CLOCKWISE Chronometric Test

CLOCKWISE
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- Developed by Clockwise Director Dr Roland Brandstätter
- Determination of Circadian Phenotype - distinguishes reliably between Early (‘Larks‘), Intermediate, and Late (‘Owls‘) Body Clock Types
- Full Evaluation of the Body Clock
- Detection of Circadian Disruption and Insomnia
- Fully validated
- Published in peer-reviewed high-impact scientific journals

The Clockwise Chronometric Test collects information on a variety of factors, including wake-up times, sleep-onset times, sleep-onset delays, sleep durations, alarm use, light exposure, food intake, exogenous schedules (work, training, competition, school, university timetables), sleep quality, daytime fatigue, periods of mental and physical high and low activities, energy drink-, coffein- and alcohol consumption, etc. Completion of the chronometric test takes 15 min on average. For each individual, scores are allocated to wake-up times and sleep-onset times during weekdays, weekends, and free days, the time lag between weekday and weekend wake-up times, times of high (mentally and physically active) and low (tiredness, fatigue) activity periods and meal times. Masking factors, such as working hours, university timetables, and training schedules, are taken into account when allocating scores which are used to categorize into early (ECT), intermediate (ICT), and late (LCT) circadian phenotypes.

BACKGROUND

Circadian rhythms are internally generated biological rhythms with durations of around 24 hours. Most physiological aspects of our human biology have a circadian rhythmicity; for example: memory, mood, body temperature, and the sleep-wake cycle. These circadian rhythms are endogenous, persisting in constant environmental conditions, repeating through the same order, and the same interval through time.

Our circadian rhythms are generated from our internal biological clock, which in turn interacts with two external Zeitgeber systems, the solar clock (light-dark cycle) and the social clock (our daily routines). Circadian rhythmicity shows inter-individual differences particularly demonstrated by the sleep/wake-cycle. The temporal relationship an individual's biological clock has with one of its Zeitgebers is known as the 'phase of entrainment'.

Differences seen between individuals relationship with external and internal time, are called circadian phenotypes and categorized into early, intermediate and late types. Chronotype, a term used by Roenneberg and co-workers, is used to categorise the sleep preferences of individuals by a single-parameter approach, i.e. the point of mid-sleep on free days. Circadian phenotype, however, takes into consideration multiple factors, including sleep/wake and activity parameters on weekdays, weekends and free days. The term Morningness-Eveningness is a highly subjective measure of whether individuals are Morning-types (M-types), Evening-types (E-Types), or Neither-types (N-types) by Horn and Östberg.

Early circadian phenotypes (ECT) are often referred to as 'larks' and wake up in the early morning when they are most alert and fall asleep early evening when they struggle to stay awake. In comparison, late circadian phenotypes (LCT), also known as 'owls', often wake later in the day, sometimes even after midday, are most active in the evening and go to bed late at night exhibiting more of a 'nocturnal' activity. Furthermore, a certain number of people do not fit into one of these two extremes and are found in between and categorized as intermediate circadian phenotypes (ICT).

The wide differences seen in sleep rhythms are because they are influenced partly by the environment and partly by genetics. The varied lifestyles and environments of humans play a crucial part in their circadian phenotype.

Circadian phenotype has been demonstrated to have a major impact on an individual's lifestyle. This applies mainly to LCTs because it is their biological clock that is out of sync with their external environment. LCTs and individuals with circadian disruption are more likely to begin health-impairing behaviours, be less physically active, have low self-efficacy, attribute exercise in a negative way and have an increased risk of multiple health problems including metabolic diseases and cancer.

THE CCT

The Clockwise Chronometric Test (CCT) is a continuous development of the RBUB-Chronometric Test for commercial and scientific utilisation.

The purpose of the CCT is to quantitatively determine the circadian phenotypes of individuals by looking at the temporal structure of their sleep patterns, daily routines, and activity patterns, assessing weekdays, weekends, and free days separately. The CCT was created by Dr Roland Brandstaetter and validated with more than 10,000 participants at present (2020). It takes into account two widely used questionnaires, the Munich ChronoType Questionnaire (MCTQ), and the Horne-Östberg Morningness-Eveningness Questionnaire (MEQ); The MCTQ is quantitative but primarily based on a single parameter, i.e. mid-sleep on free days, while the Horne-Ostberg MEQ is entirely based on hypothetical and subjective questions.

The CCT is the first and only available multivariate analysis tool for the determination of the differences between the circadian entrainment status of individuals, i.e. circadian phenotype. It considers all relevant information that can be obtained from the MCTQ and MEQ and contains specific questions that allow a reliable and accurate analysis of circadian phenotype and a clear distinction between endogenous and external factors, including entraining and masking factors. The CCT covers a total of 55 parameters all of which can be quantitatively analysed and cross correlated with each other. As such, the test allows a comprehensive analysis of body clock function as a whole.

The test is modular and represents the only available chronometric test that can be adjusted to different target groups, including shift-workers, athletes, night-workers, University students, and many others.

The determination of circadian phenotype is based on comparing weekday, weekend and free day circadian parameters. For example, weekend wake up times are cross correlated with weekday/free day wake up times, weekday/weekend/free day sleep onset times, and further parameters to produce particular scores of circadian entrainment, separately for wake up times, sleep onset times, sleep durations, etc, all of which are important parameters for defining circadian phenotypes. Scores are then compared according to a specific priority list and masking factors, which might mislead in the interpretation of circadian phenotype, are omitted. This then enables a consistent and fully reliable determination of circadian phenotype. The data of each individual are then fed into the ‘Clockwise Cloud’, a data-base of more than 10,000 individuals to check for compatibility with ECT, ICT, or LCT. A series of further validations of a number of parameters is performed to validate categorization into phenotypes.

FURTHER INFORMATION ON APPLICATION AND VALIDATION

CURRENT BIOLOGY

The Impact of Circadian Phenotype and Time since Awakening on Diurnal Performance in Athletes

https://www.cell.com/current-biology/fulltext/S0960-9822(14)01639-X

FRONTIERS IN NEUROLOGY

Circadian phenotype composition is a major predictor of diurnal physical performance in teams

https://www.frontiersin.org/articles/10.3389/fneur.2015.00208/full

EUROPEAN COLLEGE OF SPORT SCIENCE

Circadian Control of Diurnal Performance Patterns in Athletes

https://youtu.be/UCCGLCr81Mc

For further information on purchase and utilisation of the Clockwise Chronometric Test, contact:

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