# Chronotype and Social Behavior

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In this review, the term chronotype is used as a collective term for various conceptualizations, such as circadian phase, circadian preference, as well as the terms morning-type and evening-type, as well as more colloquial terms "owls" and "larks". A late chronotype (or in colloquial terms, an "owl") is someone who falls asleep rather late, and therefore gets up later. In contrast, morning types (or colloquially labelled "larks") get up and start earlier, and hence, go to bed earlier. These terms should be used without discrimination, i.e. that it should be viewed as a kind of a diversity aspect rather than valuing one over the other (usually morning over evening). Thus, the chronotype clearly refers to the "timing"of sleep (Randler, 2014) and, scientifically, this is a variable distinct from sleep duration, which reflects the amount of time someone sleeps. In addition to sleep timing, other features are critical to chronotype. One is the time of peak performance, thus at what time a person is performing best and at optimal level of arousal (e.g., considering a tests). Here, morning people often reach their peak performance early in the day, while evening people reach their peak performance relatively late in the day (in the afternoon, in the evening, sometimes only at night; for an overview, see Adan et al., 2012).

Chronotype has a biological basis and is related to the circadian fluctuations of the body temperature, and is correlated with Dim Light Melatonin Onset (DLMO; Kantermann, Sung, & Burgess, 2015). For example, Kantermann et al. (2015) found a correlation between DLMO and scores on questionnaires, showing that owls had a later DLMO than larks, which backs up the questionnaire assessment of chronotype with biological data. Further, cortisol levels in the morning are associated with chronotype (Randler & Schaal, 2010). Specifically, morning people had higher cortisol levels immediately after awakening. Further, candidate genes have also been identified (Lane et al., 2016). General aspects are that on average women are more morning oriented than men (Randler, 2007), and there are striking developmental

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changes during the lifespan (Randler, 2016; Randler, Faßl, & Kalb, 2017). Young children are usually more morning oriented, and rapidly turn towards evening orientation, while at the end of adolescence and during post-adolescence, people become more morning oriented again, so that at the age of 60–70 years, morningness is on a similar level as in young children (Randler, Freyth-Weber, Rahafar, Jurado, & Kriegs, 2016; Roenneberg et al., 2004). Chronotype can be measured with a variety of questionnaires, based on unidimensional and multi-dimensional conceptualizations (see Di Milia, Adan, Natale, & Randler, 2013 for a review). In some studies, the chronotype has been placed close to a personality variable or at least regarded as an individual difference variable. It is clearly related to the personality dimensions but still a different trait (Lipnevich et al., 2017). Therefore, the question arises to what extent the chronotype can have an influence on social behavior and relationships.

## Personality and Chronotype

Different aspects of chronotype can be linked with social behavior. One important way to examine differences in social behavior is to focus on personality. Most studies in recent times are based on the Big Five conceptualization of personality (the psycho-lexical approach), and two of the five dimensions are most relevant to social behaviors: extraversion and agreeableness. Extroverted persons are characterized as sociable, talkative and do like encouragements (e. g. "I really like to talk to other people."). Most earlier studies found a clear relationship between extraversion and eveningness, thus, evening people were more extraverted (see overview in Adan et al., 2012). However, Tsaousis (2010) detected a slight positive effect between morningness and extraversion in his meta-analysis, while there was no relationship between morningness and extraversion in individual studies. This was an interesting finding. Two more recent studies showed that morning persons are more extraverted than evening persons (Randler, Schredl, & Göritz, 2017; Ruffing, Hahn, Spinath, Brünken, & Karbach, 2015). This is an interesting and new facet where no explanation is yet available. It could be related to the questionnaires used, mainly, the questionnaires dealing with chronotype. Previous work always questioned that it seems the type of personality questionnaire being responsible for contradictory results, but most recent studies during the last 10 years used the Big Five concept. Thus, one ongoing question and direction of future research would be to assess, what influences this relationship. Lipnevich et al. (2017) presented a new meta-analysis based on 620 correlations from 44 independent samples and confirmed the well-known relationship between conscientiousness and morningness. Extraversion and Openness exhibited moderate unique relations with Eveningness, while Agreeableness was largely unrelated to all circadian preference variables. As a conclusion, we find some evidence for a clear relationship between morningness and personality, with morningness associated with more conscientiousness and eveningness associated with more extraversion.

Concerning the personality dimension of agreeableness, high values in the agreeableness scale suggest that the test person is caring, compliant and has a strong need for harmony (e. g. "I try to be kind to everyone I meet."). Agreeableness was often related to morningness with an effect size of: r = .14 (Tsaousis, 2010; meta-analysis). However, in a recent study, this relationship could not be found anymore (Lipnevich et al., 2017).

Other personality dimensions are also tested in such association studies. Individual differences in aggression and hostility are also key to social behavior. Aggression-Hostility, however, was unrelated to chronotype in a Spanish and German sample (Muro, Gomà-i-Freixanet, & Adan, 2009; Randler, Gomà-i-Freixanet, Muro, Knauber, & Adan, 2015) based on the same chronotype questionnaire, the reduced morningness-eveningness questionnaire (Adan & Almirall, 1991).

## Socializing and Chronotype

Closely related to the concept of extraversion is one's sense of humor, and humor can also have a social component. Randler (2008) found that evening people score higher on the sense of humor, showing that chronotype is related to this individual trait variable. However, as humor might be a component resulting from extraversion, the analysis was recalculated controlling for extraversion as a confounding factor. Individuals scoring as evening types reported a greater sense of humor than morning individuals (with higher morningness scores). In a stepwise linear regression, Extraversion, Agreeableness, Openness, and Chronotype each accounted for a significant amount of variance in sense of Humor scores. That is, the relationship between scores on Sense of Humor and evening orientation was significant after controlling for personality dimensions. However, eveningness was related to sense of Humor scores in women but not in men, and social but not cognitive humor was predicted by eveningness (Randler, 2008), again emphasizing the different expression of social aspects of chronotypes.

More negative aspects of social behaviour have also ben related to chronotype. For example, negative behaviors at school was measured by Lange and Randler (2011). Here, the chronotype scores correlated positively with pro-social behavior, and negatively with behavioral problems, suggesting that larks do better cope with the social aspects of the school environment (Lange & Randler, 2011). Cyberbullying is a more recent construct, evolving with the social media. Victims of cyberbullying perpetration have been reported to suffer many psychological and emotional problems that can lead them as far to suicide (Kırcaburun & Tosuntaş, 2018). These authors reported that chronotype and sleep quality were significant predictors of cyberbullying perpetration (Kırcaburun & Tosuntaş, 2018), with evening-type students showing higher scores on the cyberbullying scale than neither-type students and morning-type students. Concerning aggression, a recent review by Schlarb et al. (2014) showed that children and adolescents from the evening type revealed more behavioral and emotional problems as aggression or antisocial behaviour.

Concerning social networks, Aledavood, Lehmann, and Saramäki (2018) collected their data based on a smartphone app with >700 volunteers. These authors reported that owls maintain larger personal networks, albeit with less time spent per contact, and evening people were more central in their social network. This fits well with the personality dimensions discussed above with evening owls being more extraverted. Another important point was that owls showed a homophily by preferring social contacts with other owls. In sum, evening types have a disadvantage concerning some aspects of social behaviour, while also have an advantage in some kinds of socialising, i.e. in establishing and maintaining contacts.

Although some regression models presented in research papers indicate that sleep sleep duration and chronotype might have independent influences on social behaviour (e.g., Owens, Dearth-Wesley, Lewin, Gioia, & Whitaker, 2016), it is not clear if this is direct effect of chronotype or whether it is a by-product of sleep and shorter sleep duration, because evening people suffer of sleep debt during the weekdays. This is especially the case in school pupils and adolescents. Here, only experimental sleep extension programs may give an answer and might help to investigate behavioural changes and scores on questionnaires.

## Mate Choice and Pair Bonding

Another interesting aspect of social behaviour is pair behavior, which usually happens in dyads. There are only a handful of studies that looked at these aspects (for example, Richter, Adam, Geiss, Peter, & Niklewski, 2016). Piffer (2010) was the first to study this hypothesis on the basis of 134 Italian men. He found a correlation of −0.26, indicating that men with a higher evening orientation reported more sexual partners from the opposite sex. Gunawardane, Custance, and Piffer (2011) confirmed this hypothesis in a sample from Sri Lanka. Subsequently, we examined this question in German men with a somewhat more complex approach (structural equation models, Randler et al., 2012). In fact, it was also found here that men of the evening type reported a higher reproductive success. This result remained even when controlling for age, extraversion and also for propensity for going out. In addition to chronotype, older age, high extraversion, and more "going out" were statistical predictors of higher reproductive success. Jankowski, Díaz-Morales, and Randler (2014) also examined women for the first time about the construct of socio-sexuality. Socio-sexual orientation is a construct that describes the propensity for occasional sex and sexual activity, especially in unbound relationships (Penke & Asendorpf, 2008). Important elements here include behaviors, desires, and attitudes. In men, there was no correlation between chronotype and sociosexuality, possibly due to the small sample size, but in women evening-oriented women showed less limited global socio-sexuality ($r = 0.27$), as well as less restricted socio-sexual behavior ($r = 0.18$), attitude ($r = 0.28$) and desire ($r = 0.15$). Evening orientation can also be seen as a factor for the instability of romantic relationships and high-risk sexual behavior in women.

Subsequently, we examined the influence of attitudes of Germans. Evening orientation and short sleep duration were correlated with a higher overall score in socio-sexuality, as well as the three subscales of behavior, attitudes and desire (Randler, Freyth-Weber, et al., 2016; Randler, Jankowski, et al., 2016). Diaz-Morales et al. (2018) conducted a cross-cultural study and surveyed 1483 women from Poland, Spain, Germany and Slovakia. Again, statistical correction for age, relationship status and country showed that women with late sleep timing are less socio-sexually constrained. Thus, evening people are less restricted in their sexual encounters. Likewise, in this study, the influence of the personality variables of the Dark Triad has been corrected. The dark triad tracks subclinical personality pathology, such as narcissism, psychopathy, and Machiavellianism (Jonason, Li, Webster, & Schmitt, 2009). Although the dark triad is associated with both the evening type personality (Jonason, Jones, & Lyons, 2013; Rahafar, Randler, Castellana, & Kausch, 2017), and although the dark triad and evening type are both associated with reproductive success (Jonason et al., 2009), there were no correlations in the present study.

In general, the findings on evening types and reproduction fit well with the Maestripieri study (2014). In his study, both female and male night owls were single rather than in long-term relationships. Female night owls had average cortisol profiles and risk tendencies more similar to those of men than those of morning-type women. These results thus support the hypothesis that evening orientation is associated with psychological and behavioral traits that are crucial for short-term mating strategies (Maestripieri, 2014). So far, however, no one examined to what extent this had an effect on the reproductive fitness (the actual reproductive success measured as number of children). A current study at the University of Tübingen examined more 1800 people of both sexes in terms of reproductive success (number of children) and chronotype, and found that – in contradiction to the hypothesis – morning people of both sexes had a higher number of children (Kasaeian, Weidenauer, Hautzinger, & Randler, 2019).

Despite the evidence of a chronobiological aspect in sexual selection, there is further evidence that chronotype is actually an assortative trait when choosing a longer-term partner. Assortative mate choice has been demonstrated in many areas, such as in education, body height and religious attitudes. Two studies show that there is an assortative partner choice when it comes to chronotype (Randler, Barrenstein, Vollmer, Díaz-Morales, & Jankowski, 2014; Randler & Kretz, 2011). This shows, in contrast to the above hypothesis, that for longer-term bonds, similar partners are preferred. In fact this would be interesting research venue for agonistic force processes, with assortative mating on the one side and a preference for evening men on the other. Interestingly, the results of Jocz, Stolarski, and Jankowski (2018) from Poland showed no indication for assortative morning in chronotype. Also Hida et al. (2012) found no correlation between questionnaire scores in couples, but significant correlations between the sleep and wake-up times of a couple, and most pronounced at the mid-point of sleep center - a marker of the chronotype. Similar results were found by Gunn, Buysse, Hasler, Begley, and Troxel (2015) with Americans. Even though the questionnaire values between the couple did not

correlate, the times when falling asleep and getting up were correlated. So at least for long-term relationships, a similar sleep timing seems to be beneficial.

The different activity profile of the chronotypes may also be the reason why morning types are more common for morning types. So, assortative mating may be simply a by-product, because evening people meet each other in the evening, and morning people in the morning. Due to the increasing online dating, there could be a shift towards lower correlations between the chronotypes of pair members because the mating place is no more outside but rather starts during the online dating which is at least somewhat independent of clock times. Although there is a daily mismatch of different chronotypes, Randler and Kretz (2011) found no evidence that relationship satisfaction was affected by such a mismatch.

In a special mate choice study, women were asked what chronotype they had themselves, what their partner, and which partner they would prefer (Randler et al., 2014). It was found that women preferred an even higher synchronicity, i.e., the ideal partner deviates slightly from the current partner. However, one may assume that this will be the case with almost every variable studied in partner choice questions. Interestingly, however, so far studies are missing that show that women generally prefer evening types. One reason might be that women would prefer more extraverted individuals, so as evening types usually had a higher extraversion than morning types (e.g., Adan et al., 2012; but see Randler, Schredl, & Göritz, 2017), the preference for evening types may be only a by-product of the covariance between eveningness and extraversion. This could possibly be done separately according to short-term or long-term relationships. One central question is whether this should be addressed by questionnaires or by some kind of experiments, e.g., a computer-based dating online system or by real choices. However, the corresponding experimental studies are not easy to do because many variables need to be controlled and only the chronotype should be varied. Unlike the appearance, the chronotype is a variable that is not easily visible like other facets of sexually selected traits. In a large survey study, Kasaeian et al. (2019) reported that evening people scored higher on a short-term mating strategy, while morning people scored higher on a long-term mating strategy. To address these limitations, future research should measure the reproductive outcome in total, i.e., in lifetime reproductive success as it is done in other mammals. However, reproduction in humans is strongly under anthropogenic selection because of the use of contraceptives, so future studies might look at the relationships in men and women, as well as parenting by comparing different chronotypes.

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