

Review

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Review

Toward a Classification of Chronotype Questionnaires

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The plain language summary

Chronotyping is a key methodology for the assessment of individual differences in adaptation of the human sleep-wake cycle to 24-h periodicity of geophysical and social environments. Throughout the 50-yr period of scientific publications on chronotype questionnaires, they have been steadily growing in number and diversity. The available questionnaires often have different aims, use different assessment methodologies, and are thus not interchangeable. Consequently, some researchers would be confused about the different concepts behind these questionnaires; therefore, it is essential to know what instrument to choose for a given research purpose. A system of questionnaire classification ("questionnaire identifier") can help in navigating between numerous published questionnaires for choosing an optimal instrument for self-assessment of individual differences in the study of sleep and biological rhythms and for predicting the properties of yet-unconstructed questionnaires. To our knowledge, no effort has been made to create a structured system to clarify the relationships and conceptual differences between numerous chronotype questionnaires and scales. Such a system, based on a set of questionnaires and questionnaire-scale properties, has been proposed. This "questionnaire identifier" might be used for 1) choosing an optimal instrument for self-assessment of individual differences in the domain of chronobiology and sleep science and 2) predicting properties of yet-unconstructed questionnaires.

Abstract

Purpose: Chronotyping is a key methodology for assessing individual differences in human adaptation to 24-h periodicity of geophysical and social environments. Throughout the 50-yr period of publications on chronotype questionnaires, there has been steady growth in number and diversity. Therefore, it is becoming increasingly difficult to determine which questionnaires can be optimally applied to address a given question in sleep and biological rhythm research. Consequently, this study aimed to develop a structured system for classifying and comparing chronotype questionnaires. **Methods:** The PubMed bibliographic database and 9 previously published reviews were searched for publications on chronotype questionnaires and/or their implementation in chronobiological and sleep studies. **Results:** A total of 75 questionnaires were identified, of which 60 and 15 were designed for only chronotype and chronotype and something else assessment, respectively. The proposed set of 20 questionnaire and questionnaire scale properties allows the distinction of any of the 60 questionnaires from the 59 other questionnaires. **Conclusion:** The structured system of questionnaire classification ("questionnaire identifier") was proposed to help in navigating between numerous published questionnaires for choosing an optimal instrument for self-assessment of individual differences in a study of sleep and biological rhythms and for predicting properties of yet-unconstructed questionnaires.

Keywords: morningness-eveningness; chronotyping; individual variation; self-assessment; classification

Introduction

The façade of the Social Science Research Building of the University of Chicago bears Lord Kelvin's dictum: "If you cannot measure, your knowledge is meager and unsatisfactory" [1]. Measurement is considered a hallmark of scientific enterprise. A valid and reliable measurement is critical in any field of science, including research on individual differences in chronobiology and sleep [2,3].

The first scientifically recognized dimension of individual variation in human adaptation to the 24-h periodicity of geophysical and social environments was an individual's preference for either the early or late phase of the daily rhythmicity of sleep/wakefulness and rest/work. In 1976, Östberg, in co-authorship with Horne, published the first English-language questionnaire tool, the Morningness-Eveningness Questionnaire (MEQ) [4], that was soon translated into a dozen languages and remains the most popular questionnaire applied to self-assess individual variation in the field of sleep and biological rhythm research.

Somewhat later, the same methodology was applied to construct several other scales for the self-assessment of morningness-eveningness. The scales encouraged by MEQ publication [4] include the 7-item Diurnal Type Scale (DTS) [5], one of the two scales of the 16-item Marburger questionnaire (MQ) [6], and the 13-item Composite Scale of Morningness (CSM) [7].

Soon after the publication of the MEQ in 1979, Folkard, Monk and Lobban [8] proposed the first questionnaire instrument for the multi-dimensional (multi-scale) self-assessment of individual differences in daily rhythms. They suggested that morningness-eveningness is not the only chronobiological characteristic of individuals that determines the success or failure of biological adaptation to night and shift work. Factor analysis of responses to the initially proposed list of 20 items of their Circadian-Type Questionnaire (CTQ) [8] yielded three factorial dimensions. One dimension was interpreted as a well-established questionnaire construct named "morningness-eveningness," while two other dimensions were named "rigidity-flexibility" (of sleeping habits) and "languidness-vigorousness" (or "inability-ability to overcome drowsiness") [8].

Later, the development of several other questionnaires was encouraged by applying a multidimensional approach to chronotyping [8] for e.g., the 16-item Chronotype Questionnaire (ChQ) [9] and the 40-item Sleep-Wake Pattern Assessment Questionnaire (SWPAQ-40) [10].

After five decades of intensive research, chronotype remains the central concept in studies of individual variation in the fields of chronobiology, chronomedicine, chronopsychology, and sleep-wake times. Therefore, self-assessment of chronotypes is a key methodology for studying the differences between people in their capacity to adapt to the 24-h cyclicity of environmental factors. However, a scientific consensus has not yet been reached on the method of ranking and typing people according to the dimensions of individual variation in daily patterns of performance, sleepiness and sleep-wakefulness [2]. The concepts behind questionnaires used to assess chronotypes are often different.

In addition, the process of developing questionnaires within the framework of different concepts has intensified in recent years. The examples of such questionnaires that were published in the last decade are the 15-item Morningness-Eveningness-Stability Scale improved (MESSi) [11], the 168-item Sleep-Wake Adaptability Test (SWAT-168) [12], the Athlete Sleep Screening Questionnaire (ASSQ) [13], the 15-item Mood Rhythm Instrument (MRhI) [14], the 30-item Morningness-eveningness Exercise Preference Questionnaire (MEEPQ) [15], the 10-item Francis Owl-Lark Indices (FOLI) [16], the Single-Item Chronotyping (SIC) [17], the Sleep, Circadian Rhythms, and Mood (SCRAM) questionnaire [18], and a series of chrononutrition questionnaires, such as the Chrononutrition pro-file-questionnaire (CPQ-M) [19], the Food Timing Questionnaire and Food Timing Screener (FTQ and FTS, respectively) [20], the ChronoNutrition Questionnaire (CNQ) [21], and the Chrono-Nutrition Behavior Questionnaire (CNBQ) [22]. Therefore, more questionnaires are required.

It was emphasized [23] that the available chronotype questionnaires often have different aims, use different assessment methodologies, and are thus not interchangeable. Consequently, some

researchers are confused about the different concepts behind these questionnaires; therefore, it is essential to know what instrument to choose for a given research purpose [23].

To our knowledge, no effort has been made to create a structured system to clarify the relationships and conceptual differences between numerous chronotype questionnaires and scales. Therefore, the following two questions arise: Is it possible to create a “questionnaire identifier” for 1) choosing an optimal instrument for assessing individual differences in a chronobiological and sleep study and 2) determining whether such an instrument is still missing and might be constructed to fill the gap between the constructed questionnaires? Consequently, the purpose of this paper was to create such a structured system for facilitating comparisons of properties of chronotype questionnaires (“questionnaire identifier”). A list of chronotype questionnaires was created via a literature search, properties of these questionnaires and their scales were defined, criteria for categorization of each of these properties were proposed, and major results of such categorization of the identified questionnaires were presented, exemplified, and discussed.

Material and Methods

The main aim of the literature search was to identify publications reporting the results of the development and/or implications of chronotype questionnaires in human sleep and biological rhythm research. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines for systematic search were followed [23]. The PubMed bibliographic database was searched for publications from inception to 1/10/2025. Previously published reviews on chronotype questionnaires and the results of their implications in sleep and biological rhythm research were also manually searched to identify additional questionnaires (Figure 1).

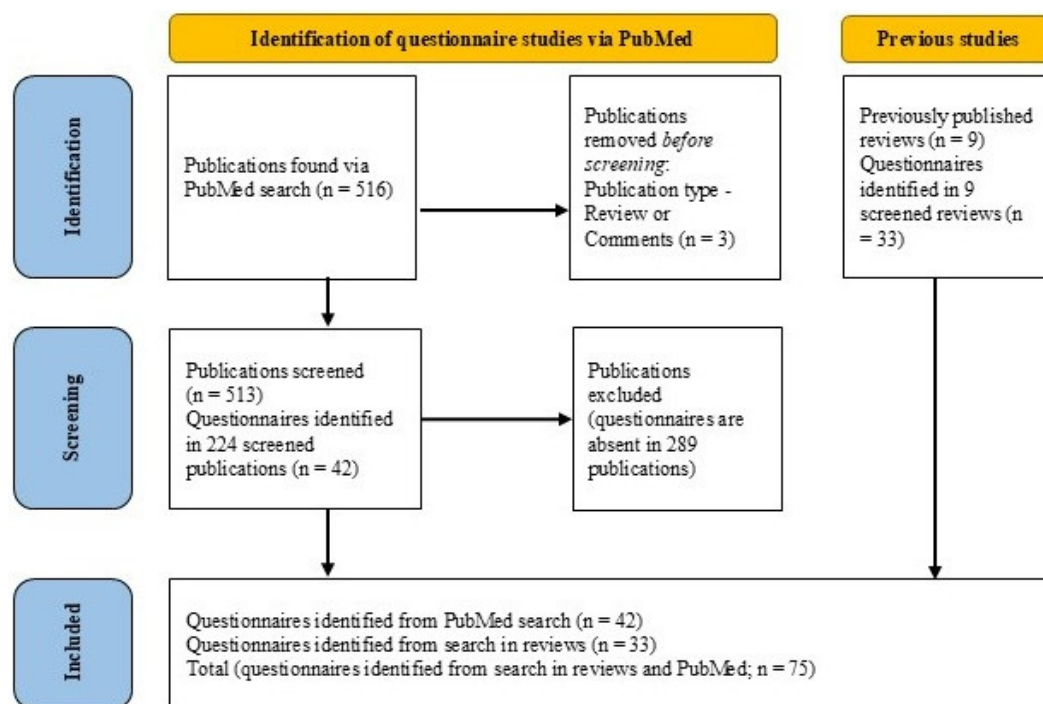


Figure 1. PRISMA flow diagram illustrating the steps of identification of chronotype questionnaires.

A total of 42 questionnaires were identified by searching in 224 of 516 publications found by screening their titles and abstracts via a PubMed search using the following search terms: (((Chronotype [Title/Abstract] OR Diurnal [Title/Abstract] OR Morningness-Eveningness [Title/Abstract] OR Morning preference [Title/Abstract] OR Evening preference [Title/Abstract]) AND (Scale [Title/Abstract] OR Questionnaire [Title/Abstract] OR Inventory [Title/Abstract])) AND

(Validation [Title/Abstract] OR Validity [Title/Abstract] OR Psychometric [Title/Abstract] OR Reliability [Title/Abstract] OR Construction [Title/Abstract] OR Development [Title/Abstract]).

Additionally, a search of previously published papers included nine reviews by Cavallera and Giudici, [25], Di Milia et al. [2], Almoosawi et al. [26], Tonetti et al. [27], Putilov [3], Putilov et al. [17], Vidueira et al. [28], Coelho et al. [29], and Buest de Mesquita Silva et al. [30]. This search showed that 33 questionnaires were missing from the results of the PubMed search (Figure 1 and Table S1).

Results

In the four subsections of this section, the results of the identification of chronotype questionnaires are reported (2.1), a set of properties of questionnaires and their scales are defined (2.2), and the properties of the questionnaires (2.3) and their scales (2.4) were categorized and exemplified.

Identification of Chronotype Questionnaires

In total, 75 chronotype questionnaires were identified through a search of publications in PubMed and an additional search of previously published papers, including nine reviews on chronotypes and methods of their self-assessment (Figure 1).

The upper part of Table S1 lists the 42 questionnaires identified in 224 of the 516 publications in PubMed. Most of these questionnaires (#8-42) were rarely used in these publications (i.e., four or fewer) as compared to the following questionnaires that were more frequently used (i.e., at least 12 publications, #1-7), the MEQ [4], 32-item Munich Chronotype Questionnaire (MCTQ) [31], 5-item reduced Morningness-Eveningness Questionnaire (rMEQ) [32], CSM [7], 10-item Morningness-Eveningness Scale for Children (MESc) [33], MESSi [11], and 27-item Children's Chronotype Questionnaire (CCTQ) [34]. The questionnaires are listed in the upper part of Table S1.

Moreover, 33 other questionnaires were identified by searching previously published papers, including 9 reviews. The questionnaires are listed in the lower part of Table S1.

Table S2 includes primary references and a brief description of each of the 75 identified questionnaires.

Tables 1 and S3 show the results of grouping the questionnaires based on their relationships. In Table 1, the total list of 75 questionnaires in Table S3 was shortened to a shorter list of 30 questionnaires addressing unspecified adult populations and did not include assessments of other than chronotype states/traits/abilities (see notes in Table 1). The relationships between questionnaires are described in the brief descriptions of questionnaires (Table S2). Such relationships usually include the reduction, extension, and mixing of previously published scales; their adaptation to a specific population; results of editing or recontextualization of all or some of the primary questionnaire items; modification of response options; and reversal of scoring (Table S2). Related questionnaires were included in the subfamilies and families. As a rule, questionnaires of different subfamilies also differ in the conceptualization of assessed constructs (s) and/or in several questionnaire properties (Tables 1, S2, and S3). Although some questionnaires can be viewed as isolates, it seems that the concepts behind any of 60 identified questionnaires for assessing chronotype can be traced back to the conceptualizations originally introduced in two pioneer questionnaires for self-assessment of either a morningness-eveningness construct or several sleep-wake adaptabilities, the MEQ [4] and the CTQ [8], respectively (Tables 1, S2 and S3).

Table 1. Grouping chronotype questionnaires in families and subfamilies.

#	Family or	Subfamily	#.Abbreviation-	Number of items and name (abbreviation, yr, and
Isolate			# of items	author(s))

1	1.1.MEQ	1.1.1.MEQ	1.1.1.1.MEQ-19	The 19-item Morningness-Eveningness Questionnaire (MEQ; 1976, Horne, Ostberg).[4]
2		1.1.2.rMEQ	1.1.2.1.rMEQ-1	The 19th item of MEQ (MEQ19th; 1976, Horne, Ostberg) [4]
3			1.1.2.2.rMEQ-5	The 5-item reduced MEQ (rMEQ; 1990, Adan, Almirall)[32]
4	1.2.DTS	1.2.1.DTS	1.2.1.1.DTS-7	The 7-item Diurnal Type Scale (DTS; 1980, Torsvall & Åkerstedt)[5]
5	1.3.CSM	1.3.1.CSM	1.3.1.1.CSM-13	The 13-item Composite Scale of Morningness (CSM; 1989, Smith et al.)[7]
6		1.3.4.MA	1.3.4.1.MA-5	The 5-item Morning Affect factor (MA factor, 2005, Caci et al.)[35]
7		1.3.5.PS	1.3.5.1.PS-12	The 12-item Early-Late Preferences Scale (PS; 2002, Smith et al.) [36]
8	1.4.STQ	1.4.1.STQ	1.4.1.1.STQ-18	The 18-item Sleep Timing Questionnaire (STQ; 2003, Monk et al.) [37].
9		1.4.2.MCTQ	1.4.2.1.MCTQ-32	The 32-item Munich Chronotype Questionnaire (MCTQ; 2003, Roenneberg et al.)[31]
10		1.4.3.PD	1.4.3.1.PD-2	The two-item Perfect Day (PD; 2017, Gross et al.) [38].
11	1.6.MRhl	1.6.1.MRhl	1.6.1.1.MRhl-15	The 15-item Mood Rhythm Instrument (MRhl; 2016, de Souza et al.)[14]
12	1.8.SACL	1.8.1.SACL	1.8.1.1.SACL-13	The 13-item Scale for Assessment of Circadian Lateness (SACL; 2005, Putilov, Putilov) [39]
13	1.9.FOLI	1.9.1.FOLI	1.9.1.1.FOLI-10	The 10-item Francis Owl-Lark Indices (FOLI; 2021, Francis et al.)[16]
14	2.1.CTQ	2.1.1.CTQ	2.1.1.1.CTQ-20	The 20-item Circadian-Type Questionnaire (CTQ; 1979, Folkard et al.)[8]
15			2.1.1.3.rCTI-11	The 11-item Circadian Type Inventory-revised (CTI-r; 2005, Di Milia et al.) [40]
16		2.1.2.CAPS	2.1.2.1.CAPS-38	The 38-item Circadian Amplitude and Phase Scale (CAPS; 2011, Di Milia et al.) [41]
17	2.2.ChQ	2.2.1.ChQ	2.2.1.1.ChQ-16	The 16-item Chronotype Questionnaire (ChQ; 2011, Ogińska).[9]
18			2.2.1.2.SCAS-8	The 8-item Revised Subjective Amplitude Scale (SCAS; 2017, Oginska et al.) [42]
19		2.2.2.CCQ	2.2.2.1.CCQ-16	The 16-item Caen Chronotype Questionnaire (CCQ; 2013, Dosseville et al.) [43]
20	2.3.CIREN	2.3.1.CIREN	2.3.1.1.CIRENS-3	The three-item CIRcadian ENergy Scale (CIRENS; 2011, Ottoni et al.) [44]
21	2.4.MESSi	2.4.1.MESSi	2.4.1.1.MESSi-15	The 15-item Morningness–Eveningness-Stability Scale improved (MESSi; 2016, Randler et al.)[11]
22	2.5.MQ	2.5.1.MQ	2.5.1.1.MQ-16	The 16-item Marburger questionnaire (MQ; 1981, Moog)[6]
23		2.5.2.SRM	2.5.2.1.SRM-17	The 17-item The Social Rhythm Metric (SRM; 1990, Monk et al.) [45]
24	2.6.VJT	2.6.1.VJT	2.6.1.1.VJT-19	The 19-time point Visuo-verbal Judgment Task (VJT; 2015, Marcoen et al.) [46]

25		2.6.2.SIC	2.6.2.1.SIC-1	The Single-Item Chronotyping (SIC; 2021, Putilov et al.)[17]
	2.7.SWPA	2.7.1.SWPA		The 40-item Sleep-Wake Pattern Assessment Questionnaire
26	Q	Q	2.7.1.1.SWPAQ-40	(SWPAQ-40: 1990, Putilov) [10]
27			2.7.1.2.SWPAQ-72	The 72-item SWPAQ (SWPAQ-72: 2007, Putilov) [47]
				The 168-item Sleep-Wake Adaptability Test (SWAT-168;
28		2.7.2.SWAT	2.7.2.1.SWAT-168	2016, Putilov)[12]
29			2.7.2.2.rSWAT-60	The 60-item SWAT (SWAT-60; 2021, Putilov) [48]
				The 38-item Lark-Owl (Chronotype) Indicator (LOCI; 1998,
30	2.8.LOCI	2.8.1.LOCI	2.8.1.1.LOCI-38	Roberts) [49]

Notes. The list of 30 of 75 identified questionnaires. Reduced by excluding reduced versions with similar properties and assessing chronotypes for other than unspecified adult study participants, that is, the reduction was based on Property 1a. For (questionnaire) for (assessing) and 1b. In (questionnaire for assessing) in (study participants). The questionnaires can be traced back to the concepts behind just two pioneer questionnaires: the MEQ [4] and CTQ [8]. 1. and 2. Questionnaires for assessing only the phase parameter of diurnal rhythm (1...) and for assessing also or only other than phase parameter(s) (2...), respectively; 1-30 – numbers were assigned to questionnaires in this and the next two tables. See Tables S1-S3 for the full list of the questionnaires.

List of Properties for Classification of Questionnaires

To create a structural system for the classification of published and future chronotype questionnaires, a set of 20 questionnaires and questionnaire scale properties were defined (Tables S4 and S5). The following 11 properties were included in the subset of the questionnaire properties (1a-5b):

- 1a. For (questionnaire for assessing)
- 1b. In (questionnaire for assessing in study participants)
- 2a. Size (questionnaire size)
- 2b. Items (number of questionnaire items)
- 3a. Parameter (diurnal rhythm parameter)
- 3b. Scales (number of questionnaire scales)
- 4a. Variation (individual variation)
- 4b. Outcome (outcome of assessment)
- 4c. Clock h (includes clock h in questions and/or answers)
- 5a. Behavior (sleep-wake behavior)
- 5b. Interval (interval of the sleep-wake cycle)

The following nine properties were included in the subset of the properties of the questionnaire scales (6a-9b) in addition to the subset of the questionnaire properties (1a-5b):

- 6a. ME scale(s) (morningness-eveningness scale(s))
- 6b. Dimensions (number of dimensions per each of morningness-eveningness scales)
- 6c. Items (number of items in morningness-eveningness scale(s))
- 7a. Amplitude/stability (amplitude/stability scale(s))
- 7b. Items (number of items in amplitude/stability scale(s))
- 8a. Wakeability (wakeability scale(s))
- 8b. Items (number of items in wakeability scale(s))
- 9a. Sleepability (sleepability scale(s))
- 9b. Items (number of items in sleepability scale(s))

Categorization of 11 Properties of Questionnaires

The following questionnaire properties were defined (1a-5b).

1a. For (questionnaire for assessing). Most of the identified questionnaires were designed to assess chronotypes (n=60). These questionnaires were further categorized in accordance with their other properties 1b-6i (Tables S2-S5). The remaining questionnaires (n=15) were designed to assess chronotypes in addition to one or more other individual characteristics (Tables S3-S5). Therefore, owing to the combination of several assessed characteristics of the study participants in these 15 questionnaires, they were not further categorized here and were included only in the Supplementary Materials. The SCRAM [18] and chrononutrition questionnaires [19–22] can serve as examples of such questionnaires for assessing chronotypes and other factors.

1b. In (questionnaire for assessing in study participants). Most questionnaires were developed to assess chronotypes in unspecified adult populations. Tables 1–3 list such questionnaires, with the exception of most reduced versions. The entire list of 60 identified questionnaires for chronotype, nothing else assessment, is provided in Tables S3-S5 (i.e., the questionnaires designed to assess specific populations and all reduced versions are included in the supplementary table). The most recent examples of questionnaires for the assessment of unspecified adults are the MESSi [11], the MRhI [14], and SIC [17]. The second-largest group included questionnaires assessing children and/or adolescents (Tables S3-S5). The most recent examples of such questionnaires are the MESC [33] and the CCTQ [34]. A minority of the remaining questionnaires targeted populations such as patients, sportspeople, shiftworkers, and adults speaking languages other than English (Tables 1–4 and S3-S5). Examples of such questionnaires are the 7-item (reduced) Basic Language Morningness (rBALM) scale [50], the ASSQ [13], the 60-item Munich Chronotype Questionnaire for shift workers (MCTQ_{Shift}) [51], and the 7-item (shortened Thai version of) Composite Scale of Morningness (sCSM) [52].

Table 2. Properties of chronotype questionnaires.

#	#.Abbreviation- # of items	2a. Size	2b. Items	3a. Parameter	3b. Scales	4a. Variatio n	4b. Outpu t	4c. Clock h	5a. Behavio r	5b. Interval
1	1.1.1.1.MEQ-19	Pr	19	Ph	1	TL	Sc	Ch+	Act+Pre	T+W
2	1.1.2.1.rMEQ-1	Re	1	Ph	<1	Ty	Sc	Ch-	Pre	W
3	1.1.2.2.rMEQ-5	Re	5	Ph	1	TL	Sc	Ch+	Act+Pre	T+W
4	1.2.1.1.DTS-7	Pr	7	Ph	1	TL	Sc	Ch+	Act+Pre	T+W
5	1.3.1.1.CSM-13	Pr	13	Ph	1	TL	Sc	Ch+	Act+Pre	T+W
6	1.3.4.1.MA-5	Re	5	Ph	1	TL	Sc	Ch-	Act+Pre	T
7	1.3.5.1.PS-12	Fu	12	Ph	1	TL	Sc	Ch-	Pre	T+W
8	1.4.1.1.STQ-18	Pr	18	Ph	2	TL	Ch	Ch	Pre	T
9	1.4.2.1.MCTQ-32	Pr	32	Ph	<1	SL	Ch	Ch	Act	T
10	1.4.3.1.PD-2	Re	2	Ph	<1	TL	Ch	Ch	Pre	T
11	1.6.1.1.MRhI-15	Pr	15	Ph	1	SL	Ch	Ch	Act	W
12	1.8.1.1.SACL-13	Pr	13	Ph	1	TL	Sc	Ch	Pre	T+W
13	1.9.1.1.FOLI-10	Pr	10	Ph	2	TL	Scs	Ch+	Pre	T+W
14	2.1.1.1.CTQ-20	Pr	20	Ph+	3	T+AL	Scs	Ch-	Pre	T+W
15	2.1.1.3.rCTI-11	Re	11	Ph-	2	AL	Scs	Ch-	Pre	T+W
16	2.1.2.1.CAPS-38	En	38	Ph+	3	T+AL	Scs	Ch-	Pre	T+W
17	2.2.1.1.ChQ-16	Pr	16	Ph+	2	TL	Scs	Ch-	Pre	T+W
18	2.2.1.2.SCAS-8	Re	8	Ph-	1	TL	Sc	Ch-	Pre	T+W
19	2.2.2.1.CCQ-16	Fu	16	Ph+	2	TL	Scs	Ch-	Pre	T+W
20	2.3.1.1.CIRENS-3	Pr	3	Ph+	<1	S+AL	Sc	Ch-	Act	W
21	2.4.1.1.MESSi-15	Fu	15	Ph+	3	T+S+AL	Scs	Ch-	Act+Pre	T+W

22	2.5.1.1.MQ-16	Pr	16	Ph+	2	T+SL	Scs	Ch+	Act+Pre	T+W
23	2.5.2.1.SRM-17	Pr	17	Ph-	1	SL	Ch	Ch	Act	T+W
24	2.6.1.1.VJT-19	Pr	19	Ph+	4	S+AL	Scs	Ch+	Act	W
25	2.6.2.1.SIC-1	Pr	1	Ph+	<1	Ty	Na	Ch-	Act	W
26	2.7.1.1.SWPAQ-40	Pr	40	Ph+	5	AL	Scs	Ch-	Pre	T+W+S
27	2.7.1.2.SWPAQ-72	En	72	Ph+	6	AL	Scs	Ch-	Pre	T+W+S
28	2.7.2.1.SWAT-168	Pr	168	Ph+	6	AL	Scs	Ch-	Pre	T+W+S
29	2.7.2.2.rSWAT-60	Re	60	Ph+	6	AL	Scs	Ch-	Pre	T+W+S
30	2.8.1.1.LOCI-38	Pr	38	Ph+	3	T+AL	Scs	Ch+	Pre	T+W

Notes. 2a-5b. Abbreviation for questionnaire properties. 2a. (Questionnaire) size: Pr - primary size (full list of items in primary questionnaire), Fu - full (similar to the primary list of items in secondary questionnaire), Re - reduced (smaller than the primary list of items in secondary questionnaire), and En-enlarged (larger than the primary list of items in secondary questionnaire). 2b. (Number of) items in questionnaire. 3a. (Diurnal rhythm) parameter: Ph - phase parameter, Ph+ - phase, and other parameter(s); Ph- other than phase parameter(s). 3b. (Number of) scales: 1 - number of scales (as sums of items) equal to 1, <1- single item or less than three items or non-summed responses (e.g., a difference calculated by subtracting one response from another). 4a. (Individual) variation: Ty - type (single item naming chronotype), TL - trait-like, SL - state-like, AL - ability-like, T+AL - trait- and ability-like, T+S+AL- trait-, state- and ability-like, and S+AL - state- and ability-like. 4b. (Assessment) output: Na - names of chronotypes, Sc - score on the only scale/item, Scs - scores on more than one scale, Ch - clock h rather than score. 4c. (Includes) clock h: Ch+ - Clock h in question or answer, or clock h is calculated from several clock h answers, Ch+ - Clock h is among answers or questions, and Ch- - clock h is not mentioned in answers and questions. 5a. (Sleep-wake) behavior: Act - actual (current) behavior, Pre - preferred behavior or behavior under specified hypothetical circumstances, Act+Pre - actual and preferred. 5b. Interval (of the sleep-wake cycle): T - interval of sleep-wake and/or wake-sleep transition, W - interval of wakefulness, T+W - both intervals of sleep-wake transition and wakefulness, T+W+S - both these two intervals and sleep interval, T+S - both intervals of sleep-wake transition and sleep (see such a category in Table S4). Reduced versions with similar properties were excluded from this table. Moreover, only questionnaires for assessing chronotypes in unspecified adult study participants were included (properties 1a and 1b). See also the notes in Tables 1, S1-S5.

Table 3. Properties of scales of chronotype questionnaires.

#	#.Abbreviation-	6a.	6b.	6c.	7a.	7b.	8a.	8b.	9a.	9b.
	number	ME	Dimen - sions	Items	Amplitude / Stability	Items	Wake- ability	Items	Sleep- ability	Items
	of items	scale(s)								
1	1.1.1.1.MEQ-19	ME	>1	19	0	0	0	0	0	0
2	1.1.2.1.rMEQ-1	ME	<1	1	0	0	0	0	0	0
3	1.1.2.2.rMEQ-5	ME	1	5	0	0	0	0	0	0
4	1.2.1.1.DTS-7	ME	>1	7	0	0	0	0	0	0
5	1.3.1.1.CSM-13	ME	>1	13	0	0	0	0	0	0
6	1.3.4.1.MA-5	M	1	5	0	0	0	0	0	0
7	1.3.5.1.PS-12	ME	>1	12	0	0	0	0	0	0
8	1.4.1.1.STQ-18	M,E	<1	3,3	0	0	0	0	0	0
9	1.4.2.1.MCTQ-32	ME	<1	1	0	0	0	0	0	0
10	1.4.3.1.PD-2	ME	<1	1	0	0	0	0	0	0

11	1.6.1.1.MRhI-15	ME	>1	15	0	0	0	0	0	0
12	1.8.1.1.SACL-13	ME	1	13	0	0	0	0	0	0
13	1.9.1.1.FOLI-10	M,E	1	5,5	0	0	0	0	0	0
14	2.1.1.1.CTQ-20	ME	1	6	2	8,5	0	0	0	0
15	2.1.1.3.rCTI-11	0	0	0	2	5,6	0	0	0	0
16	2.1.2.1.CAPS-38	ME	>1	14	2	14,10	0	0	0	0
17	2.2.1.1.ChQ-16	ME	1	8	1	8	0	0	0	0
18	2.2.1.2.SCAS-8	0	0	8	1	8	0	0	0	0
19	2.2.2.1.CCQ-16	ME	1	8	1	8	0	0	0	0
20	2.3.1.1.CIRENS-3	ME	<1	2	0	0	<1	1	0	0
21	2.4.1.1.MESSi-15	M,E	1	5,5	1	5	0	0	0	0
22	2.5.1.1.MQ-16	ME	1	8	1	8	0	0	0	0
23	2.5.2.1.SRM-17	0	0	0	1	17	0	0	0	0
24	2.6.1.1.VJT-19	M,E	1	4,6	0	0	2	5,4	0	0
25	2.6.2.1.SIC-1	ME	<1	<1	0	0	<1	<1	0	0
	2.7.1.1.SWPAQ-									
26	40	M,E	1	12,8	0	0	1	4	2	4,12
	2.7.1.2.SWPAQ-									
27	72	M,E	1	12,12	0	0	2	12,12	2	12,12
28	2.7.2.1.SWAT-168	M,E	1	28,28	0	0	2	28,28	2	28,28
29	2.7.2.2.rSWAT-60	M,E	1	10,10	0	0	2	10,10	2	10,10
30	2.8.1.1.LOCI-38	M,E	1	13,13	0	0	1	12	0	0

Notes. 6a-9b. Abbreviation for questionnaire scale properties. 6a. ME scale(s) (morningness-eveningness scale(s)): ME, one score or clock h or names for morningness-eveningness types, M - one score for morning subconstruct of morningness-eveningness, M, E - one score (or clock time) for morning subconstruct and one score (or clock time) for evening subconstruct of morningness-eveningness, 0 - no morningness-eveningness scale. 6b. (Number of) dimensions (per ME scales): 1 - one scale - one factorial dimension, >1 - number of factorial dimensions per 1 scale is larger than 1, <1- single item or three items or non-summed responses (e.g., like a difference calculated by subtracting one response from another), 0 - no morningness-eveningness items. 6c, 7b, 8b, 9b: (Number of) items in such scale(s). 7a. Amplitude/Stability (scale(s)): 1 - one scale - one factor, 2 - two scales - two factors, 0 - no any amplitude/stability scales. 8a. Wakeability (scale(s)): 1 - one scale - one factor, 2 - two scales - two factors, <1- single item, 0 - no wakeability scales. 9a. Sleepability (scale(s)): 2 - two scales - two factors, 0 - no sleepability scales. See also notes to Tables 1, 2, S1-S5.

Table 4. Number of chronotype questionnaires in each category of a property.

Property of Property # Its short name	Questionnaire						
	1a.	1b.	2a.	3a.	4a.	4b.	4.c
For	in	Size	Parameter	Variation	Output	Clock h	
Number	Ch+=15	-	-	-	-	-	-
of	Ch=60	AN=39	Pr=21	Ph=38	Ty=2	Na=1	Ch=11
categories		AL=4	Fu=9	Ph+=15	TL=35	Sc=29	Ch+=26
of		SW=2	Re=27	Ph-=6	SL=10	Scs=19	Ch-=23
properties		AP=3	En=3		AL=6	Ch=9	

		AS=1 CA=11			S+AL=2 T+AL=3 T+S+AL=2 T+SL=1			Ch+Scs=1
Total number	75	60	60	60	60	60	60	
Property of	Questionnaire			Questionnaire scale(s)				
Property #	5a.	5b.	6a.	6b.	7a.	8a.	9a.	
Its	short	Behavio	Interva	ME	Dimension	Amplitude		
name	r	r	l	scale(s)	s	/	Wake- ability	Sleep- ability
Number	-	-	-	-	-	-	-	-
of	Act=12	T=7	ME=41	1=25	1=11	1=2	2=4	
categories	Pre=25	W=7	M=2	>1=23	2=4	2=4	0=56	
	Act+Pre	T+W=4						
of	=22	1	M,E=11	<1=8	0=45	<1=2		
		T+W+S						
properties		=4	0=6	0=4		0=52		
		T+S=1						
Total number	60	60	60	60	60	60	60	

Notes. *Questionnaires for assessing chronotypes and other factors were not included in these calculations (1a. For (questionnaire for assessing), we used the category Ch+ in Tables S3-S5, n=15). 1b-9a. Abbreviation of questionnaire or chronotype scale property: Categories (Number of) items (2a, 6c, 7b, 8b, 9b) were not included. See the notes in Tables 1, 2, 3 and S1-S5.

2a. Size (questionnaire size). Some of the initially developed questionnaires were further developed but remained of a similar size in terms of the number of scales and items (full size \approx primary size). These primary and secondary questionnaires can be exemplified by the 13-item CSM [7] and the 13-item Basic Language Morningness (BALM) [53], MESSi [11], the 15-item Morningness-Eveningness-Stability Scale improved for adolescents (aMESSi) [54], the 16-item Chronotype Questionnaire (ChQ) [9] and the 16-item Caen Chronotype Questionnaire (CCQ) [43]. Instead, some questionnaires were expanded (Tables 2–4, S2-S5). Examples include the 38-item Circadian Amplitude and Phase Scale (CAPS) [41] developed from the CTQ [8] and the 72-item Sleep-Wake Pattern Assessment Questionnaire (SWPAQ-72) [47] developed from its primary 40-item version [10,55]. More often, a questionnaire was reduced to solve problems of its length, which would often prevent study participants from completing the questionnaire in full (Tables S3-S5). The most popular of the remarkably reduced versions of MEQ [4] is the rMEQ [32]. Another example is the 6-item Ultra-Short Version of the Munich ChronoType Questionnaire (μ MCTQ) [56] developed by MCTQ [31]. It was sufficient to obtain only the chronotype measure suggested by this questionnaire (the difference in two clock times for sleep). Moreover, the reductions were aimed at solving two other problems of an earlier developed morningness-eveningness scale, their multi-dimensional structure, and the low item-scale correlation coefficients of several questions (Table S2). Examples of such reduced versions of the 19-item MEQ [4] are the 15-item (shortened) Morningness-Eveningness Questionnaire (MEQ-15) [57] and the 4-item version of the Morningness-Eveningness Questionnaire (MEQ-4) [58,59], respectively.

2b. Items (number of questionnaire items). However, a reduction in the number of items might decrease reliability of the Morningness-eveningness scale. The reliability of the maximally reduced scale, a single-item or three-item measure, can be assessed using conventional internal consistency

methods such as Cronbach's alpha. Therefore, they are evaluated using other approaches, such as test-retest reliability, where scores, clock times, and clock types are correlated at two different time points. Examples of single-item scales that measure a construct with a single question are the SIC [17] and the 19th item of the Morningness-Eveningness Questionnaire (MEQ19th) [4,60]. Moreover, a single clock time can be calculated from the responses to more than one question, for example, using a few items from either MCTQ [31] or μ MCTQ [56].

3a. Parameter (diurnal rhythm parameter). Starting from the first questionnaire for assessing morningness-eveningness, MEQ [4], the majority of published questionnaires were designed to self-assess only one parameter of circadian (diurnal, daily) rhythm, its phase. The list of such questionnaires included MEQ [4], DTS [5], CSM [7], MESC [33], 12-item Early-Late Preferences Scale (PS) [36], and 12-item Student Morningness-Eveningness Questionnaire (SMEQ) [61]. A small part of the questionnaire contained one or more scales for assessing parameters other than the phase (Tables 1–4 and S3-S5). The list of such questionnaires included the CTQ [8], CAPS [41], SWPAQ [10,47,55], SWAT [12,48], ChQ.[9], CCQ [43], MQ [6] and 17-item Social Rhythm Metric (SRM) [45].

3b. Scales (number of questionnaire scales). Consequently, the vast majority of chronotype questionnaires contained only one scale (Tables S3-S5). The number of scales in the other questionnaires (>1) varied from 2 (for instance, the MQ [6]) to 6 (for instance, the 72-item SWPAQ [47] and SWAT [12]). Moreover, chronotype can be assessed using one item with several response options for choosing a score or name of chronotype (e.g., MEQ19th [4,60] or SIC [17], respectively). It can also be assessed using one continuous variable calculated from the responses to several questions. Examples include clock h in the MCTQ [31] and two-item Perfect Day (PD) [38]. This can also be the difference between the scored responses to two questions; for example, two items of the three-item CIRcadian ENergy Scale (CIRENS) [44].

4a. Variation (individual variation). The study participants were directly asked about their chronotypes. This is an assessment of type rather than trait, for example by applying SIC [17]. Question(s) can refer either to most typical/usual situation/circumcises or to actual (current) situation/circumcises (e.g., today or this week), for example in the PS [36] or in the SRM [45]. Consequently, these are assessments of trait-like or state-like individual variation. Theoretically, an individual's trait-like characteristics are stable, long-lasting, and internally caused, whereas state-like characteristics can be temporal, short-lasting, or caused by external circumstances. In fact, the term "chronotype" can be used for trait- rather than state-assessments [3]. Finally, the study participants were asked about their ability to do something during a certain time of the day after a certain period of permanent wakefulness or insufficient sleep. Examples of such questionnaires are the SWAT [12], the SWPAQ [10,47,55], and 11-item Circadian Type Inventory-revised (CTI-r) [40]. Consequently, this is an assessment of ability-like rather than trait-like individual variation (Tables 1–4 and S3-S5). In the pioneer study published by Folkard et al. in 1978 [8], the term "adaptability" was invented to stress that these are the factors determining the success or failure of biological adaptation to night and shift work.

4b. Outcome (outcome of assessment). A study participant could simply be asked to choose their chronotype from several options. The only example is the SIC [17]. In the vast majority of questionnaires, the responses of a study participant to several items are used to calculate a score that determines his/her position on a scale, for example, by using the MEQ [4] or the MEQ19 [4,60]. Scores can be calculated on more than one scale, for example, using the CTQ [8]. Moreover, clock time can be calculated from responses to several items, for example, by using responses to the MCTQ [31] and the 18-item Sleep Timing Questionnaire (STQ) [37] (Tables 1–4 and S2-S5).

4c. Clock h (includes clock hours for questions and/or answers). Clock h can be mentioned in the questions and/or answer(s). The 13-item Scale for Assessment of Circadian Lateness (SACL) [39] can serve as an example of a questionnaire intentionally designed to ask about only one of several clock time options (each of which is assigned a score). However, questions and answers can be intentionally worded to avoid any reference to clock times. For instance, PS [36] asks to compare a study participant with most other people, for example, earlier or later than the other (Tables 1–4 and S2-S5).

5a. Behavior (sleep-wake behavior). One or more items refer to actual (current) behavior (including answers about actual sleep timing, as in the MCTQ [31] asking about weekdays and free days). Moreover, one or more items refer to preferred behavior or behavior under specified hypothetical circumstances. These items refer to preferred and hypothetical sleep timing, as in PD [38], which asks only about free days. As a rule, items included in a chronotype questionnaire asked either mostly or only about such a preference, as exemplified by either the MEQ [4] or STQ [37], respectively (Tables 1–4 and S2-S5).

5b. Interval (interval of sleep-wake cycle). Questions can refer to the interval of transition from wakefulness to sleep, and/or the interval of transition from sleep to wakefulness. Examples of such questionnaires are the PD [38] or the 5-item Morning Affect factor (MA) [35]. Moreover, scales of a questionnaire can refer either to an interval of wakefulness between these transitions, for example, the MRhI [14], or to this interval and, additionally, to the situation of further prolonged wakefulness on night and next day hours, for example, the 19-item Point Visuo-verbal Judgment Task (VJT) [46]. Many rare items of the whole scale of a multi-scale questionnaire either refer to the interval of night sleep or ask about the ability to nap during the wake phase of the sleep-wake cycle, such as nighttime or daytime (anytime) sleepability scales of the SWAT [12] and SWPAQ [10,47,55] (Tables 1–4 and S2-S5).

Categorization of 9 Properties of Questionnaire Scales

The following properties of questionnaire scale(s) were defined (6a-9b).

6a. ME scale(s) (morningness-eveningness scale(s)). Starting with MEQ [4], most chronotype questionnaires included one scale for the assessment of morningness-eveningness (Tables 1–4 and S2-S5). When the conventional psychometric procedures were applied for construction and/or evaluation of such a scale, they yielded not one, but, at least, two factors. Therefore, starting from the SWPAQ [10], morning and evening subconstructs of the morningness-eveningness construct were confirmed by the development of two scales in several questionnaires, including the MESSi [11], SWAT [12], MEEPQ [15], FOLI [16], and 38-item Lark-Owl (Chronotype) Indicator (LOCI) [49] (Tables 1–4 and S2-S5). Moreover, it was demonstrated that an original ME scale can be intentionally reduced to develop a short scale for reliable assessment of just one – morning – subconstruct of morningness-eveningness construct called Morning Affect (MA) [35].

6b. Dimensions (number of dimensions per each of morningness-eveningness scale). Since conventional psychometric procedures were not applied for the construction of earlier published ME scales (e.g., the MEQ [4], DTS [5] and CSM [7]), their multidimensional nature was revealed only in later studies implementing the factor-analytic approach (Table S2). Most usually, the remarkable reduction of a ME scale, for example, to either five or four items, yields a one-factor solution. When a somewhat larger number of items were left on a reduced scale, it remained multidimensional, for example, the 6-item (reduced) Morningness-Eveningness Questionnaire (MEQ-6) [62].

6c. Items (number of items on the morningness-eveningness scale(s)). Although factor analysis of a 4- or 5-item scale, such as the rMEQ [23], usually yields a single factor, such a scale can contain several constructs that are found in different factors when responses to the primary (much larger) scale, such as the MEQ [4], are factor-analyzed. Consequently, implementing such an approach to reduce the number of items can decrease the reliability of a scale that contains several constructs of the primary scale (Table S2). Nevertheless, a questionnaire such as STQ [37] can require the reporting of only three clock times for the calculation of each of the (morning and evening) components of morningness-eveningness.

7a. Amplitude/stability (amplitude/stability scale(s)). The entrained circadian rhythm is characterized by phase and amplitude parameters, and it is well established that individual differences in phase parameters are suitable for self-assessment using a morningness-eveningness scale. The development of one or two amplitude/stability scale(s) was encouraged by the idea that psychological and behavioral manifestations of differences in circadian amplitude parameters are also suitable for self-assessments (Table S2). The CTQ [8], CTI-r [40], CAPS [41], ChQ [9], CCQ [43],

and MESSi [11] contained scale(s) designed to assess the amplitude and stability of diurnal rhythmicity. One of the two scales, MQ [6] and SRM [45], was designed to assess the stability of diurnal timing, that is, day-to-day replicable rise- and bed-times.

7b. Items (number of items in amplitude/stability scale(s)). One scale for the assessment of the amplitude/stability parameter was developed in MESSi [11], ChQ [38], CCQ [43], the MQ [6], and SRM [45]. In contrast, the CTQ [8] and its descendants, the CAPS [41], the CTI-r [40], and the 18-item Circadian Type Inventory (CTI) [64], were developed to assess subjective rhythm amplitude by scoring on two scales, languid-vigor and flexible-rigid, because it was hypothesized that low-amplitude (e.g., languid) and flexible rhythms would show better adjustment to night work. This hypothesis predicted that these scales would be intercorrelated, but the established scales were independent of each other (Table S2).

8a. Wakeability (wakeability scale(s)). As people differ in their ability to keep waking in sleep-promoting conditions, ability-like individual variations can also be assessed (Table S2).

8b. Items (number of items in wakeability scale(s)). Wakeability can be assessed using at least two scales (e.g., in the SWAT [12,48], because it can manifest in various circumstances (e.g., either appropriate or inappropriate for waking time of the day, in nap-provoking conditions during daytime, and in the condition of prolongation of wakefulness to night and next day hours; Tables 1–4 and S2-S5). For instance, one scale was constructed in the primary version of the SWPAQ [10], but an additional scale was developed in its enlarged version [47]. Moreover, both the primary and reduced versions of the SWAT [12,48] include two wakeability scales.

9a. Sleepability (sleepability scale(s)). The individual characteristics of the sleep-wake behavior can be described with two opposing one another terms, “wakeability” and “sleepability.” However, these characteristics cannot be assigned to opposing poles of a single factorial dimension. A study participant can report that it is easy for him/her not only to remain awake but also to fall asleep, while another participant can have problems with both waking and falling asleep at the same time of the day. Therefore, factor analysis usually yields separate dimensions of wakeability and sleepability, indicating the need to develop separate wakeability and sleepability scales (Table S2).

9b. Items (number of items on the sleepability scale(s)). Consequently, in addition to the wakeability scale(s), two separate sleepability scales were developed in the SWPAQ [10,47,55] and SWAT [12,48] (Table S2).

Discussion

The number and variety of chronotype questionnaires have profoundly increased over the last 50 years, after the first publication of such a questionnaire [4]. It is sometimes essential to determine which of these questionnaires would be better applicable for answering a given research question in the field of chronobiology and sleep science. Here, a structured system is proposed to 1) facilitate comparisons of the properties of chronotype questionnaires and 2) predict the features of unconstructed questionnaires. A set of chronotype questionnaire properties was defined, and 60 questionnaires were classified to distinguish them from 59 other questionnaires. The proposed structured system can help navigate between numerous questionnaires without much effort, for example, without inspecting the content of each questionnaire. Therefore, this system might serve as a “questionnaire identifier” to choose the right instrument for a study of individual differences in the domain of chronobiology and sleep science. This system can also help in 1) uncovering empty territories in the questionnaire landscape by predicting the unique properties of yet-unconstructed questionnaires and 2) developing new versions of previously published questionnaires.

For example, Marcoen et al. [46] published a 19-time point VJT that asked participants to score the expected level of sleepiness at 19 different time points within a 1.5-day interval of permanent wakefulness. Because sleepiness is correlated with wakeability rather than sleepability, the VJT cannot be an appropriate instrument for assessing sleepability at different clock times during this 1.5-day interval of permanent wakefulness. Therefore, another version of this questionnaire was developed to assess sleepability. For instance, a question about how easily study participants think

they would fall asleep can be used instead of a question about sleepiness level. The response options can distinguish between the time intervals required to voluntarily fall asleep at each of the 19 time points of the VJT (e.g., less than one min, 1-5 min, 6-10 min, 11-30 min, and > 30 min). Originally, the VJT [46] was used to validate flexibility scores obtained with the CTI [62], and in a more recent study, it was applied for the validation of chronotypes self-chosen with the SIC [17]. The proposed new version might be implicated in the validation of sleepability scales of questionnaires as the SWPAQ [47] and SWAT [48].

Studies on age- and sex-associated differences in morningness-eveningness illustrate the importance of choosing an optimal questionnaire tool for research on individual differences in the field of chronobiology and sleep science. It is well established that sleep duration gradually decreases with advancing age [65,66], while circadian sleep timing shows an n-shape age trend with the most prominent delay of bedtime in late adolescence to early adulthood. In other words, age-associated shifts occur toward later and earlier sleep timing during the transition through adolescence and adulthood, respectively, [31,67,68]. Irrespective of age, the difference in sleep timing between the morning and evening types was approximately equal to two hours [69]. Since sleep timing dramatically varies with age, morning types identified in a sample of late adolescents usually report weekend wakeups at the same clock time as evening types in samples of people of younger and older ages, that is, early adolescents and middle-age adults [69–71]. Moreover, when morning and evening types are forced to wake up on weekdays at approximately the same clock time to attend the same workplace or class, the difference between them in weekend sleep timing becomes much shorter than two hours due to a more pronounced shift of the 24-h pattern of weekday light exposure in the evening than morning types [72]. Such issues of comparison of sleep timing in chronotypes of different ages, even under identical environmental conditions, were recognized by the authors of some questionnaires, such as PS [36] and SWPAQ [10]. Therefore, these questionnaire tools do not mention clock times. Consequently, such questionnaires, rather than questionnaires asking about actual or preferred clock times, are recommended for the comparison of chronotypes of participants of various ages. Moreover, as discussed in [23], profoundly different results of the comparison of chronotypes might be obtained in studies implicating questionnaires asking about either actual (current) or preferred clock time.

In the last paragraphs of this section, studies on sex-associated differences in morningness-eveningness are reviewed to illustrate the importance of choosing an optimal chronotype questionnaire to study the gender gap between chronotypes. On one hand, the literature suggests that sex-associated differences in scores on a morningness-eveningness scale are modest, with a slightly larger evening preference in male than female study participants (e.g., [73–76]). In particular, publications applying three morningness-eveningness scales, MEQ [4], rMEQ [32] and CSM [7], were reviewed by Randler and Engelke [77]. The results suggest that, on average, the choice of one of these three questionnaires did not influence the difference in chronotypes between genders. However, exceptions (a larger evening preference in females rather than males) and non-significant results have been reported in many publications. For instance, Zimmermann [78] did not find significant sex-associated differences in the chronotypes of college students. The following published studies exemplify conflicting results on sex-associated differences obtained using morningness-eveningness scales. In a study by Natale et al. [79], a significantly higher proportion of morning types among females compared with males was found only in the group born between April and September but not in the group born from October to March. Díaz-Morales and Parra-Robledo [80] found that sex-associated differences change with age, whereas younger men and men over 40 years of age were more morning-oriented than women. Buekenhout et al. also showed that after the age of 48 years, males exhibited greater morningness than females [81]. Moreover, Duarte et al. found that women were more morning-oriented than men until the age of 30 years and that there were no significant differences between men and women between 30 and 45 years of age [82]. Merikanto and co-workers [83] reported that eveningness was more common among women than men, and Gaina et al. [84] found that female students showed a greater evening preference than male students in a study of

Japanese first- to third-year junior high school students (age 12–15 yrs). Carskadon et al. [33] noted age-associated changes in sex-associated differences even during shorter age intervals. With the onset of puberty, girls report a higher evening orientation than boys in the MESC [33], and the tendency for eveningness progressively dissipates after adolescence.

These results can be explained by studies applying questionnaires designed to separately assess sleep-wake habits in the morning and evening. Females, irrespective of age, showed greater morning lateness and lesser evening lateness than males on two separate morning and evening scales of the SWPAQ [85]. In a study applying two – morning and evening – scales of the LOCI [49], Preckel et al. [86] found relatively more females than males of types combining morning lateness with evening earliness and relatively more males than females of types combining morning earliness with evening lateness. In support of these findings, analysis of sleep times in 340 paired male and female subsamples yielded, on average, a 0.16-h earlier bedtime and a 0.10-h later risetime in females than in male subsamples [87]. However, different results have been obtained in several studies that applied MESSi scales [11]. Females scored lower than males on the scale assessing evening preference, while the male-female gap was not significant for the scale assessing morning affect [88,89].

Overall, the above-mentioned studies suggest that the results of testing sex-associated differences in morningness-eveningness can vary depending on the applied morningness-eveningness scales. This can be explained by the difference in the ratio between items asking about behavior and habits in the morning and evening hours. An example of a study supporting this conclusion was provided by the results of a direct comparison of sex-associated differences in morningness-eveningness assessed with the rMEQ [32] and the PS [36] published by Tonetti et al. [90]. They replicated gender differences (higher morningness in women) only for the rMEQ. Consequently, to show either significant or non-significant sex-associated differences, separate assessments of the morning and evening components of morningness-eveningness can be recommended. It is likely that a separate assessment of these components can support the significance of the male-female gap, and summing scores on separate morning and evening scales can support the non-significance of this gap. Consequently, the answer “No” appears to be the correct answer to the question: Is there any sex-associated difference in morningness-eveningness?

Conclusion

Throughout the 50-yr history of scientific publications on chronotype questionnaires, their numbers and varieties have grown continuously. To help navigate the questionnaires, a structured system of classification based on a set of questionnaire and questionnaire scale properties was proposed. This “questionnaire identifier” might be recommended for 1) choosing an optimal instrument for self-assessment of individual differences in the domain of chronobiology and sleep science and 2) predicting properties of yet-unconstructed questionnaires.

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