Diurnal interindividual differences
in the habitual activity pattern of top level athletes

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Circadian rhythm studies have shown significant variations over the day in the speed and accuracy with which people perform their daily work, and large interindividual differences in times of optimal performance and subjective alertness. These studies led to the distinction of two different types of body temperature and efficiency curves, according to an early (“morning type”) and a late (“evening type”) peak during the waking period (Kleitman, 1963). In addition, intermediate gradations have been noted between the two extremes. The classification in morning and evening types is today a subject of systematic physiological and behavioral research. A self-assessment questionnaire has been developed (Horne and Östberg, 1976) to differentiate between these diurnal types. The questionnaire consists of questions inquiring about sleep-wake habits and preferred time of physical and mental activity. The biological clocks of the two diurnal types have been shown to keep time in a different way producing a phase difference in their physiological indices and performance levels in motor and cognitive tasks. For example, in comparison to evening types, morning types have a phase advance in body temperature (Horne and Östberg, 1976), subjective alertness and fatigue (Akerstedt and Fröberg, 1976; Fröberg, 1977) and reaction time over the day (Kleitman, 1963; Fröberg, 1977; Kerkhof et al., 1981). So far, however, in sport biorhythmicity and diurnal individual variability have been almost ignored. This is unfortunate particularly for applied psychophysiology of sport, because the ability to perform a given task is greatly affected by the time at which it is to be performed. Hence, it is vitally important that athletes are aware of the cyclic oscillations shown by their psychological and physiological functions and the differential adaptation that may result from the latter. In this way, in fact, will be possible for them to achieve an optimal distribution over the day of their training and rest schedules, so that the time of their “best psychological efficiency” correspond to the time of the sport performance. For this reason we focused to investigate the preferred habitual activity pattern of athletes practicing two different sport activities: golf and waterpolo. With respect to the latter, the formers showed an advanced habitual activity pattern. However, this was found to
be true in high-performing athletes, but not in low performers (Rossi, Zani, and Mecacci, 1983). These data suggested the possibility of an influence of the particular sport activity practiced by the athletes on the diurnal habitual activity pattern.

The present study was designed to examine the diurnal interindividual differences of top level athletes practicing several different sport activities.

**METHOD**

**Subjects and procedure**

The athletes occupied the top national levels. In all a sample of 87 subjects was obtained. The number and the mean age of the subjects for each sport is given in the Table 1.

All the subjects filled out an Italian version (Mecacci & Zani, 1983) of the Morningness-Eveningness Questionnaire of Horne and Östberg (1976). The latter consists of 19 questions on habitual bed and rising time, subjective fatigue after rising and before going to bed, preferred hours of day of physical and mental performance. Besides that on the psychophysiological basis the questionnaire has shown an acceptable reliability also on statistical basis. The coefficient of reliability, in fact, was found to be $r = .89$ (p<0.001) (Posey and Ford, 1981). A single morningness-eveningness score was computed for each subject using the scoring criterion of Horne and Östberg (1976), resulting in five categories:

1. Score 16-30: extremely evening type
2. Score 31-41: moderately evening type
3. Score 42-58: neither type
4. Score 59-69: moderately morning type
5. Score 70-86: extremely morning type.

**RESULTS**

Means and standard deviations for the morningness-eveningness scores of the different samples of athletes are given in the Figure 1. As the mean age was significantly different ($F = 6.80 = 15.09$; p<0.01) through the athletes’ samples, one-way analysis of covariance, with the age as
TABLE 2.

<table>
<thead>
<tr>
<th></th>
<th>Golf</th>
<th>Shooting</th>
<th>Fencing</th>
<th>Pentathlon</th>
<th>Basket</th>
<th>Volleyball</th>
<th>Waterpolo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golf</td>
<td>0.417</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shooting</td>
<td>1.880</td>
<td>2.356*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fencing</td>
<td>1.620</td>
<td>1.570</td>
<td>0.430</td>
<td>0.430</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentathlon</td>
<td>2.085*</td>
<td>2.650*</td>
<td>0.740</td>
<td>0.740</td>
<td>0.198</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basket</td>
<td>2.541*</td>
<td>2.564*</td>
<td>1.579</td>
<td>1.579</td>
<td>0.916</td>
<td>0.749</td>
<td></td>
</tr>
<tr>
<td>Volleyball</td>
<td>2.885*</td>
<td>3.600*</td>
<td>2.335*</td>
<td>1.596</td>
<td>1.470</td>
<td>0.768</td>
<td>0.340</td>
</tr>
</tbody>
</table>

*p<0.05.

covariate and the score as dependent variable, was performed to test the differences in morningness-eveningness preferences. A significant difference was found among the samples (F 6.79=2.6; p<0.01). A decrease in morningness scores was evident going from golf and shooting to volleyball or waterpolo. Table 2 shows the results of tests for simple effects (t-test for independent samples).

DISCUSSION

Athletes' diurnal habitual activity patterns, as estimated by means of the M-E-Q, were significantly different. Answering to the question whether this is due to the fact that practicing hard at different times of day these athletes might develop different habitual activity patterns or, vice versa, to inborn biological differences in the diurnal trend of subjective alertness and fatigue, which turns in diurnal differences in efficiency curves, it is still difficult because of the few data available. Anyway, based on present findings a few important suggestion can be made. The first is that a new scientific approach to the sport activities, taking into account the results obtained by the psychophysiological research concerned with the individual differences in the diurnal activity pattern, might guarantee the maintenance and the improvement of the high level performance reached nowadays by athletes. The second is that this might help in designing and promoting activity programs enabling the athletes fully developing their physical and psychological skills avoiding, at the same time, any risk factors. This might be done:

1. Carrying out specific and differential training schedules which can minimize the effects of a phase position of the psychological and physiological functions not fitting the match time or to activate, where possible, phase changes of the latter; these changes might be able to turn a loser to a winner seen the small differences found between the different athletes at high-performing level.

2. Programming during training sessions, the additional work athletes have to face practicing at different times of day, especially when the latter are not matching their preferred times for physical and mental performance and the peak of their "well-being" over the day.

3. Not forcing, during training or pre-match periods, athletes to strict or prefixed schedules, unsuitable to their preferred activity pattern, the achievement of the peak of their performance, and the best psychophysiological conditions.

SUMMARY

When dealing with athletes' performance levels there come into play biological factors and environmental influences. From the psychophysiological point of view the interindividual diurnal differences in subjective alertness and optimal performance.
are most important. Different sport activities were chosen to verify the hypothesis of an influence of the latter on the habitual activity pattern of the athletes. Results showed significant differences in the morningness-eveningness expressed preferences among athletes in agreement with their sport activity. Based on these findings a few suggestions for specific training activity programs are given.

REFERENCES


[Authors’ address:
L. Mecacci
Istituto di Psicologia del C.N.R.
Via dei Monti Tiburtini 509
00157 Roma (Italy)]

[Code number 1085]