

some authors suggest cultural and environmental factors may also modulate circadian typology (Randler & Díaz-Morales, 2007). Morningness has also been found to be associated with cortisol awakening response, the response being larger in individuals waking up earlier in the morning (Fries et al., 2009; Kudielka et al., 2007; Randler & Schaal, 2010), suggesting it only emerges when the organism must confront the activity of the daily upcoming demands. Studies on psychiatric disorders and circadian typology suggest ET is a risk factor for attention-deficit and hyperactivity disorder (Caci et al., 2009a), bulimia nervosa and hiperphagia (Fleig & Randler, 2009; Natale et al., 2008), addiction (Adan et al., 2004; Falcon & McClung, 2009; Prat & Adan, 2011), or depressive symptoms (Grandin et al., 2006; McClung, 2007).

For the purpose of understanding the relationships between circadian rhythms and behavior, specific research on personality has been conducted during the past several decades using different questionnaires and morningness measures. Some authors suggest the differences observed in previous results on the association between morningness and personality might have to do with the different theoretical models used to assess personality (Randler, 2008; Tsaousis, 2010), rather than with the different measures used to assess morningness, as none of them seems to be psychometrically superior (Di Milia et al., 2008). Research on this topic in adult samples has found negative, although very low, correlations between morningness and extraversion, and it was suggested they were probably due to the impulsive component inherent to the extraversion dimension (Tankova et al., 1994). Further research has shown significant negative correlations between morningness and impulsivity (Caci et al., 2005), and a recent study (Adan et al., 2010b) using Dickman's Impulsivity Model (Dickman, 1990) has shown MT present lower scores in dysfunctional impulsivity, a result that was significantly determined by male scores. Studies using the lexical Big Five model of personality (Costa & McCrae, 1992; Rammstedt & John, 2007) reported MT tend to be more conscientious and agreeable (Hogben et al., 2007; Tonetti et al., 2009; Tsaousis, 2010). A positive correlation has also been found between morningness and Stability, which is the metatrait resulting from the shared variance of Neuroticism reversed, Agreeableness, and Conscientiousness (DeYoung et al., 2007). A study by Adan et al. (2010a), which measured personality with the Temperament and Character Inventory (TCI; Cloninger et al., 1993), showed in both sexes that ET presented lower scores than MT in persistence and self-directedness, whereas lower scores in harm avoidance and higher scores in novelty seeking were only observed in ET men (Caci et al., 2004). Another study with a student sample (Muro et al., 2009) using the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ; Zuckerman et al., 1993) found MT scored significantly higher than did ET and NT on Activity. A significant interaction between

circadian typology and sex was found for Neuroticism-Anxiety: MT men tend to be more anxious than ET and NT men, whereas the opposite pattern was found in women: NT showed higher scores than did ET and MT. No significant results were found in Impulsive-Sensation Seeking dimension. However, a recent study by Tonetti et al. (2010) using Zuckerman's Sensation-Seeking Scale (Zuckerman et al., 1978) reported ET obtained significant higher scores than MT in the sensation-seeking trait.

The present work aims to study in greater depth the association between Activity and morningness and to clarify the relationship of morningness with Impulsive Sensation-Seeking using the ZKPQ. The need for disentangling the relationship between personality and daily biological rhythms might help researchers explain the origins of the most relevant human evolutionary and survival behaviors (Eysenck, 1992) and, thus, to understand the genesis and development of personality structures in which the hypothalamus also plays a central role (Zuckerman, 2005). For this purpose, we used a larger and more representative sample from the first study using the ZKPQ (Muro et al., 2009), including not only students but also workers, widening the age range to include young adults and adults so as to control life span-age differences. Likewise, since a significant interaction between circadian typology and sex was found, and according to life span differences in women (Randler & Bausback, 2010), a sample constituted exclusively of women was used.

MATERIALS AND METHODS

Participants and Procedure

The initial convenience sample consisted of 436 women (full-time students = 40.5% and workers = 59.5%). They completed the questionnaires anonymously between the months of January and March. All participants gave informed consent prior to their inclusion in the study and did not receive any academic school credit for their collaboration. Inattention and social desirability were controlled through the Infrequency scale of the ZKPQ: participants scoring ≥ 4 (1.8%) and those with incomplete forms (3.7%) were rejected (Gomà-i-Freixanet et al., 2004). The final sample consisted of 412 women ranging in age from 18 to 55 yrs (mean = 30.71; SD = 11.27; median = 28). Women were distributed into three age groups (Gomà-i-Freixanet & Valero, 2008): 18–25 yrs (mean = 19.83; SD = 1.79 yrs); 26–40 yrs (mean = 31.96; SD = 4.05 yrs); and 41–55 yrs (mean = 47.72; SD = 3.92 yrs). The Ethical Committee of the university approved the protocol, and the study met the international standards of ethical chronobiology research (Portaluppi et al., 2010).

Materials

To assess circadian typology, participants completed the Spanish version of the reduced Morningness-Eveningness Questionnaire (rMEQ; Adan & Almirall, 1991). It consists

of five items covering daily physical performance and sleep/awake preferences. Three circadian typologies can be determined by the cutoff scores: scores ranging from 4 to 11 classify individuals as evening-type (ET), from 12 to 17 as neither-type (NT), and those from 18 to 25 as morning-type (MT). The rMEQ shows convergent validity with other morningness measures, such as the Composite Scale of Morningness or the Morningness-Eveningness Questionnaire (Caci et al., 2009b), and it is a reliable measure that shows high sensitivity in classifying subjects in the dimension of morningness-eveningness. The internal reliability for the present sample in terms of the Cronbach's α was 0.73.

To assess personality, the Spanish adaptation of the ZKPQ (Gomà-i-Freixanet & Valero, 2008; Gomà-i-Freixanet et al., 2004) was administered. It consists of 99 dichotomous items covering five scales and an additional Infrequency (Infreq; 10 items) scale that allows eliminating subjects with careless or social desirability responding. This scale ensures that none of the basic traits are affected by this response-set bias. The five personality dimensions are *Neuroticism-Anxiety*, *Activity*, *Sociability*, *Impulsive Sensation-Seeking*, and *Aggression-Hostility*. *Neuroticism-Anxiety* (N-Anx; 19 items) describes frequent emotional upset, tension, worry, fearfulness, indecision, lack of self-confidence, and sensitivity to criticism. *Activity* (Act; 17 items) has two subscales. The first one, *General Activity*, describes the need for general activity and impatience or restlessness when there is nothing to do. The second, *Work Activity*, measures preference for challenging and hard work, active busy life, and high energy level. *Sociability* (Sy; 17 items) also involves two subscales. *Parties and Friends* describes the number of friends and amount of time spent with them, outgoingness at parties, and preference for being with others, whereas *Isolation Intolerance* indicates intolerance for social isolation and for engaging in solitary activities. *Impulsive Sensation-Seeking* (ImpSS; 19 items) is a factor that describes *Impulsivity* as a lack of planning, tendency to act impulsively without thinking, and *Sensation Seeking* as seeking of excitement, novel experiences, and willingness to take risks for these types of experiences. Finally, *Aggression-Hostility* (Agg-Host; 17 items) reflects a readiness to express verbal aggression; rude, thoughtless, or antisocial behavior; vengefulness and spitefulness; having a quick temper; and impatience with others. The questionnaire has demonstrated good

internal reliability, temporal stability, validity, and cross-cultural replication (Gomà-i-Freixanet et al., 2008a, 2008b; Martínez et al., 2010; Zuckerman, 2002).

Data Analysis

Pearson's correlations were computed between the scores of the different personality scales, and between these and direct scoring on the rMEQ. Two multivariate analyses of variance (MANOVAs) were performed, one considering the dimensions and the other considering the scores of the subscales of the ZKPQ as dependent variables and taking circadian typology (morning-, neither-, evening-type) and the three age groups (18–25, 26–40, 41–55 yrs) as factors. Partial eta-square (η^2) and Cohen's d were obtained as a measure of effect size. Moreover, for each personality dimension a multiple regression analysis was performed to detect which factor (rMEQ score, age, or their interaction) was the best predictor. Data analyses were performed using the SPSS statistical package (version 17.0; Chicago, IL, USA), and statistical tests were bilateral with Type I error set at 5%.

RESULTS

The distribution of participants was as follows: MT made up 19.17% of the sample, NT 57.04%, and ET 23.79% (Table 1). The circadian typology groups differed significantly on age ($F(2, 409) = 29.43; p < .0001; \eta^2 = .126$). Post hoc comparisons showed MT women were older (mean \pm SD: 37.88 \pm 9.83 yrs) than NT (28.57 \pm 11.45 yrs) and ET (28.27 \pm 8.61 yrs) ones. The MT group differed from NT (Cohen's $d = 0.85$) and ET (Cohen's $d = 1.04$) groups.

The internal consistency (Cronbach's α) of the personality scales was (from lower to higher): 0.67 for Agg-Host, 0.71 for Act, 0.74 for Sy, 0.80 for ImpSS, and 0.85 for N-Anx. Correlations between ZKPQ dimensions, total rMEQ score, and age are shown in Table 2. Age showed a significant positive association with rMEQ. In contrast, age showed significant negative correlations with N-Anx, Sy, ImpSS, and Agg-Host. Significant negative correlations were also found between rMEQ scores and N-Anx, Sy, ImpSS, and Agg-Host, whereas a positive one was found between rMEQ and Act.

Further analyses using MANOVA showed significant differences between age groups and ZKPQ scales. The younger group (18–25 yrs) showed significantly higher

TABLE 1. Number of subjects by age and circadian typology group

Age group	Circadian typology			Total
	MT	NT	ET	
18–25 yrs	32	127	8	167 (40.53%)
26–40 yrs	39	61	49	149 (36.16%)
41–55 yrs	8	47	41	96 (23.30%)
Total	79 (19.17%)	235 (57.03%)	98 (23.78%)	412

MT = morning-type; NT = neither-type; ET = evening-type.

TABLE 2. Correlations among ZKPQ scales, age, and total score of the rMEQ

	Age	rMEQ	N-Anx	Act	Sy	ImpSS
rMEQ	0.319**					
N-Anx	-0.151**	-0.103*				
Act	0.081	0.190**	0.065			
Sy	-0.267**	-0.116*	-0.037	0.114*		
ImpSS	-0.291**	-0.200**	0.165**	0.143**	0.212**	
Agg-Host	-0.221**	-0.194**	0.304**	0.045	0.145**	0.328**

rMEQ = reduced Morningness-Eveningness Questionnaire; N-Anx = Neuroticism-Anxiety; Act = Activity; Sy = Sociability; ImpSS = Impulsive Sensation Seeking; Agg-Host = Aggression-Hostility.

* $p < .05$; ** $p < .01$.

TABLE 3. Descriptive statistics (mean \pm standard error) for each scale of the ZKPQ by age and circadian typology

ZKPQ	Age group (yrs)			Circadian typology		
	18-25 ($n = 167$)	26-40 ($n = 149$)	41-55 ($n = 96$)	ET ($n = 79$)	NT ($n = 235$)	MT ($n = 98$)
N-Anx	8.95 \pm 0.60	6.87 \pm 0.37	7.58 \pm 0.62	7.78 \pm 0.64	8.56 \pm 0.32	7.07 \pm 0.61
Act	8.28 \pm 0.47	7.76 \pm 0.29	8.35 \pm 0.48	7.10 \pm 0.50	7.99 \pm 0.25	9.29 \pm 0.48
GenAct	4.03 \pm 0.29	3.69 \pm 0.18	4.17 \pm 0.30	3.33 \pm 0.31	3.87 \pm 0.15	4.68 \pm 0.30
WorkAct	4.25 \pm 0.23	4.07 \pm 0.14	4.19 \pm 0.24	3.76 \pm 0.25	4.13 \pm 0.12	4.61 \pm 0.24
Sy	9.10 \pm 0.43	7.87 \pm 0.27	7.14 \pm 0.44	8.28 \pm 0.46	8.21 \pm 0.23	7.61 \pm 0.44
Parties	3.37 \pm 0.24	3.01 \pm 0.15	2.69 \pm 0.25	3.25 \pm 0.26	3.06 \pm 0.13	2.77 \pm 0.25
Isol	5.73 \pm 0.28	4.86 \pm 0.17	4.45 \pm 0.29	5.04 \pm 0.30	5.16 \pm 0.15	4.85 \pm 0.29
ImpSS	9.10 \pm 0.54	7.28 \pm 0.33	6.56 \pm 0.55	8.56 \pm 0.57	7.60 \pm 0.28	6.79 \pm 0.55
Imp	2.89 \pm 0.28	2.82 \pm 0.17	2.56 \pm 0.29	3.22 \pm 0.30	2.77 \pm 0.15	2.26 \pm 0.29
SS	6.22 \pm 0.36	4.46 \pm 0.22	4.00 \pm 0.37	5.34 \pm 0.38	4.82 \pm 0.19	4.52 \pm 0.37
Agg-Host	7.94 \pm 0.40	6.79 \pm 0.25	6.57 \pm 0.41	8.01 \pm 0.42	7.02 \pm 0.21	6.27 \pm 0.41

N-Anx = Neuroticism-Anxiety; Act = Activity; GenAct = General Activity; WorkAct = Work Activity; Sy = Sociability; Parties = Parties and Friends; Isol = Isolation Intolerance; ImpSS = Impulsive Sensation Seeking; Imp = Impulsivity; SS = Sensation Seeking; Agg-Host = Aggression-Hostility; ET = evening-type; NT = neither-type; MT = morning-type.

TABLE 4. Change statistics (R^2 , F) from multiple regression performed for each dimension of the ZKPQ

ZKPQ	Age			rMEQ			rMEQ scores \times Age		
	R^2	F	p value	R^2	F	p value	R^2	F	p value
N-Anx	0.023	9.65	0.002	0.026	1.37	0.242	0.032	2.35	0.126
Act	0.006	2.67	0.103	0.036	12.73	<0.001	0.039	1.15	0.285
GenAct	0.009	3.87	0.050	0.039	12.45	<0.001	0.045	2.77	0.097
WorkAct	0.002	0.71	0.399	0.020	7.81	0.005	0.020	0.01	0.939
Sy	0.071	31.45	<0.001	0.072	0.46	0.499	0.076	1.58	0.210
Parties	0.032	13.38	<0.001	0.035	1.57	0.211	0.051	6.62	0.010
Isol	0.067	29.66	<0.001	0.067	0.00	0.963	0.068	0.81	0.777
ImpSS	0.085	38.15	<0.001	0.098	5.78	0.017	0.098	0.01	0.916
Imp	0.010	4.15	0.042	0.026	6.85	0.009	0.027	0.33	0.564
SS	0.124	57.80	<0.001	0.128	2.30	0.130	0.129	0.37	0.543
Agg-Host	0.050	21.46	<0.001	0.066	7.34	0.007	0.067	0.28	0.596

The variables considered were age, rMEQ scores, and their interaction computed as the product of the two former variables.

rMEQ = reduced Morningness-Eveningness Questionnaire; N-Anx = Neuroticism-Anxiety; Act = Activity; GenAct = General Activity; WorkAct = Work Activity; Sy = Sociability; Parties = Parties and Friends; Isol = Isolation Intolerance; ImpSS = Impulsive Sensation Seeking; Imp = Impulsivity; SS = Sensation Seeking; Agg-Host = Aggression-Hostility.

scores than the older groups (26-40 yrs and 41-55 yrs) on N-Anx ($F(2, 403) = 4.31$; $p = .014$; $\eta^2 = .021$), Sy ($F(2, 403) = 5.27$; $p = .006$; $\eta^2 = .025$), Isol ($F(2, 403) = 5.49$; $p = .004$; $\eta^2 = .027$), ImpSS ($F(2, 403) = 6.11$; $p = .002$; $\eta^2 = .029$), SS ($F(2, 403) = 11.19$; $p < .001$; $\eta^2 = .053$), and Agg-Host ($F(2, 403) = 3.73$; $p = .025$; $\eta^2 = .018$).

MANOVA also showed significant differences among circadian types on the scales of the ZKPQ. The chronotypes differed on Act ($F(2, 403) = 5.17$; $p = .006$; $\eta^2 = .025$), GenAct ($F(2, 403) = 5.16$; $p = .006$; $\eta^2 = .025$), WorkAct ($F(2, 403) = 3.08$; $p = .047$; $\eta^2 = .015$), and Agg-Host ($F(2, 403) = 4.50$; $p = .012$; $\eta^2 = .022$). Post hoc

comparisons showed significant differences between the MT and the other two groups, with scores of MT being significantly higher for Act and GenAct and lower for Agg-Host. For the WorkAct subscale, only significant differences between MT and ET were obtained (Table 3). A tendency toward significance for ImpSS and its Imp subscale was noted, with post hoc comparisons showing significant differences between MT and ET on both scales ($p < .05$) and with ET obtaining significant higher scores than MT. Any interaction between circadian typology and age was statistically significant.

Multiple regression analyses, considering the rMEQ scores and age as continuous variables, provided similar results as those obtained with MANOVA, when both variables were transformed into three categories. Change statistics (R^2 , F) obtained with this approach are shown in Table 4. Statistical significance of morningness and age interaction was found only for the Parties subscale ($F(2, 403) = 6.62$; $p = .010$), i.e., being older and scoring high on morningness showed the lowest scores on Parties (mean = 1.93; SD = 1.89), whereas younger women scoring high on morningness obtained the highest scores in this subscale (mean = 3.50; SD = 2.51).

DISCUSSION

The present study replicates the usual distribution of morningness (Randler, 2007; Tonetti et al., 2009; Tsaousis, 2010), and as found in previous studies the three typologies differed significantly on age (Adan et al., 2010b; Díaz-Morales, 2007; Randler, 2008), with MT being oldest. The distribution of the three chronotypes in the sample showed skewing towards eveningness in the youngest group (18–25 yrs), whereas the distribution in the oldest group (41–55 yrs) showed skewing towards morningness. These results are in line with the hypothesis that the increase of sexual hormones in adolescence mediates a change towards eveningness, whereas the decrease of sexual hormones during menopause increases morningness (Randler & Bausback, 2010). Mean differences in personality dimensions for the three age groups followed the same tendencies as those obtained in other Spanish samples (Gomà-i-Freixanet & Valero, 2008; Gomà-i-Freixanet et al., 2004).

Regarding morningness and personality, the three circadian typologies differed on Activity and its two subscales of General Activity and Work Activity, showing that MT women are more active than NT and ET women. Thus, MT women might be described as persons who require general activity, are unable to relax and do nothing when the opportunity arises, have a preference for hard and challenging work, and show an active and busy life of high energy level. These results are in accordance with another study using the ZKPQ (Muro et al., 2009), and they seem to suggest peak-value differences on activity rhythms might be closely related to the biological origins of the behavioral

activity of women of all ages. Thus, confronting daily upcoming demands (Fries et al., 2009) might make individuals increase their activity levels and, therefore, their awakening time. Additionally, it has been suggested that the hormonal changes that occur across women's life span and individual differences in hypothalamic-pituitary-adrenal (HPA) axis functioning mediate women's activity and morningness levels (Netter, 2004; Randler & Bausback, 2010; Randler & Schaal, 2010). It might also be possible the correlations found in former studies between Extraversion and morningness could be due to the activity trait of the Extraversion dimension (Eysenck, 1992), and not just due to its impulsive component, as some authors have suggested (Adan et al., 2010b; Caci et al., 2005; Tankova et al., 1994).

The findings for the Impulsive Sensation-Seeking dimension, which is considered equivalent to the Big Five's Conscientiousness factor reversed and very close to Cloninger's Novelty Seeking (Zuckerman & Cloninger, 1996), are similar to those obtained in previous studies (Adan et al., 2010a; Caci et al., 2004, 2005; Tonetti et al., 2010). In the present study, ET women scored significantly higher than MT in this dimension. ET, compared to MT, showed more pronounced lack of planning, tendency to act impulsively without thinking, seeking of excitement and novel experiences, and willingness to take risks just for the sake of these types of experiences. The obtained results also confirm a significant association between circadian typology and Aggression-Hostility, suggesting ET women tend to express more frequently than MT and NT verbal aggression, antisocial behavior, vengefulness, and spitefulness, plus having a quick temper and impatience with others. This result is in line with ones previously found with other personality models (DeYoung et al., 2007; Tsaousis, 2010). Nevertheless, instead of interpreting this result as a risk for developing aggressive disorders, and taking into account the ZKPQ measures normal personality traits, it is suggested that ET might have less social skills than MT and NT, being more aggressive in social interactions, and, thus, they might have problems in adapting to social rules and showing normative behavior. However, no statistical differences were observed in N-Anx among the circadian typologies. This result is different than that found in students of a narrow age range (Muro et al., 2009), suggesting differences in N-Anx between circadian chronotypes are reduced with advancing age. We have to mention as well the present results regarding ImpSS and Agg-Host are different from ones previously found using the ZKPQ, in which no statistically significant relationships were found with morningness. In the future, the present results should be replicated in a male sample, since ImpSS and Agg-Host correlate with testosterone levels (Zuckerman, 2005), and a stronger association with circadian typology due to biological sex differences would be expected.

The obtained results on the relationship between circadian typology and personality are of interest for two

reasons. First, results on Activity, considered as a basic developmental trait of temperament (Buss & Plomin, 1984), and part of Eysenck's Extraversion broad dimension (Eysenck, 1992; Zuckerman et al., 1993), have been replicated. They suggest that future research on biological rhythms and personality in humans should take into account personality models that include measures such as behavioral activity levels, need of stimulation through motor behavior, or regulation of arousal level (Zuckerman, 2005). According to our results, it might be stated that higher behavioral activity levels correlate with environmental sunlight preference in women, probably because daily light input facilitate alertness and vigilance and, thus, humans' general activity. Future research on this topic should also be studied together with biological correlates, such as cortisol daily peak values and awakening responses effect on the HPA axis that might influence individual differences in performance and activity organization (Fries et al., 2009; Kudielka et al., 2007). Second, and in line with Adan et al. (2010b), we believe morningness should be regarded as an important protective factor that helps humans succeed in adapting their behavior to environmental demands, instead of signaling psychological risks of belonging to the eveningness group and being prone to impulsive and aggressive disorders.

In summary, morning-type women are more active, less impulsive, and less aggressive than evening-type and neither-type women. Nevertheless, before generalizing, these results should be replicated in a representative male sample of wide age range, since sex differences are significant when exploring the biological basis of personality (Adan et al., 2010a, 2010b; Gomà-i-Freixanet et al., 2008b; Zuckerman, 2002). This study encourages the use of biological personality models in the study of the relationship of chronotype with biological rhythms in order to reach coherent conclusions on the topic. The use of lexical personality models might lead to misleading conclusions, since they rely on the encoding of personality traits in language and reflect observed behaviors in social interactions, but they may not necessarily mirror and explain the proportional biological relevance of these traits in human evolution (Zuckerman, 2005). Therefore, using psychobiological models allows researchers to explore the causal and biological origins of behavior (Eysenck, 1992; Gomà-i-Freixanet et al., 2004). The relevance of the hypothalamus, both for personality development (Zuckerman, 2005) and for biological rhythms processes (Levy & Schibler, 2007), might be a key point to explore such origins.

Finally, it is suggested that circadian typology and personality variables should be included in the design of educational and working schedules, as individuals do not respond equally to environmental demands. As much as possible, individual differences in biological activity rhythms should be taken into account in therapeutic approaches in order to design more personalized

and effective health prevention programs and psychological interventions.

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REFERENCES

- Adan A, Almirall H. (1991). Horne and Östberg morningness-eveningness questionnaire: a reduced scale. *Pers. Individ. Differ.* 12:241-253.
- Adan A, Natale V. (2002). Gender differences in morningness-eveningness preference. *Chronobiol. Int.* 19:709-720.
- Adan A, Prat G, Sánchez-Turet M. (2004). Effects of nicotine dependence on diurnal variations of subjective activation and mood. *Addiction* 98:1599-1607.
- Adan A, Lachica J, Caci HNatale V. (2010a). Circadian typology and temperament and character personality dimensions. *Chronobiol. Int.* 27:181-193.
- Adan A, Natale V, Caci H, Prat G. (2010b). Relationship between circadian typology and functional and dysfunctional impulsivity. *Chronobiol. Int.* 27:606-619.
- Buss A, Plomin R. (1984). *Temperament: early developing personality traits* (200 pages). Hillsdale, NJ: Erlbaum.
- Caci H, Robert P, Boyer P. (2004). Novelty seekers and impulsive subjects are low in morningness. *Eur. Psychiatr.* 19:79-84.
- Caci H, Mattei V, Baylé FJ, Nadalet L, Dossios C, Robert P, Boyer P. (2005). Impulsivity but not Venturesomeness is related to Morningness. *Psychiatr. Res.* 134:259-265.
- Caci H, Bouchez J, Baylé FJ. (2009a). Inattentive symptoms of ADHD are related to evening orientation. *J. Atten. Disord.* 13:36-41.
- Caci H, Deschaux O, Adan A, Natale V. (2009b). Comparing three morningness scales: age and gender effects, structure and cut-off criteria. *Sleep Med.* 10:240-245.
- Cloninger CR, Svrakic DM, Przybeck TR. (1993). A psychobiological model of temperament and character. *Arch. Gen. Psychiatr.* 50:975-990.
- Costa PT, McCrae RR. (1992). Four ways five factors are basic. *Pers. Individ. Differ.* 13:653-665.
- DeYoung C, Hasher L, Djikic M, Criger B, Peterson JB. (2007). Morning people are stable people: circadian rhythm and the higher-order factors of the Big Five. *Pers. Individ. Differ.* 43:267-276.
- Díaz-Morales JF. (2007). Morning and evening-types: exploring their personality styles. *Pers. Individ. Differ.* 43:769-778.
- Dickman SJ. (1990). Functional and dysfunctional impulsivity: personality and cognitive correlates. *J. Pers. Soc. Psychol.* 58:95-102.
- Di Milia L, Bohle P. (2009). Morningness or morning affect? A short composite scale of morningness. *Chronobiol. Int.* 26:494-509.
- Di Milia L, Wikman R, Smith P. (2008). Additional psychometric evidence and construct validity for a revised Preferences Scale of Morningness. *Chronobiol. Int.* 25:776-787.
- Eysenck HJ. (1992). Four ways five factors are not basic. *Pers. Individ. Differ.* 13:667-673.
- Falcon E, McClung CA. (2009). A role for the circadian genes in drug addiction. *Neuropharmacology* 56:91-96.
- Fleig D, Randler C. (2009). Association between chronotype and diet in adolescents based on food logs. *Eat. Behav.* 10:115-118.
- Fries E, Dettenborn L, Kirschbaum C. (2009). The cortisol awakening response CAR: facts and future directions. *Int. J. Psychophysiol.* 62:67-73.

- Gomà-i-Freixanet M, Valero S. (2008). Spanish normative data of the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ) in a general population sample. *Psicothema* 20:324-330.
- Gomà-i-Freixanet M, Valero S, Puntí J, Zuckerman M. (2004). Psychometric properties of the Zuckerman-Kuhlman Personality Questionnaire in a Spanish sample. *Eur. J. Psychol. Assess.* 20:134-146.
- Gomà-i-Freixanet M, Wismeijer AAJ, Valero S. (2005). Consensual validity parameters of the Zuckerman-Kuhlman Personality Questionnaire: evidence from self-reports and spouse reports. *J. Pers. Assess.* 84:279-286.
- Gomà-i-Freixanet M, Soler J, Valero S, Pascual JC, Pérez V. (2008a). Discriminant validity of the ZKPQ in a sample meeting BPD diagnosis vs. normal-range controls. *J. Pers. Disord.* 22:178-190.
- Gomà-i-Freixanet M, Valero S, Muro A, Albiol S. (2008b). Zuckerman-Kuhlman Personality Questionnaire: psychometric properties in a general population sample *Psychol. Rep.* 103:845-856.
- Grandin LD, Alloy LB, Abramson LY. (2006). The social zeitgeber theory, circadian rhythms and mood disorders: review and evaluation. *Clin. Psychol. Rev.* 26:679-694.
- Hogben AL, Ellis J, Archer SN, Von Schantz M. (2007). Conscientiousness is a predictor of diurnal preference. *Chronobiol. Int.* 24:1249-1254.
- Hur Y. (2007). Stability of genetic influence on morningness-eveningness: a cross-sectional examination of South Korean twins from preadolescence to young adulthood. *J. Sleep Res.* 16:17-23.
- Kudielka BM, Bellingrath S, Hellhammer DH. (2007). Further support for higher salivary cortisol levels in "morning" compared to "evening" persons. *J. Psychosom. Res.* 62:595-596.
- Levi F, Schibler U. (2007). Circadian rhythms: mechanisms and therapeutic implications. *Annu. Rev. Pharmacol. Toxicol.* 47:593-628.
- Martínez Y, Bosch R, Gomà-i-Freixanet M, Valero S, Ramos-Quiroga JA, Nogueira M, Casas M. (2010). Variables diferenciales de personalidad en los subtipos de TDAH en la edad adulta. *Psicothema* 22:236-241.
- McClung CA. (2007). Circadian genes rhythms and the biology of mood disorders. *Pharmacol. Ther.* 11:222-232.
- Mishima K, Tozawa T, Satoh K, Saitoh H, Mishima Y. (2005). The 3111T/C polymorphism of hClock is associated with evening preference and delayed sleep timing in a Japanese population sample. *Am. J. Med. Genet. B* 133:101-104.
- Muro A, Gomà-i-Freixanet M, Adan A. (2009). Morningness-eveningness, gender, and the Alternative Five Factor Model of Personality. *Chronobiol. Int.* 26:1235-1248.
- Natale V, Ballardini D, Schumann R, Mencarelli C, Magelli V. (2008). Morningness-eveningness preference and eating disorders. *Pers. Individ. Differ.* 45:549-553.
- Portaluppi F, Smolensky MH, Touitou Y. (2010). Ethics and methods for biological rhythm research on animals and human beings. *Chronobiol. Int.* 27:1911-1929.
- Prat G, Adan A. (2011). Influence of circadian typology on drug consumption, hazardous alcohol use, and hangover symptoms. *Chronobiol. Int.* 28:248-257.
- Randler C. (2007). Gender differences in morningness-eveningness assessed by self-report questionnaires: a meta-analysis. *Pers. Individ. Differ.* 43:1667-1675.
- Randler C. (2008). Morningness-eveningness sleep-wake variables and big five personality factors. *Pers. Individ. Differ.* 45:191-196.
- Randler C, Bausback V. (2010). Morningness-eveningness in women around the transition through menopause and its relationship with climacteric complaints. *Biol. Rhythm Res.* 41:415-431.
- Randler C, Díaz-Morales JF. (2007). Morningness in German and Spanish students: a comparative study. *Eur. J. Pers.* 21:419-427.
- Randler C, Schaal S. (2010). Morningness-eveningness, habitual sleep-wake variables and cortisol level. *Biol. Psychol.* 85:14-18.
- Taillard J, Philip P, Chastang JF, Bioulac B. (2004). Validation of Horne and Östberg Morningness-Eveningness Questionnaire in a middle-aged population of French workers. *J. Biol. Rhythms* 19:76-86.
- Tankova I, Adan A, Buela-Casal G. (1994). Circadian typology and individual differences: a review. *Pers. Individ. Differ.* 16:671-684.
- Tonetti L, Fabbri M, Natale V. (2008). Sex differences in sleep-time preference and sleep need: a cross-sectional survey among Italian preadolescents, adolescents and adults. *Chronobiol. Int.* 25:745-759.
- Tonetti L, Fabbri M, Natale V. (2009). Relationship between circadian typology and big five personality domains. *Chronobiol. Int.* 26:337-347.
- Tonetti L, Adan A, Caci H, De Pascalis V, Fabbri M, Natale V. (2010). Morningness-eveningness preference and sensation seeking. *Eur. Psychiatr.* 25:111-115.
- Tsaousis I. (2010). Circadian preferences and personality traits: a meta-analysis. *Eur. J. Pers.* 24:356-373.
- Zuckerman M. (2002). Zuckerman-Kuhlman Personality Questionnaire (ZKPQ): an alternative five-factorial model. In De Raad B, Perugini M (eds.). *Big five assessment*. Seattle: Hogrefe and Huber Publishers, 377-396.
- Zuckerman M. (2005). *Psychobiology of personality* (336 pages). Cambridge, UK: Cambridge University Press.
- Zuckerman M, Cloninger CR. (1996). Relationships between Cloninger's, Zuckerman's and Eysenck's dimensions of personality. *Pers. Individ. Differ.* 21:283-285.
- Zuckerman M, Eysenck SB, Eysenck HJ. (1978). Sensation seeking in England and America: cross-cultural, age, and sex comparisons. *J. Consult. Clin. Psychol.* 46:139-149.
- Zuckerman M, Kuhlman DM, Joireman J, Teta P, Kraft M. (1993). A comparison of three structural models for personality: the big three the big five and the alternative five. *J. Pers. Soc. Psychol.* 65:757-768.