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INDIVIDUAL DIFFERENCES IN ENERGY-TENSION CYCLE AND SELF-REGULATION OF MOOD

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ABSTRACT. The theory of mood proposed by Thayer is examined in a sample of Spanish psychology students ($N = 176$). Results showed the existence of a circadian pattern of energy and tension levels, individual differences, such as gender, circadian type (morningness or eveningness), and some possible cross-cultural differences, though energy levels in American and Spanish samples were similar. Data also indicated differences in the assessment and interpretation of personal problems in relation to mood: according to energy level and mood, everyday problems and stress situations are interpreted in different ways. Finally, the results showed different manners in which people regulate mood. Implications for intervention and future research are discussed.

Key words: Energy-tension cycle, individual differences, regulation of mood.

DIFERENÇAS INDIVIDUAIS NO CICLO DE ENERGIA-TENSÃO E AUTOCONTROLE EMOCIONAL

RESUMO. Este estudo examinou a teoria do autocontrole emocional proposta por Thayer em uma amostra de estudantes de Psicologia da Espanha ($N=176$). Os resultados mostram a existência de um padrão dos níveis de energia em tensão, assim como diferenças individuais em função do sexo, ritmos cardíacos (matutino ou vespertino) e algumas diferenças possíveis entre as diferentes culturas, não obstante, as diferenças nos níveis de energia na amostra americana e espanhola não são significativas. Os dados obtidos indicam também diferenças na avaliação da interpretação dos problemas pessoais em relação ao estado de ânimo: em função dos níveis de energia e tensão, os problemas cotidianos e as situações estressantes são interpretadas de formas diferentes. Finalmente, os resultados mostram que as pessoas controlam a emoção de diferentes formas. Implicações dos resultados para investigação e futuras pesquisas são discutidas.

Palavras-chave: ciclo de energia e tensão, diferenças individuais, autocontrole emocional.

DIFERENCIAS INDIVIDUALES EN EL CICLO DE ENERGÍA-TENSIÓN Y AUTORREGULACIÓN EMOCIONAL

RESUMEN. El estudio examina la teoría de autorregulación emocional propuesta por Thayer en una muestra de estudiantes de psicología de España ($N = 176$). Los resultados muestran la existencia de un patrón de los niveles de energía y tensión, así como diferencias individuales en función del género, los ritmos circadianos (matutino o vespertino) y algunas posibles diferencias entre las distintas culturas, no obstante, las diferencias en los niveles de energía en la muestra americana y española no resultaron significativas. Los datos obtenidos indican también diferencias en la evaluación de la interpretación de los problemas personales en relación al estado de ánimo: en función de los niveles de energía y tensión, los problemas cotidianos y las situaciones estresantes son interpretadas de forma diferente. Finalmente, los resultados muestran que las personas autorregulan sus emociones de forma diferente. Las implicaciones de los resultados para la intervención y las futuras investigaciones son discutidas.

Palabras-clave: Ciclo de energía y tensión, diferencias individuales, autorregulación emocional.

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Mood is a central element of personality and human behaviour (Frederikson, 2002; Frederikson & Branigan, 2005), and mood management is basic to many of our everyday activities. When experiencing positive feelings, people are significantly more likely to be sociable and cooperative and to help others (Isen, 1987). In this framework, the importance of well-being, health and happiness, and their association with positive emotions, are being increasingly recognized (Avia & Vázquez, 1998; Seligman & Csikszentmihalyi, 2000; Thayer, 2001).

Emotional experience is quite varied, since it depends on how situations are experienced and assessed, and there are multiple ways of perceiving such situations. An essential question concerns the nature of emotions. Some authors claim that there are differences between emotion and mood according to antecedents, action-specificity, and time course (Ekman & Davidson, 1994; Russell & Barrett, 1999; Thayer, 1989). Emotions emerge from significant life situations and from appraisals of their significance for our well-being; moods emerge from processes that are often unknown (Goldsmith, 1994; Thayer, 1989). Secondly, emotions function mostly to bias behaviour and to select specific courses of action, whereas moods function mostly to bias cognition (Ekman & Davidson, 1994). Third, emotions emanate from short-lived events, while moods emanate from mental events that last for hours or longer. Further, a fourth difference relates to time course, in that moods are more enduring than emotions (Ekman & Davidson, 1994; Thayer, 1989).

Thayer (1996) conceptualizes mood as a subjective experience of a bio-psychological nature. Psychological, physical and social well-being, behavioural effectiveness, and the quality of interpersonal relations bring about the experience of specific emotions or of sets of sensations that define mood. The theory of mood proposed by Thayer (1978, 1989) is closely associated with central states of general bodily arousal, and involves conscious components of energy (vs. tiredness) and tension (vs. calmness). Dimensions similar to these arousal-related ones are often described as Positive and Negative Affect (Watson & Tellegen, 1985). Bodily arousal (e.g., cardiovascular, cognitive, muscle-skeletal) interacts in a somewhat general or holistic manner with positive and negative moods.

These energetic and tense arousals are two bipolar and independent dimensions that extend

from energy to tiredness and from tension to calmness, respectively. From these two continuous dimensions, four fundamental moods can be identified: calm - energy (positive mood), calm - tiredness (positive mood), tense - energy (mood not always negative) and tense - tiredness (mood related to discomfort).

Thayer suggests a circadian variation related to energy and tension, which he has demonstrated in different studies, showing that mood changes throughout the day in specific patterns (Thayer, 1978, 1987, 2001). In this sense, we experience more positive moods in periods of higher energy, and more negative moods with the appearance of tense-tiredness, a condition associated with greater vulnerability to tension, nervousness and anxiety.

In addition, energetic and tense arousal displays the following complex relationship: from low to moderate levels there is a positive correlation, and from moderate to high levels, a negative correlation.

Another important characteristic of behaviour is the ability to manage one's own thought processes, motivation and action. This is a distinctively human characteristic highlighting our active nature and the positive character of behaviour, and is demonstrated in attempts to self-regulate bad moods (Bandura, 1978; Bermúdez, 1996; Moreno-Jiménez, Garrosa & Gonzalez-Gutiérrez, 2002; Thayer, 1978).

Behavioural strategies that reduce discomfort and negative feelings, and those that raise energy are motivated by low energy levels and increased tension. Mood research on these processes can focus on type of nutrition, regularity of exercise, and indeed, every little detail or moment of the day (Thayer, 2001). Self-regulation of mood varies according to gender and personality traits. Several investigations also show that the ingestion of sugar increases both energy levels and sleep quality (Spinweber, 1981; Thayer, 1987).

Thayer (1987, 2001) pays special attention to nutrition and physical exercise, including activities that can influence levels of energy, tiredness and tension. Several studies indicate that physical exercise is a better regulator of moods than eating (Thayer, 2001). Thayer argues that moderate physical exercise has a primary mood effect of increased energy and a secondary effect of reduced tension. In other words, depending on the amount and intensity of exercise, energy will increase immediately, or, with more intense exercise, decrease initially and then increase after a time (Thayer, 1996). Supporting these ideas is

an extensive body of literature about the benefits of physical exercise on emotions (Folkins & Sime, 1981; Lox, Martin, & Petruzzello, 2003).

As far as emotional problems are concerned, there is evidence to indicate that women experience more of these types of problem than men (Fujita, Diener & Sandvik, 1991), and this may be due to the fact that women feel emotions more intensely. Women engage in rumination more frequently than men, while men tend to use distraction to deal with depression (Nolen-Hoeksema, 2003). However, when women use rumination strategies, they focus repeatedly on the negative side of problems, and this may perpetuate the depression. Findings in relation to gender differences in coping are not conclusive, however. For example, research by Nolen-Hoeksema, Morrow and Fredrickson (1993) clearly established the rumination tendency in women, but distraction was not confirmed in men; in the work of Moreno-Jimenez et al. (2002), negation strategies were found to be more frequent in men, while women showed higher scores in state-anxiety and rumination.

In any case, social support is probably an important emotional regulator (Pines & Zaidman, 2003; Thayer, Newman & McClain, 1994), and a gender difference in the tendency to seek social support has been the focus of much research. Women show social interaction tendencies when they are depressed or under stress (Amirkhan, 1990; Flaherty & Richman, 1989; Funabiki, Bologna, Pepping & FitzGerald, 1980; Houtman, 1990).

As regards inter-subject differences in energy, Thayer suggested in his first study (1978) that there were no significant differences, though differences did emerge in psycho-physiological variables such as daily cycles of temperature and cardiac rate. On the other hand, it seems true that people who experience high levels of negative affect also tend to experience high levels of positive affect (Larsen & Diener, 1987).

One of the more consistent findings in the area of personality and well-being is the association among the variables of extraversion, happiness, and positive affect (Argyle & Lu, 1990; Diener, Sandvik, Pavot & Fujita, 1992). In this sense, it seems that there are tendencies for optimism and pessimism (Scheier & Carver, 1985, 1987; Seligman, 1991) that can show oscillations throughout the day, depending on energy and tension levels (Thayer, 1987). These oscillations may explain variations in problem perception. For example, a problem is considered more difficult in a

tense-tired mood and easier in a calm-energy mood (Thayer, 1987).

Based on the above theoretical and empirical findings, the main aim of the present research was to test the theory of mood proposed by Thayer (1996) in a Spanish sample. We sought to investigate: 1) the existence of a circadian pattern of energy and tension levels, 2) the existence of differences on gender and circadian type (morningness or eveningness), 3) the existence of differences in assessment and interpretation of personal problems in relation to mood, and finally, 4) how people regulate mood.

METHOD

Subjects

The study involved 176 students on a "Personality" course, one of the units in the second-year programme of a Psychology degree at the Autonoma University of Madrid. Respondents had an average age of 19 years, and 26.5% were men and the other 73.5% women. Out of the total 176, 30.9% were assessed as 'morningness' (36% men and 64% women), while 64.2% were 'eveningness' (33.3% men and 66.6% women).

Procedure

This study was presented as an option within the Personality course, but volunteers were informed only about the procedure and were unaware of the aims of the research. Respondents made systematic self-statements on their moods every day for a period of six days using the Activation-Deactivation Adjective Checklist (Thayer, 1989). An energy/tension graph was drawn using the average scores for the six days. Subsequently, the 'best and worst times' were analyzed according to Thayer (1978), connecting positive moods with high energy level and low tension and negative moods with low energy level and high tension. According to Morningness-Eveningness Questionnaire – MEQ (Horne & Östberg, 1975) students were defined as 'morningness' or 'eveningness', respectively.

Another task involved evaluating the relevance of a present problem with the Ratings of Perceptions of Personal Problems. The specific time and the activity carried out prior to thinking about the problem were recorded and the relevance or degree of severity assigned to the problem was assessed from 1 (minimum) to 5 (maximum), over a period of three days. The purpose of this task was to analyze the relationship among problem assessment, time of day and activities carried out, in order to check whether

students with high energy and low tension levels played problems down, and whether the fact of an activity being sedentary or energetic influenced the problem evaluation. Likewise, the students' behaviours under negative moods were analyzed in order to identify unhealthy conducts.

Finally, another task was carried out to evaluate energy levels using the Self-Report of Raising Energy before and after a 10-minute walk, in order to confirm the data obtained by Thayer (1996) with respect to the benefits of regular exercise.

MEASURES

Activation-Deactivation Adjective Checklist (Thayer, 1989) was used to assess energetic and tense arousal (Thayer, 1967, 1978, 1986). This is a self-report test that provides information about the adjectives. It has been validated in a variety of ways, including through correlations with psychophysiological variables (Thayer, 1967, 1970), morningness cycles (Thayer, 1967, 1978; Thayer et al., 1994), and various kinds of performance measures (Thayer, 1978). There are five adjectives on each subscale, and each adjective is self-rated on a 5-point continuum. The adjectives included in these two subscales were, on the one hand, energetic, lively, active, vigorous, and full of pep, and on the other, tense, clutched-up, fearful, jittery, and intense. Energetic score is the total sum for the energetic items, and tense score is the total sum for the tense items. Minimum score on each subscale is 5 points, and maximum, 25 points.

Morningness-Eveningness Questionnaire – MEQ (Horne & Östberg, 1975) is a self-report measure that has been used for the assessment of preferred timing of complex behaviours. The MEQ includes 19 items, and the sum yields a global score, designated here as the Morningness-Eveningness Score (MES), ranging from 16 to 86. The highest scores indicate definite morningness, and the lowest ones definite eveningness.

Ratings of perceptions of personal problems: Self-statement of severity and relevance of problems. The questionnaire registers the activity carried out prior to self-assessment of the problem. Severity is evaluated on a 5-point continuum (from 'no worry' coded as 1 to 'very worried' coded as 5).

Checklist of strategies for changing a bad mood: This is a behaviour list for negative moods obtained by Thayer et al. (1994) in several studies since 1981.

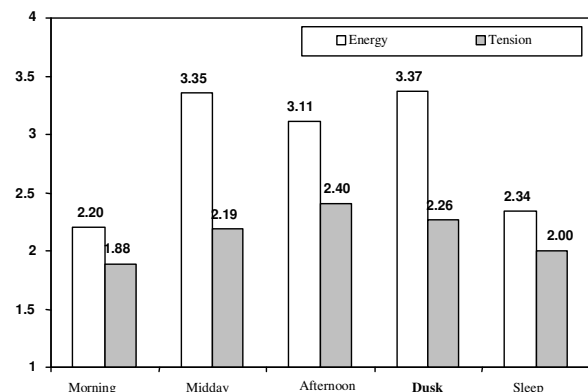
The Checklist has 32 behaviour categories used for modifying a negative mood, raising energy levels and reducing tension.

Self-report of Raising Energy: Self-statement of energy increase. Using the Activation-Deactivation Adjective Checklist (Thayer, 1989), the students assessed their energy level after a sedentary behaviour (e.g., watching TV). They then went for a ten-minute walk, after which energy level was assessed once more.

RESULTS

Cycle of Energy-Tension

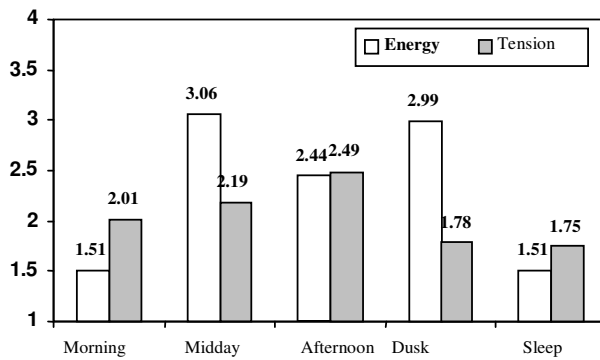
First of all, the results obtained in relation to energy and tension levels were analyzed with a statistical package. As Graph 1 shows, average energy level (E) reaches the acrophase at dusk (E=3.37), though a high point was also attained at the end of the morning (E=3.35); later, energy levels decrease until sleep. Likewise, tension (T) increases throughout the day, reaching maximum level in the afternoon (T=2.40), when energy level has decreased in relation to the late-morning level (E=3.11).



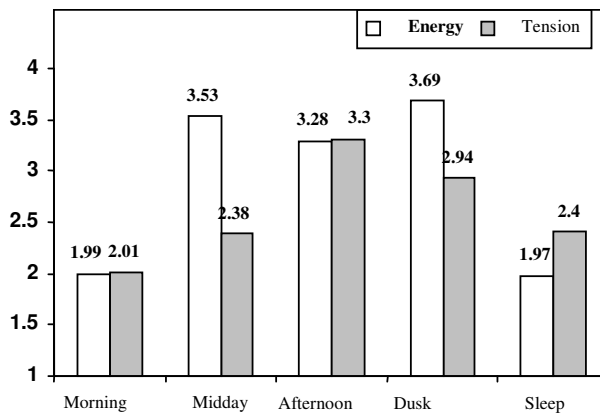
Graph 1. Energy-Tension Cycle

Considerable differences are found on analyzing energy-tension cycles according to gender, type of cycle and 'morningness'/eveningness' characteristic. Graphs 2 and 3 show different patterns from those found in Graphs 4 and 5. For example, women's energy levels (Graphs 4 and 5) throughout the day are always higher than their levels of tension, whereas in the case of men (Graphs 2 and 3) we find three points (morning, afternoon and sleep) when tension levels are higher than energy levels, so that there are significant gender differences at these times ($F_M = 15.27$, $p = 0.00$; $F_A = 13.37$, $p = 0.00$; $F_S = 29.05$, $p = 0.00$). As regards

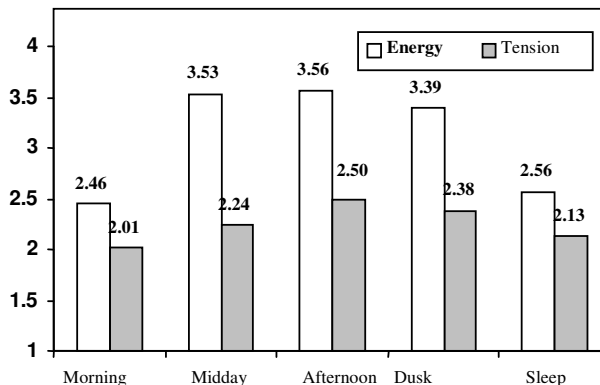
‘morningness’ and eveningness’ (Graphs 2 and 4, as compared to Graphs 3 and 5), energy acrophases appear at completely different moments of the day. For example, the highest-energy point for morningness (Graphs 2 and 4) is at noon (E_N 3.06 men; E_N = 3.53 women), whereas for eveningness (Graphs 3 and 5) it is at dusk (E_D = 3.69 men; E_D = 3.64 women). The differences at dusk are statistically significant, for both energy and tension levels ($F_{D(E)} = 6.60$, $p = 0.12$; $F_{D(T)} = 6.43$, $p = 0.13$).



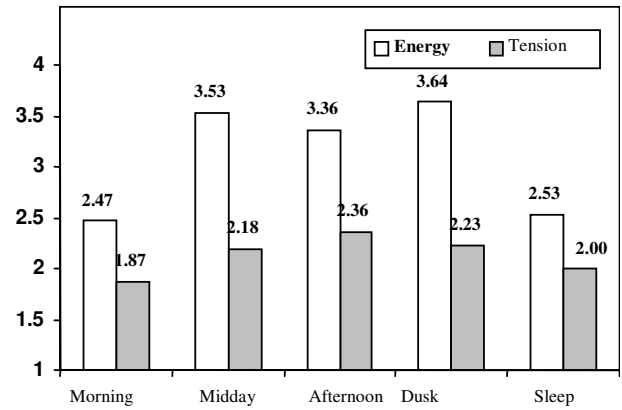
Graph 2. Men Morningness'



Graph 3. Men Eveningness



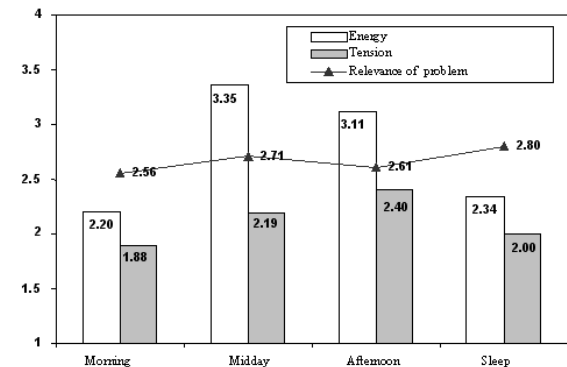
Graph 4. Women Morningness'



Graph 5. Women Eveningness'

Problem perception

Next, the data relating to previous activity, relevance of the problem and energy-tension were analyzed. The graph shows that at the time of waking up, considering Energy (E) and Tension (T) levels and problem relevance (PR), levels of energy and tension are low, with a problem relevance of 2.56, which increases to 2.71 at noon, decreasing relatively in the evening to 2.61, and reaching an acrophase just before sleep (PR=2.80), when energy and tension levels begin to decrease once more.



Graph 6. Energy-Tension-Relevance of Problem

With regard to previous activity, examination of the results obtained through self-report techniques reveals non-significant differences between kind of previous activities and problem relevance, but some tendencies were observed. For example, activities related to distraction behaviours, such as watching TV or reading, are more frequently associated with low scores in problem relevance, while activities such as thinking or chatting with friends about the problem are related to high scores in problem relevance.

Strategies for changing a bad mood

The next results analyzed concern the strategies used by the students for changing a bad mood.

According to the Thayer's theory (2001), these strategies were divided into two categories: healthy and unhealthy.

Table 1. Healthy Behaviours / Unhealthy Behaviours

Healthy behaviours	%	Unhealthy behaviours	%
Speaking to someone	86.4	Eating something	66.9
Listening to music	83.8	Avoiding someone/something that causes your negative mood	53.9
Keeping under control	70.1	Watching TV	24.0
Taking part in pleasant activities	71.7	Preferring to be alone	13.6
Trying to find reason for your mood	45.5	Smoking	5.8
Reading / Writing	36.4	Going shopping	5.2
Doing exercise	29.9	Taking stimulating substances	3.9

Talking to somebody is the healthy conduct used by the highest percentage of the sample (86.4%), followed by listening to music (83.8%), keeping under control (70.1%), taking part in pleasant activities (71.7%), trying to find the reason for one's mood (45.5%), reading or writing (36.4%) and doing exercise (29.9%). As far as unhealthy strategies are concerned, eating something is reported by the highest percentage (66.9%), followed by avoiding the person or situation that causes the negative mood (53.9%), watching TV (24.0%), trying to be alone (13.6%), smoking tobacco (5.8%), going shopping (5.2%) and taking stimulating substances (3.9%).

Energy Increase

Subjects assessed their energy levels before and after doing moderate physical exercise (a ten-minute walk). Significant differences were obtained between the two measures. Average energy level prior to the exercise was 10.73, while after the exercise it was 18.46, or rather, an increase of 7.73 ($t = -33.43$; $p = 0.00$).

However, in the Spanish sample, raw scores at dusk are even higher than at noon. These differences may be due not only to cross-cultural factors (Hanin, 2004; Natale, Adan & Scapellato, 2005), but also to the fact that most people in our study were eveningness.

The analysis of our sample revealed a characteristic pattern in eveningness of two energy acrophases: at noon and at dusk. As far as tension levels are concerned, the data fit Thayer's model (Thayer, 1987). Furthermore, energy and tension are directly related in the morning: that is, as tension increases, so does energy, until the afternoon, when the tense-calmness state appears and tension increases while energy decreases. In this mood we are prone to be more vulnerable and to develop tension that can predispose us to negative reactions. Finally, tension and energy levels decrease at sleep time. These data suggest that people are in a more positive mood at times of higher energy, with sufficient energy to take on any kind of activity, while at lower energy levels the probability of a tense-calmness state increases, with more vulnerability to tension, nervousness and anxiety.

DISCUSSION

Data obtained with this sample of Spanish students show that energy rhythms are related to moods, as Thayer's model predicts. Thus, energy levels vary throughout the day, in the same way as levels of blood sugar or noradrenalin, or heart and breathing rates (Arruda & Stern, 1999; Lane, 2005; Thayer, 1996). Results also show possible cross-cultural differences, though energy levels in American and Spanish samples show similar patterns, that is, a progressive energy increase until noon, when energy begins to decrease, and another increase at dusk.

Thus the energy-tension cycle data found in a Spanish sample are similar to those obtained by Thayer in American samples (Thayer, 1987), except that the energy acrophase in Americans (Thayer, 1996) was at 1 pm, while in the Spanish sample it was at 8 pm (dusk). The explanation for this may lie in sample characteristics and cultural/lifestyle differences, especially if we consider that our sample comprises 73.5% women and 66.6% eveningness. On the other hand, in the analysis of gender and morningness-eveningness variables, the pattern found in the woman-eveningness graph (Graphic 5) fits in with the global graph (Graphic 1).

In relation to gender and morningness-eveningness characteristics, the patterns obtained in each sub-sample show significant differences. Tension levels in men were higher than energy levels at three points in the day (waking up, afternoon and sleep time), while women had higher energy than tension levels throughout the day; and while morningness (men and women) had their energy acrophase, as Thayer predicts, around midday, the maximum energy scores for eveningness were at dusk. It would be interesting to find out whether these differences are related only to gender and morningness-eveningness characteristics, or whether they are influenced by aspects such as positive personality, optimism, resilient personality, self-esteem or self-efficacy, as well as analyzing the implication of these differences for health and well-being.

In the problem relevance study, problems are assessed as very important at sleep time, when energy levels are very low, and these results are in line with those of Thayer (1987). According to energy level and mood, everyday problems and stress situations are interpreted in different ways. When people have low energy they lack the resources to deal actively with situations (Thayer, 1996, 2001). However, when people feel energetic, moods are more positive, and they feel more optimistic and positive about solving problems and dealing with stress situations. Thus, problems – even insignificant ones – and stressors have greater impact in the tense-calmness state, when energy is lacking and people are vulnerable and prone to negative reactions (Thayer, 1996, 2005). Thayer's approach is interesting, as it opens the way for understanding and controlling problems, considering them in a relative, variable and ephemeral way like moods. As regards the activity carried out prior to problem assessment, activities more related to avoidance are associated with low scores in problem relevance, while task-orientated activities are associated with high scores (Rietjens et al., 2005).

In relation to self-regulation processes, behaviours for modifying negative moods (such as feelings of displeasure and discomfort) were analyzed. Phoning, talking to or being with someone was the behaviour most commonly used for changing a negative mood, the support provided by social interaction tending to relieve tension: we feel better talking to someone who can calm us down or help us. In turn, social interaction is a cognitive distracting factor that frees our mind from problematic thoughts, and a pleasant activity that improves moods, as Thayer et al. (1994) also found. Finally, doing exercise is the behaviour considered most beneficial for changing mood. It is not necessary

to do intensive exercise: immediately significant results in moods, and in the long term in health, can be achieved through moderate exercise (Blair et al., 1989; Thayer, 1987). A brisk, five or ten-minute walk produces an immediate energy increase that improves mood (Thayer, 2001). Even so, many people undoubtedly use behaviours such as smoking, drinking alcohol, taking drugs and eating excessively to modify their negative moods. These findings are interesting, since it is clear that people can learn to self-regulate their moods through more effective and positive behaviours (with beneficial consequences in psychological, physical and social health in the long term), such as doing exercise, relaxation techniques, breathing exercises, and so on (Palmero & Fernández-Abascal, 1998; Thayer, 2001). Moreover, negative moods may lead to psychopathologies such as depression, low self-esteem, negative thoughts and certain dysfunctional behaviours; on the other hand, positive moods, and personal control are adaptive, enhancing mental and physical health (Seligman, 1991; Taylor & Brown, 1988). Coping strategies and overall emotional maturity are critical to control and manage moods, and to have a large list of coping strategies according to the situations (Saarni, 1997). In this sense, emotionally mature people who are aware of their moods, can control and manage their feelings in a positive way. For example, they will do exercise when they feel in a negative mood, and will avoid drinking alcohol or eating to modify it, in the knowledge that these types of behaviour do not change moods effectively – that is, they will use positive coping strategies, with beneficial effects for health in the long term. Emotionally mature people know that they can modify their moods for their own good, guiding themselves towards well-being and happiness. From this perspective, positive thoughts about oneself are associated with positive emotions and the energy necessary for achieving our important goals (Harter, 1986, 1999).

The present study adds to previous research by examining Thayer's Biopsychological Model of Mood and Arousal (Thayer, 1979; 1989) in a Spanish sample and finding possible cross-cultural differences. However, future research would be needed to compare American and Spanish samples. This research also finds gender differences and variations in energy-tension cycles resulting from morningness and eveningness dispositions. Based on the reviewed studies that state that gender differences on emotion regulation exist (see, Díaz-Morales, 2007; Fujita, Diener & Sandvik, 1991; Gross & John, 2003), we consider it as the main individual variable to control,

although it is quite clear that personality variables, as emotional stability, would be worthy of consideration as control variables in future developments. Another important limitation of the Thayer's theory relates to the issue of what extent these circadian variations are dependent on wake-sleep cycles rather than time of day per se. An additional concern is the fact that the present study relied solely on self-report measures, although these instruments are widely validated with psycho-physiological indicators (Thayer, 1987). However, we acknowledge that future researches would benefit by including both subjective and objective indicators to study these personality differences.

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