, seventy-seven of the original potential sample declined to participate. Though participants did not differ from non-participants in age or gender distribution, it may be that there were differences in their level of fatigue, and that our final sample is biased toward less fatigued individuals. With a view to generalization of the results, the broader population mentioned above must involve individuals doing activities across a range of levels in terms of how tiring they are. Third, even though in this study variables as age, gender and work shift were controlled to eliminate their potential confounding effect over fatigue, other possible factors (e.g. low job satisfaction, work stress) might have been not considered in this way, so this question should be addressed in a future direction. Finally, this study was based on a narrowly-defined population (nurses), among which fatigue is a very common symptom with potentially dangerous consequences (Witt 2012). To generalize the results, a broader population including people involved in other work-related or non-work-related fatiguing activities should be examined.

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