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Validation of the Italian Version of the Morningness-Eveningness Questionnaire for Adolescents by A. Lancry and Th. Arbault

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Study Design A
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Statistical Analysis C
Data Interpretation D
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Background: This study aimed to validate the Italian version of the Morningness-Eveningness questionnaire for adolescents by Lancry and Arbault.

Material/Methods: The Morningness-Eveningness Questionnaire by Lancry and Arbault was translated from French into Italian by using forward-backward translation. Students aged 11–15 years old were enrolled from two schools in Milan (Italia). Validation of the questionnaire was performed in subsequent phases. A pre-test was given to 66 students aged 11–15 years (males 57.4%, females 42.6%) from a convenience sample. Syntactic aspects of the pre-test were improved, and the questionnaire in a revised version was re-administered to 292 students of same age (males 43.8%, females 54.1%) from a convenience sample.

Results: Factor analysis was performed on pre-test data, using the principal component method accounting for Morningness-Eveningness. Problematic items possibly uncorrelated with the extracted factor were identified, and reliability produced a Cronbach's Alpha close to 0.7. In the test phase factor analysis was performed using the principal component method. Based on reliability analyses, we excluded a number of items because of their low performance, giving rise to a Cronbach's Alpha of 0.819. Pearson product-moment external correlations between Morningness-Eveningness disposition and temperament, behavioral, and cognitive aspects were evaluated.

Conclusions: A factor analysis, Cronbach's alpha and concurrent validity coefficients with disposition, behavior, and cognition, were performed, suggesting potential reliability and validity. The questionnaire is a useful and relevant tool for measuring Morningness-Eveningness disposition in adolescents, which has seldom been investigated with adequate psychometric instruments.

MeSH Keywords: Adolescent • Circadian Rhythm • Questionnaires

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Background

Individuals have biological rhythms which shift over a 24-hour period. These rhythms have been studied from the chrono-biological [1] and chrono-psychological perspectives. Psychometric measures have been produced to evaluate such rhythms with specific reference to timing and aspects of wakefulness and sleepiness over the 24 hours. Under this perspective, it has been noticed that people can be described as belonging to two types: Morning and Evening types. Morning types awake early, are refreshed on waking up, and go to bed early in the evening; whereas evening types get up with difficulty, are tired when they wake up, and stay up late at night [2]. In 1976 Horne and Östberg presented the MEQ (Morningness-Eveningness Questionnaire) to measure Morningness-Eveningness disposition, and various different instruments have been created over the years. The reduced scale of the MEQ (rMEQ) was created by Adan and Almirall [3], the Marburger Questionnaire by Moog [4], the Composite Scale by Smith, Reilly, and Midkiff [5], the Preference Scale by Smith, Folkard, Schmieder, Parra, Spelten, Almiral et al. [6], the Morningness-Eveningness Questionnaire by Lancry and Arbault [7], and the Munich Chronotype Questionnaire by Roenneberg, Wirz-Justice, and Merrow [8].

Physiological and biological parameters characterize Morningness-Eveningness disposition. Morningness is associated with sleep phases, and the decay rate of slow-wave activity seems to be faster in Morning types compared with Evening types [9]. Morning types have a circadian temperature phase 2 hours earlier than Evening types [10], acrophases of cortisol occur earlier in the Morningness group with respect to the Eveningness group [11], and Morning types reveal a more rapid decline in melatonin levels after the peak than Evening types [12]. Morningness-Eveningness disposition has a heredita-bility of around 50% [13], and different polymorphisms in clock genes have a relationship with Morningness-Eveningness disposition, with specific reference to hCLOCK, PER1, and PER2 [14]. A shift from Morningness to Eveningness has been observed during adolescence [15], while after adolescence Morningness tends to increase with age [16], and people from the age of 50 onwards types tend toward Morningness [2]. Larger percentages of Eveningness have been reported among males, and Morningness is frequently observed among females [17], though not always [18]. A larger number of Evening types have been observed among boys than in girls in adolescence [16,19]. Morning and Evening types have been the subject of interest in relation to a wide range of behavioral variables. The relationship between Morningness-Eveningness disposition and personality traits has been observed; positive correlations between Agreeableness and Morningness [20], and between Conscientiousness and Morningness [18], and a negative correlation between Open-mindedness and Morningness [21] have been pointed out. Evening types are more extraverted than Morning types [22], show higher scores on Openness [23], and tend to be more neurotic than Morning types [24], though there are exceptions [23]. Evening types score higher on psychoticism than Morning types [25]; higher scores have been reported in Evening types than in Morning types using Zuckerman's Sensation Seeking Scale [26]. People with neither a Morning nor an Evening disposition tend to be closer to Evening types in Isolation Intolerance [27]. Morningness is positively related to Stability in undergraduates [28], and Neuroticism is related to Eveningness only in females and in adolescents aged 10–17 years [20]. It has been suggested that the relationship between Morningness-Eveningness and Neuroticism is modulated by sex [29]. Morningness-Eveningness disposition has been researched with reference to psychopathology. Circadian timing is delayed in patients with depressive disorders [30], Evening types are prone to depressive symptoms [31], and levels of depression in Evening types tend to be moderated by age [32] and hormones. Higher scores on suicidal thoughts have been identified in Evening types [33], and Eveningness is positively correlated with bulimic behavior [34]; a higher percentage of risky and aggressive driving is significantly correlated with Eveningness [35]. Drug consumption has a negative effect on circadian expression, and the effect of drug addiction on circadian expression can persist for weeks or months after drug use has ceased [18]. Evening types report higher consumption of some psychoactive substances (caffeine, alcohol, nicotine), even in adolescence [18], and undergraduate students of Morningness disposition tend to consume more caffeine in the evening than Morning types [2].

Adolescents with Eveningness disposition show lower scores on vitality, physical well-being, relations with parents, relations with teachers, and school work [36], and early midpoint of sleep as well as conscientiousness and intelligence seems to be associated with better grades in primary school [37]. The importance of implementing prevention programs aimed at improving sleep habits has been pointed out [38]. Effects of timing are relevant on academic performance: Adolescents of Evening disposition show poorer academic achievement [2], they tend to have more difficulty getting up in the Morning and more alertness in the Evening than Morning types during school terms [39]. Exercise, meditation, taking showers, and conflict over breakfast with reference to Morningness-Eveningness disposition in adolescents have been studied [39]. Evening types have reduced sleep quality when compared with Morning and neither types on weekdays, while Evening types tend to reach the same levels on weekends, suggesting the occurrence of a sleep deficit during weekdays due to social commitments [40]. Morningness-Eveningness disposition with reference to sleep patterns can have important consequences on social environment, since sleepiness is an important public problem associated with accidents in the workplace and decreased productivity [41].

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In humans, sleep and wakefulness are influenced by homeostatic process and internal circadian clock, and desynchronization of the two processes can be associated with sleep disruption during shift work and jet lag [18], and can have cardiovascular and metabolic consequences [42]. The contribution of external and social factors to Morningness-Eveningness disposition is relevant, and desynchronization of the two processes can be associated with circadian rhythm sleep disorders and delayed sleep phase disorder [18]. Night shifts are more difficult for Morning types than for Evening types [18]; Morning shift workers are more alert during morning hours of work, while Evening types are more alert during evening hours of work [43]. Workers with rigid sleep attitudes are more prone to health problems [44], and flexibility is positively correlated to shift work tolerance [45]. Sleep is a physiological state that needs integrity to allow the organism to recuperate, and noise is made of external stimuli processed by sensory functions despite a non-conscious perception. Studies support evidence that night-time noise is associated with cardiovascular diseases and stroke particularly in the elderly, and suggest that nocturnal noise exposure is more relevant for the genesis of cardiovascular disease than daytime noise exposure [46].

Few studies have been published about Morningness-Eveningness with reference to jet lag, [18] and more research is required in this direction. Latitude and longitude also tend to play a role in circadian rhythms: there are more Morning types toward the East and North and in rural municipalities than in urban municipalities [18]. Studies point out that subjects living at relatively high latitude, such as Canada, Spain, and Italy and born in the fall tend to be Morning types in comparison to those born in other seasons; at low latitude (Kochi, Japan) an effect of season of birth on Morningness confined to young female children has been observed [47]. No correlations are noted between changes in atmospheric pressure and duration of sleep; however, a slight increase in motility during sleep has been detected when the barometric pressure is higher than usual [48]. Small changes in atmospheric pressure due to weather may be important in obstructive sleep apnea [49]. Finally, a decrease in the strength of the Zeitgeber can be noticed in Evening types, who obtained lower levels of light exposure during daytime and higher during nighttime and with a more irregular lifestyle than Morning types [18].

People born in autumn and winter tend to be more Morningness-oriented, while those born in spring and summer tend to be more Eveningness-oriented [50]; this is also observed in adolescents [18].

Researchers have also explored Morningness-Eveningness disposition with reference to cognitive parameters. It has been suggested that the nature of a task and the strategies used to carry it out might be critical factors in diurnal performance trends [51]. According to what is known as the "arousal model", circadian performance variations reflect underlying circadian rhythms in arousal levels [18]. According to the model known as the "synchrony effect", it has been suggested that people who are more alert in the morning tend to perform better in the morning than in the afternoon, while people who are more alert in the evening tend to perform better in the afternoon or evening than in the morning [52]. Cognitive styles can be associated with Morningness-Eveningness; from this perspective, Eveningness has been correlated with creative thinking [53], Morningness disposition with left-thinking style, and Eveningness disposition with right-thinking style [54].

Morningness-Eveningness has been explored with reference to sports [25,55], and is correlated with creative thinking in young people playing recreational sports [56]. Morning-oriented adolescents are more physically active, and give more positive attributes to the effects of physical activity; these findings can have an impact on programs devoted to increasing physical activity in adolescence [57]. Findings of a walking task exercise reveal that Evening types are at a disadvantage when performing a physical task in the morning [58]. With the purpose of determining whether exercise on a stationary cycle ergometer during night shifts can delay temperature rhythm, it has been observed that there is a correlation between temperature rhythm phase shift and Morningness-Eveningness – greater Eveningness results in larger phase shifts [59].

Exhaustive reviews concerning Morningness-Eveningness have been published recently by Adan et al. [18], by Cavallera, Boari, Ortolano, and Giudici [60], and by Cavallera and Giudici [2].

Over the years, specific questionnaires have been produced aimed at gaining a better understanding of Morning and Evening types. The MEQ by Horne and Östberg [61] is the best-known questionnaire in this direction, but research is scarce with specific reference to Morningness-Eveningness disposition in youth; the Morningness-Eveningness questionnaire by Lancry and Arbault [7], the Morningness-Eveningness scale for children (MESC) by Carskadon, Viera, and Acebo [62], and the Children's Chronotype Questionnaire (CCTQ) by Werner, Lebourgeois, Geiger, Jenni [63] are objects of interest. This study aimed to validate the Italian version of the Morningness-Eveningness questionnaire for adolescents by Lancry and Arbault.

Material and Methods

The Morningness-Eveningness Questionnaire by Lancry and Arbault was translated from French into Italian. A forward-backward translation was performed by two translators, and the process of translation was supervised by one bilingual translator. The original French version was translated into Italian by one translator, and the Italian version was then back-translated into

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Table 1. Timetable range coding for items D1, D2, D6, D10, D16.

Item	Time range			
D1	≤20:45	≤21:55	≤22:45	>22:45
D2	≤7:27	≤9:33	≤13:04	>13:04
D6	≤22:28	≤23:25	≤00:13	>00:13
D10	≤9:54	≤12:45	≤14:56	>14:56
D16	≤8:52	≤9:31	≤10:21	>10:21
Code	**4**	**3**	**2**	**1**

French by a second translator. The original and the back-translated versions were compared and, where necessary, modifications were made to correct language errors and to ensure conceptual equivalence between the two texts rather than literal translation. Following statistical reliability analyses in the pre-test phase, syntactic aspects of the questionnaire items were improved, and a final version of the questionnaire was produced and discussed in a group with the supervisor and teachers of the schools. The questionnaire in the pre-test and test phases were administered to students aged 11–15 years old from two major schools in Milan (Italy): Collegio San Carlo and Collegio Parini. The questionnaires were checked for omissions and duplications at the time of completion. Students were given 30 minutes to self-administer the questionnaire in a separate setting; their parents were informed of the research and gave their informed consent. The study was approved by the Local Institutional Review Board, and oral informed consent was obtained from each potentially eligible participant. The test was validated in subsequent phases**.** A convenience sample of 66 students aged 11 to 15 years was enrolled in the pre-test phase: mean age 13.36, 57.4% males and 42.6% females. A second convenience sample of 292 students was enrolled in the test phase: mean age 12.90, 43.8% males, 54.1% females. As suggested by Lancry and Arbault (1991), items D1, D2, D6, D10, and D16 were encoded according to the scheme presented in Table 1.

Moreover, items D3, D4, D9, D13, D15, and D17 were reversed by the usual rule $Rev(X)=X_{max}+X_{min}-X$, making it possible to correctly perform the procedure of Scale Reliability Analysis when needed. In the final version of the translated and validated scale D10 is item 8, D16 is item 14.

Results

A factor analysis was first performed on pre-test data (Table 2) using the principal component method accounting for Morningness-Eveningness. Since we were looking for a single common characteristic, accounting for the Morningness-Eveningness level of the types, only one component was extracted (method: principal components, 1 factor extracted).

Table 2. Pre-test AF factor loadings.

Item	Loadings
D1	.715
D2	.331
D3	**–.008**
D4	.644
D5	.701
D6	.534
D7	**–.101**
D8	**.112**
D9	.482
D10	.320
D11	.536
D12	.779
D13	.214
D14	.494
D15	**.069**
D16	.215
D17	.643

Bold figures highlight problematic items, possibly uncorrelated with the extracted factor. This may be due to an improper formulation of the corresponding questions. Thus, syntactic aspects of the questionnaire items were improved in order to make them more intelligible. Furthermore, the assessment of reliability of the component previously extracted was performed (Table 3). Cronbach's Alpha is quite close to 0.7 (Cronbach's Alpha=0.658), whereas item statistics confirm that items D3 and D7 seem to be less reliable. Nevertheless, the non-significance of the Non-Additivity test suggests that a summated scale, over all items, may be correctly employed. The result of the Tukey test of Non-Additivity was non-significant (p-value=.546 NS).

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Table 3. Pre-test reliability analysis.

Item	Item – total correlation	alpha – if removed
D1	.512	.619
D2	.237	.647
D3	**–.037**	**.686**
D4	.474	.618
D5	.559	.610
D6	.364	.630
D7	**–.122**	**.697**
D8	**.036**	**.678**
D9	.356	.630
D10	.137	.660
D11	.419	.625
D12	.570	.605
D13	**.060**	.665
D14	.409	.629
D15	**.109**	**.667**
D16	.219	.649
D17	.492	.612

With reference to the Test-phase data, factor analysis was performed by using the principal component method and extracting a single component (Table 4).

Item D5 and, particularly, items D7 and D8 show low performances; moreover, subsequent reliability analyses suggest the exclusion of items D7 and D8. Table 5 reports the final results.

The Cronbach's Alpha (items D7 and D8 excluded) was 0.819 and the Tukey test of Non-Additivity was non-significant (p-value=.117 NS). The non-significance of the Non-Additivity test suggests that a summated scale, over all remaining items, may be correctly employed.

The summated scale is defined by the following expression: SCALE=sum (D1–D6, D9–D17). It is interesting to analyze the relationship between the values of the summated scale (Scale) and the factor scores (expressed in standard units) given by the Factor Analysis procedure (AF Score). Their linear relation is:

Scale=28.084+7.154 (AF Score)
R squared=.981 (F test p-value 0.000)

Table 4. Pre-test AF factor loadings.

Item	Loadings
D1	.376
D2	.442
D3	.594
D4	.556
D5	**.290**
D6	.570
D7	**.004**
D8	**.209**
D9	.387
D10	.529
D11	.736
D12	.483
D13	.372
D14	.638
D15	.548
D16	.646
D17	.756

where R-squared index (0.981) and F test significance suggest that the Scale values may be correctly adopted instead of the factor scores, and are computationally more complicated.

Correlations between Morningness-Eveningness disposition and age have also been calculated, giving rise to the following results: –0.124 (p-value=0.022, one-tailed test). As expected, with age, Morningness-Eveningness disposition increases towards Morningness. Finally, external validations were performed by evaluating the linear correlation between items and temperaments, as well as with variables accounting for behavioral aspects (items H18–H21: preferred wake and sleep times) and cognitive aspects (items D22–D27: fatigue and alertness in the morning, in the afternoon, in the evening). Correlation between items and temperaments was not significant, whereas correlations between Morningness-Eveningness disposition and behavioral aspects, items H18 and H19, significantly decrease towards Morningness-Eveningness disposition; item H21 significantly increased, as expected, and item H20 was not significant (Table 6).

With reference to correlations between Morningness-Eveningness disposition and behavioral aspects disposition, items D22, D26, and D27 significantly decrease towards

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Table 5. Test reliability analysis, items D7 and D8 excluded.

Item	Item – total correlation	alpha – if removed
D1	.306	.817
D2	.357	.813
D3	.463	.806
D4	.457	.807
D5	**.219**	.820
D6	.501	.803
D7	.318	.819
D8	.436	.808
D9	.599	.797
D10	.454	.808
D11	.317	.815
D12	.520	.804
D13	.421	.810
D14	.527	.801
D15	.656	.792
D16	.219	.649
D17	.492	.612

Morningness-Eveningness disposition, while items D24 and D25 significantly increase, as expected. Item D23 correlation was not significant (Table 7).

Finally, in order to estimate the optimal classification of teenagers in three homogeneous groups (Evening types, neither types, Morning types), a k-means cluster analysis procedure was performed on score data generated by the FA. The corresponding cut-points were then evaluated on the summated scale values by using the linear relation previously suggested (Table 8).

The summated scale scores range from a minimum of 15 to a maximum of 60, since the 15 administered items use a four-point scale (1–4). The translated and validated scale results in 15 items, after excluding items 7 and 8. The code system of scoring of items 3, 4, 7, 11, 13, 15 is: 4, 3, 2, 1; the code system of scoring of items 5, 9, 10, 12 is: 1, 2, 3, 4. Coding system for items 1, 2, 6, 8, 14 refers to timetable range indicated in Table 1.

Discussion

Sleep plays a fundamental role in adolescent development, and monitoring adolescents for sleep parameters is of great relevance for improving school performance, emotional well-being, and health. The American Academy of Pediatrics supports the efforts of schools to optimize sleep in adolescents

Table 6. Correlations between scores and items H18–H21.

	H18	H19	H20	H21
Pearson correlations	–0.245	–0.136	–0.031	0.458
2 tail p-value	**0.000**	**0.027**	0.614	**0.000**
N	263	262	261	262

Table 7. Correlations between scores and items H22–H27.

	D22	D23	D24	D25	D26	D27
Pearson correlations	–0.740	0.061	0.335	0.625	–0.140	–0.349
2 tail p-value	**0.000**	0.334	**0.000**	**0.000**	**0.025**	**0.000**
N	256	255	254	254	255	256

Table 8. Cluster k-means (k=3).

	Evening subjects	Neither subjects	Morning subjects
Summated Scale range	**15–25**	**26–34**	**35–60**
%	45.0	38.3	16.7

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in order to allow students to achieve optimal levels of physical and mental health.

During puberty, youngsters tend to become more Eveningness-oriented; a decrease in Morningness occurs around age 15 years, a return to Morningness has been identified at around age 20 years [64], and the amount of sleep time decreases among children from age 11 to 15 [65]. From childhood through adolescence, sleep architecture tends to be modified, with decreases in slow-wave sleep and increases in stage 2 sleep [66].

Data about specific psychometric instruments measuring Morningness-Eveningness disposition in young people are scarce: the Morningness-Eveningness questionnaire by Lancry and Arbault (1991), the MESC by Carskadon (1993) and the CCTQ by Werner, Lebourgeois, Geiger, Jenni (2009) are among the most significant psychometric measures which can be found in the literature.

This study aimed to validate the Italian translation of the Morningness-Eveningness questionnaire by Lancry and Arbault, performed in the subsequent pre-test and test phases. Factor analysis on pre-test data accounting for Morningness-Eveningness revealed a single extracted component, confirming construct validity; the latent construct of interest and problematic items uncorrelated with the single factor because of improper syntactic formulation were identified. Items were therefore improved in the subsequent test phase. The reliability of the pre-test revealed a Cronbach's Alpha close to 0.7. In the subsequent test phase, a single component was extracted using factor analysis, a number of items were excluded because of their low statistical performance, and the Cronbach's Alpha revealed a satisfactory value, excluding the presence of threats to internal validity. External validations were performed; correlations between Morningness-Eveningness disposition and sleeping habits and correlations between Morningness-Eveningness disposition and arousal state were significant in most cases, suggesting exclusion of threats to external validity. Validation of the questionnaire therefore reveals good psychometric properties.

A classification of teenagers aged 11–15 years into three types was proposed (Evening types, neither types, Morning types) using k-means cluster analysis, and cut-off points were evaluated: a range of 15–25 for Evening types, 26–34 for neither types, and 35–60 for Morning types.

One limitation of the study is that all the types come from the same city (Milan), and from schools which have a reputation of being among the best schools in Milan. Another limitation is that, as far as we know, the questionnaire by Lancry and Arbault has not yet been translated into other languages, and therefore international references under this perspective are scarce. Another limitation might also be that the method itself is based on self-reporting, so that its effectiveness and accuracy without reference to the observations carried out by parents or teachers could be subject to discussion. It should be observed that Lancry and Arbault themselves had administered the questionnaire without any reference to reports by parents in their original work, that our sample is made up of adolescents coming from particularly good junior and senior high schools in the city of Milan, that prior to administration of the questionnaire adolescents had been informed about the questionnaire itself, and that the questionnaire is made up of easily understandable questions. Moreover, at the end of the questionnaire, students were asked if the items were clearly understandable, and were asked to make suggestions for improving the items themselves.

The importance of adequately understanding sleeping behaviors in adolescence is a topic of frequent discussion, both from a scientific perspective and in terms of common opinion among the public. Efforts to optimize sleep in adolescents are supported by scientists worldwide for reasons of physical and mental health, and educational programs have been produced to inform families and pediatricians about correct sleep behaviors as a fundamental basis of positive development processes throughout life. From these perspectives, the use of a psychometric instrument can be of significant help. It is therefore suggested that in the future the validated Italian version of the Morningness-Eveningness questionnaire by Lancry and Arbault should be distributed and used in schools as a useful and advantageous psychometric tool for obtaining a better understanding of one of the most critical times in life – adolescence.

Conclusions

The translated questionnaire by Lancry and Arbault provides a relevant tool for measuring Morningness-Eveningness in adolescents, which has seldom been explored with adequate psychometric instruments, since proper psychometric instruments on this topic are scarce.

Future research should extend investigation and administration of the questionnaire over a wider geographic area and a wider range of different types of school. Moreover, researchers should involve foreign colleagues in translation of the questionnaire by Lancry and Arbault into other languages in order to compare their respective data. Improvements in the questionnaire could contribute to a better understanding of young people's sleeping behaviors and their consequences worldwide, and to the development of preventive social and health policies for adolescents.

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