DOI: https://doi.org/10.26529/cepsj.1454

Chronotypes, Disruptive Behaviour, and Schedules in Classrooms: 'Morningness' and Psychomotor Agitation

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This empirical cross-sectional study explored the effect of chronotypes on classroom behaviour. One hundred and forty young Portuguese children, from 1st to 4th grades, were examined regarding their chronotype and disruptive behaviours occurring in the classroom. Three groups of chronotypes (i.e., morning, intermediate and evening) were identified. The Chronotype Questionnaire for Children evaluated the chronotype of children, and the Conners Scale – reduced version for teachers (self-report) identified the frequency of the following behaviours in the classroom: psychomotor agitation, inattention, and opposition. Multivariate analysis of variance and analysis of regression parameters showed that morning children are more agitated and impulsive compared to evening peers. Concerning academic achievement, students did not differ in the subjects Portuguese and Mathematics for both semesters when considering chronotype and controlling for covariates such as age and gender. Parental qualifications appeared as an influential covariate for the chronotype effect in disruptive behaviour. This evidence addresses the contributions of school policies and family supervision regarding young children: children have earlier evening chronotypes; chronotypes impact specific disruptive behaviours in the classroom; parents' education influences the sleep habits and behaviours of children in school; parents and schools need more support and evidence to correctly identify children's chronotypes, to understand how chronotype and sleep habits affect behaviours in the classroom, and to recognise that more studies should be replicated attending to the contextual factors of health outbreaks and war conflict. With reliable data, this study highlights concerns and novelties for education and psychology.

Keywords: chronotype, school policy, disruptive behaviour, young children, psychology

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Kronotipi, moteče vedenje in urniki v učilnicah: »jutranjost« in psihomotorična agitacija

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Ta empirična presečna študija je preučevala vpliv kronotipov na vedenje v razredu. Sto štirideset majhnih otrok od 1. do 4. razreda na Portugalskem je bilo vključenih v raziskavo o njihovih kronotipih in pojavljajočem se motečem vedenju v razredu. Opredeljene so bile tri skupine kronotipov (jutranji, vmesni in večerni). Z vprašalnikom o kronotipu za otroke je bil ocenjen kronotip otrok; s Connersovo lestvico – zmanjšano različico za učitelje (samoocena) – pa je bila ugotovljena pogostost naslednjih vrst vedenja v razredu: psihomotorična vznemirjenost, nepozornost in nasprotovanje. Multivariatna analiza variance in analiza regresijskih parametrov sta pokazali, da so jutranji otroci v primerjavi z večernimi vrstniki bolj agitirani in impulzivni. Kar zadeva učne dosežke, se učenci pri predmetih portugalščina in matematika v obeh semestrih ob upoštevanju kronotipa in nadzoru kovariant, kot sta starost in spol, niso razlikovali. Kvalifikacije staršev so se pokazale kot vplivna kovarianta za učinek kronotipa pri motečem vedenju. Ti dokazi obravnavajo prispevke šolskih politik in družinskega nadzora v povezavi z majhnimi otroki: otroci imajo zgodnejši večerni kronotip; kronotip vpliva na določeno moteče vedenje v razredu; izobrazba staršev vpliva na spalne navade in vedenje otrok v šoli; starši in šole potrebujejo več podpore in dokazov za pravilno prepoznavanje otrokovih kronotipov, razumevanje, kako kronotip in spalne navade vplivajo na vedenje v razredu, in za prepoznavanje, da je treba ponoviti več študij ob upoštevanju okoliščin, kot so izbruhi bolezni in vojni spopadi. Ta študija z zanesljivimi podatki izpostavlja skrbi ter poudarja novosti za izobraževanje in psihologijo.

Ključne besede: kronotip, šolska politika, moteče vedenje, majhni otroci, psihologija

Introduction

The investigation in chronobiology and psychology confirmed a relationship between the 24-hour cycle and the behaviour of individuals (Díaz-Morales et al., 2015; Gowen et al., 2019; Holler et al.; 2014; Owens et al., 2015; al., 2016). In the circadian cycle, sleep is the most important factor in understanding behaviour changes, mood fluctuation, and cognition (Huang et al., 2020; Lara et al., 2014). The shifts are most commonly studied in the relationship between sleep and the performance of adults, focusing on cognition (Mazri et al., 2019; Melo et al., 2019; Melo et al. al., 2019; Razavi et al., 2019). There is a lack observed in the literature about children and pubescents and their cognitive fluctuations attending to their sleep changes and habits (Hahn et al., 2012; Lara et al., 2014). The predisposition to accomplish tasks needs to be understood, considering the chronotype and the youngest population.

Chronotype and predisposition in 24-hour cycles

The chronotype characterises individuals according to their preferences and willingness to perform their tasks at specific times of the day (Gobinath, 2020; Li et al., 2020; Touitou et al., 2016). When we refer to the individuals' preference, we mean their biological predisposition that biases wakefulness (thus with different wakefulness flows – being awake – in the 24-hour iterative period).

Morning individuals prefer to wake up and do their chores earlier, while evening ones prefer to wake up and do their tasks later. However, individuals considered intermediate are able to adapt at any time of the day (Horzum et al., 2014). Therefore, the morning type reaches acrophase earlier and the evening one later; acrophase is defined as the moment when individuals are able to have better performance (Lara et al., 2014; Menna-Barreto & Wey, 2007; Walker et al., 2014, cited by Figueiredo, Hipólito & Tomás, 2018).

These preferences and acrophases (and also bathyphases, when subjects are less awake and their cortisol is less active) have repercussions on daily performance (Lara et al., 2014). The external biological clock is not always aligned with the internal biological clock, which leads to synchrony failure or temporal incongruity, with the evening type being the most affected in terms of attention and psychomotor activation (Dorrian et al., 2017; Hahn et al., 2012). However, when there is no congruence between social and biological rhythms, which we call desynchronisation, consequences such as changes in physiological behaviours and disturbances that vary according to the chronotype can arise (Goldstein et al., 2007; Hahn et al., 2012; Kolomeichuk et al., 2016, as cited in Figueiredo et al., 2018).

Children's sleep is essential in order for there to be no disturbances in the developmental stages of brain and sexual maturation, behaviour and in academic performance (Rotta et al., 2018). Despite the abundance of studies on the relationship between adult chronotype and performance, there is a paucity of studies linking chronotype and behaviour in a school context (Oliveira et al., 2019), thus, in children. In Portugal, the continuation of valid studies on the influence of school-age children's chronotype on their academic performance and classroom behaviour is urgently needed (Clara et al., 2020; Couto et al., 2011; Marques et al., 2019; Reis et al., 2020; Rodrigues et al., 2018). The evidence that authors provide on the correlation, and even predictive analysis, between children's chronotype and their grades, is robust. However, the relationship between classroom behaviour and the geographic variable has not been considered (Friborg et al., 2014).

Sleep, performance, and classroom behaviour

International research shows that school hours affect adolescent behaviour and discipline due to periods of inattention as a consequence of the chronotype and delay in the phase that typically occurs in adolescence (Valdez et al., 2019; Zerbini et al., 2017). Adolescents, due to their genetic inheritance, prefer later times for the beginning of classes and assessments (Kelley et al., 2017; Werner et al., 2021). This preference for later times has also been seen in the university student population (Kelley et al., 2017). When the late preference is mentioned, we are referring to the subjects' cognitive predisposition to attend classes and carry out assessments, in an improved manner, at times later than those socially stipulated, and which favour the morning population. The decrease in performance leads to an increase in emotional instability and behavioural dysfunction, which has consequences on the mental health of adolescents (Gariépy et al., 2019). As for the school-age population, the issue of chronotype is still a problem when analysing the relationship between daytime type and times conducive to performance and balanced behaviour in class. Indeed, the chronotype of younger children is not entirely morning, as previous studies of instrument validation indicate (Simpkin et al., 2014). Children have a considerable variance that places them between morning and evening (Figueiredo et al., 2020), and this will have consequences on the performance of tasks done at different times. The morning group will have an advantage in the morning hours, while the evening type will perform better in afternoon tasks (Figueiredo & Hipólito, 2021). Evening children have a longer delay in the levels of melatonin needed to fall asleep at expected times, as well as being exposed to bright light before bed, until at least two hours before bedtime (Martínez-Lozano et al., 2021; Kolomeichuk et al., 2021).

With regard to discipline and disruptive behaviour in the classroom, studies are fewer for samples of children due to their chronotype characterisation. However, researchers in older studies found that sleep deprivation directly led to performance problems and to instability in the classroom due to lack of attention but not hyperactivity problems (Fallone et al., 2005). Recently, analyses of disruptive behaviours and the possible relationship with the morning type of children are lacking, except for some international studies (Sun et al., 2021). It is true that indicators were found in this relationship by Randler et al. (2016), as they determined that morning children (in the 9th grade) have positive emotions that are manifested earlier in the day, in contrast to evening children, who have an optimistic mood later in the day. This type of emotional predisposition certainly influences the mood in the classroom and, in turn, the stability of behaviours (especially psychomotor).

Eveningness as a risk factor in child development

In addition to the study of mood and emotional expression in the 24-hour period, studies such as those by Doi et al. (2016) also suggest that sleep deficits in the evening group cause irritability at home and in social tasks. Accordingly, this is another underlying factor in understanding the impact on discipline in the classroom. Considering the difference between morning and evening types, which affects the latter with regard to sleep, behaviour, and school performance, Arbabi et al. (2015) offer an essential reference to understand how the midpoint of sleep determines performance and motivation to learn in children in the first cycle (1st–4th grades) of education. Again, evening-type children show more negative values compared to the morning group regarding learning and initiative during school hours. The reason was identified at the midpoint of late sleep in the evening population. In the predisposition to learning, variables such as conscientiousness and agreeableness are also included (Arbabi et al., 2015; Gorgol et al., 2020).

The evening group is a population at risk insofar as Sun et al. (2021) recently identified behavioural problems in the classroom because of sleep deficits and evening habits. Moreover, this trend or correlation is seen from the first years of school, as Kobayashi et al. (2015) found that the first years of preschool had groups of students with disruptive problems due to the morning type and the number of hours of sleep. In contrast, when age and sex covariates are controlled, the modification of this correlation and the predictive trend can benefit the evening type and not so much the morning one (Gorgol et al., 2020).

In short, the literature points to an almost solid relationship between the evening chronotype, lower academic and professional performance and lower

sleep quality (shorter periods of sleep, drowsiness, irritability, abrupt change in sleep habits).

The child population, especially of school age, is the least studied, especially regarding the behaviour in the classroom variable. Thus, this study aims to analyse the significance of the chronotype (considering the synchrony effect) of children aged 6–10 years in the relationship between the day type (morning/evening), academic performance and classroom behaviour. Our assumption is based on the principle that children who are healthy (non-clinical samples) in terms of sleep will present differences in performance and discipline in the classroom depending on their chronotype. The time of day will determine performance, variation in attention and psychomotor balance, the latter being related to stable behaviour in the classroom.

Along with the evidence that attests to the correlation between sleep, individual performance, and classroom behaviour, there is a variability to be considered for careful examination, specifically regarding the eveningness, the school schedules and the children's behaviours events. The evening type is negatively correlated with positive behaviours in the classroom when they are identified by teachers and psychologists. Thus, it is important to explore the correlation between sleep habits, eveningness, and disruptive behaviours that may occur in the classroom. The main objective of this study is to prove the causal relationship between eveningness and psychomotor agitation and disruptive behaviour in the classroom.

Methodology

Participants

One hundred and forty children with a mean age of 8 years old, 53 (37.9%) boys and 87 (62.1%) girls participated. After the data collection, we denoted that the chronotype questionnaire was mostly answered by the female parent (N = 116), who knows the daily sleep routine of the child well. Forty-four children attended the 3rd grade (31.9%), 42 were in 1st grade (13.8%), 33 children were in the 2nd grade (23.9%), and 19 were in the 4th grade (13.8%). All the schools are located in Lisbon, Portugal. The parents' level of education was informed through a sociodemographic questionnaire. More details appear in Table 1.

Table 1

Sociodemographic Characterisation of Children (N = 140)

		N	%
Children's age	6–7 years	38	28.8
	8–11 years	94	71.2
	Total	132	100.0
Gender	Female	87	62.1
	Male	53	37.9
	Total	140	100.0
School grade	1st grade	42	30.4
	2nd grade	33	23.9
	3rd grade	44	31.9
	4th grade	19	13.8
	Total	138	100.0
Single child	Yes	41	30.1
	No	95	69.9
	Total	136	100.0
If not (other)	0	7	7.6
	1	33	35.9
	2	44	47.8
	4	8	8.7
	Total	92	100.0
Number of children in the household	1	42	41.6
	2	44	43.6
	3	12	11.9
	5	2	2.0
	6	1	1.0
	Total	101	100.0
Number of teenagers in the household	0	1	2.3
	1	26	60.5
	2	15	34.9
	4	1	2.3
	Total	43	100.0
Same biological parents	Yes	66	61.1
	No	42	38.9
	Total	108	100.0

Instruments

The Children's Chronotype Questionnaire (CCTQ), specifically the Portuguese version of CCTQ adapted and validated by Couto et al. (2014), was used as the first instrument in this study, based on the original of Werner et al. (2009). Attending to the objective of the present study, the collected data and the running statistical analyses were specifically based on the scale of Morningness/Eveningness (M/E), one of the scales of CCTQ and in the chronotype scale composed of one item (parents should classify the sleep schedules and habits of their children).

The M/E scale (0.711) evaluates the sleep habits and preferences of the child regarding sleep and awake times. There is a cut-off point determined for the three chronotypes: morning, intermediate, and evening types. The cut-off points are informed in the literature as follows: 10 (extreme morningness) and 49 (extreme eveningness). In the Portuguese version of CCTQ: <23 (morning-type), 24–32 (intermediate-type), >33 (evening-type). The chronotype was calculated by computing the 10 items and controlling for two age ranges (4–7 years old; 8–11 yr).

Child behaviour assessment – the Portuguese version (Rodrigues, 2005) of the Conners Teacher Rating Scale was used in its reduced version of the Revised Conners Teacher Rating Scale (Conners, 1997). Teachers were required to answer 28 items concerning different behavioural characteristics on a Likert-type scale (0 to 3), where 0 corresponds to 'Never' and 3 to 'Very frequent'. The total compute indicates the frequency of negative behaviours. This instrument presents a four-factorial scale, and three scales were selected for this study: opposition problems (items 5, 15, and 23), inattention (1, 4, 8, 13, 14, 16, 19, 22, and 25), and motor activity problems (2, 9, 12, and 17).

Research Design

This study adopted an observational, statistical, comparative, and cross-sectional method. Firstly, in March 2021, the project was submitted and approved by the Ethics Committee of the Psychology Research Centre (CIP) of Universidade Autónoma de Lisboa; then, it was submitted and obtained the consent of the Directorate-General for Education (DGE), Ministry of Education and Science, in Portugal. The research project and procedures were approved by the National Data Protection Commission and by the Ethics Committee of Universidade Autónoma de Lisboa.

The sample was identified considering the grades and ages that met the criteria for the study. Secondly, the schools, teachers, and families were informed about the study and the main objective (consent was ensured by writing from both parents and teachers). The third step was the administration of

the two instruments in different sessions scheduled at schools and with families (two different moments according to the different instruments).

The sessions occurred between March and April 2021. First, the CCTQ was answered by parents to identify the chronotype of each child. Only after the chronotypes were identified were we able to follow the next phase: the Conners Scale (Rodrigues, 2005), which was delivered in each school and supervised by teachers in class. This second phase took two weeks.

The principles of the Helsinki Declaration and its later amendments or comparable ethical standards were respected. The processing and statistical analysis were performed with SPSS, version 27.

Results

First, after the examination of the internal consistency for both scales, percentile analyses and multivariate analysis of variance were completed to determine the chronotypes and their influence on classroom behaviours. Additionally, normality tests were conducted to define the inferential methods of testing. Thus, when the normal distribution of samples was not respected, the Mann-Whitney U test accounted for the differences between the groups toward sleep habits and disruptive (if observed) behaviours.

Part 1

The internal consistency of the first instrument (CCTQ) was satisfactory (0.62) but lower in comparison to Cronbach's alpha of the original version (0.81). The values for the correlation matrix were above .30.

To determine the chronotype of each child/adolescent, the percentile analyses and cut-off scores were completed as the statistical norm of the original version (Werner et al., 2009). Thus, percentiles informed each cut-off for the three chronotypes. The percentiles range is between 23 and 43 points (the cut-off was established by the first authors as described in the Instruments Section). After the score achieved in the M/E scale (by computation), considering the two age groups (4–7 years old/8–11 years old), the data revealed interesting differences between the two groups. Half of the students (47.8%) were classified as intermediate, 27.8% were morning type, and 24.3% were evening type. In the Portuguese sample, we observed changes in the chronotype as we commonly know it, with the children being more evening oriented than expected (the percentile 75 is higher than verified in previous studies that replicated the CCTQ in several countries). We are comparing only morning and evening types. Young

School populations reveal a tendency to a late phase in sleep habits, which determines the evening chronotype. This indicates the greater importance of behaviour changes in younger students than expected. Rapid sleep changes will impact behaviour in the classroom. Considering these facts, teachers and school psychologists should be aware of the school schedules when assigned to a specific range of ages (of students). See Tables 2–4.

Table 2

Morning / Evening Scale Score for Group 4–7 years of age

N	**Valid**	47
	Missing	12
Median		29.09
Std. Deviation		4.84
Skewness		.43
Kurtosis		.55
Std. Error of Skewness		.35
Minimum		20
Maximum		43
Percentiles	10	23.00
	25	27.00
	75	33.00
	90	36.00

Table 3

Morning / Evening Scale Score for Group 8–11 years of age

N	**Valid**	63
	Missing	10
Median		28.00
Std. Deviation		4.84
Skewness		.58
Kurtosis		.23
Std. Error of Kurtosis		.59
Minimum		20
Maximum		42
Percentiles	10	23.00
	25	26.00
	75	31.00
	90	35.60

Table 4
Sample characterisation according to Chronotype

		Frequency	%	% Valid	% Cumulative
Valid	Morning	32	22.9	27.8	27.8
	Intermediate	55	39.3	47.8	75.7
	Evening	28	20.0	24.3	100.0
	Total	115	82.1	100.0	
Missing		25	17.9		
Total		140	100.0		

The results regarding the classification as presented by parents are concerning. Parents or tutors were unable to identify with precision their children's sleep timetables and habits. Moreover, concerning the Q27 scale (chronotype from the perspective of the tutor or parent), 80 tutors informed that children had an evening tendency. There was a mismatch when we compared the percentile punctuations and the results from Q27 (question referring to the type "nocturnal, diurnal"). It should be noted that Q27 is only a one-item scale, and intentionally, the terminology morning/evening and intermediate type was not used. Similar words (such as 'nocturnal') were used. Parents and tutors might need an intervention policy at schools in order to understand how school and home schedules are matching or generating blocking behaviours. More details about the results are in Table 5.

Table 5
Results of the use of the Chronotype Scale

	N	%
Without a doubt of the morning type	17	13.4
More morning than evening	19	15.0
Neither morning nor evening	40	31.5
More evening than morning	20	15.7
Without a doubt of the evening type	20	15.7
Don't know	11	8.7
Total	**127**	**100.0**

Part 2

The Conners subscales (for teachers) presented a high internal consistency (Cronbach's alpha: ≥0.80) despite the higher validity of the original version (≥0.90, Conners, 1998). The frequency of maladaptive behaviours (i.e., agitation and inattention) was evaluated in this way: '0-Never', '1-A Little', '2-Often', and '3-Very Often'. The constructs and items considered were the following: opposition behaviour (items 5, 15, and 23); inattention (items 1, 4, 8, 13, 14, 16, 19, 22, and 25); psychomotor agitation (items 2, 9, 12, and 17).

The internal consistency of this second instrument was tested for the three subscales: opposition behaviour (0.84), inattention (0.93), and psychomotor agitation (0.92). The correlation matrix proved that each subscale was measuring the respective construct with coefficients above $r > .595$ for all scales. The inter-item correlation was moderate to strong.

Part 3

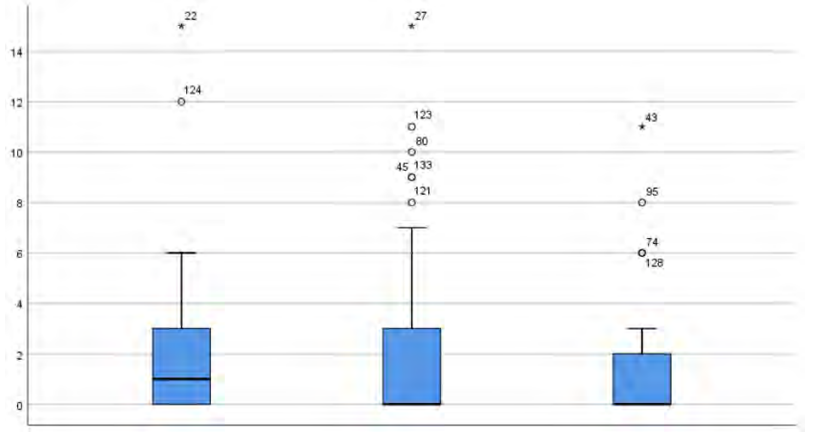
Hypotheses

Hypothesis 1 – Differences are expected between morning, intermediate, and evening children concerning disruptive classroom behaviour, with prejudice for evening subjects.

When we refer to disruptive classroom behaviour, three constructs are being tested here: opposition (indiscipline in the form of a negative response to teachers' demands and/or negative relationship with peers), inattention, and psychomotor agitation (excessive physical movements). Inattention is not associated with hyperactivity disorder. The sample was revealed to respect the conditions of homogeneity of variance and normality distribution (Levene: $p > .05$). Based on this assumption, a multivariate analysis of variance was carried out. The results showed differences in a significant manner between chronotypes (morning, intermediate, and evening): $F(2.110) = 3.156$ $p < .05$, $\eta 2 = .054$. The differences were identified specifically between morning and intermediate chronotypes with a bias for the morning chronotype. Morning-type children ($M = 3.15$) confirmed more oppositional behaviours in the classroom, while evening and intermediate types were shown to have similar behaviours ($M = 1.91$ for intermediate and $M = 1.70$ for the evening).

Figure 1

Stem and leaf analysis: chronotypes and oppositional behaviours*



Note. Morning, intermediate and evening types distributed in Y axis according to the oppositional behaviours in the X-axis (punctuations from the scale Oppositional Behaviour).

To ensure the results displayed by the multivariate analysis, we decided to explore covariates in the model of variance by using the regression parameters homogeneity test. The controlled covariates were gender and age. The level of *p* did not change for the effect produced by the chronotype variable in the interaction model.

Hypothesis 2 – Academic achievement is expected to be differentiated according to the chronotype.

When we refer to academic achievement, we used the information provided by the schools in this manner: 2 ('insufficient'); 3 ('sufficient'); 4 ('Good'); 5 ('Very good'); (-) ('Does not attend and/or others'). In the first and second semesters, morning and evening children showed very similar grades in the Portuguese subject (semester 1: morning: 3.45 – evening: 3.48; semester 2: morning type with mean grade 3.57 – sufficient; evening children with 3.63 – Sufficient tending to Good). Similarities were also observed in the academic achievement means for mathematics, but the evening chronotype children showed slightly better results for this subject. The absence of significant differences was confirmed with the multivariate analysis of variance, also when covariates such as gender and parents' age were introduced.

Hypothesis 3 – Inattention behaviours and psychomotor agitation are more expected in the evening chronotype compared to morning children.

Psychomotor agitation refers to excessive motor movements and inappropriate behaviour; this is correlated to low levels of concentration. The regression parameters homogeneity test showed an interaction effect that confirmed the relationship between chronotype, gender, and psychomotor agitation. For inattention, the conditions of variance were not seen to advance with the parameters' homogeneity test. Regarding the chronotype, gender had a significant moderate effect on excessive motor behaviour ($F(1.71) = 8.492$, $p = .005$; $\eta 2 = 1.07$). Morning children were the most agitated compared to intermediate and evening types. For inattention, no differences were observed among the different chronotypes. The age of the children did not reveal a moderate effect in this equation.

Hypothesis 4 – The chronotype is expected to have different impacts on oppositional behaviour depending on age.

The results of one univariate analysis of variance demonstrated that age did not influence oppositional behaviours. Differently, when the regression parameters test was conducted, the covariate related to the academic qualifications of parents revealed the effect of children's age and chronotype ($F(1,11) = 32.323$ $p = .000$; $\eta 2 = .0746$). After the introduction of the covariates gender, educational level of parents, and extracurricular activities of children, the parents' skills were the only producing effect for age (and chronotype) in oppositional behaviours. Through a chi-square test, data indicated that parents with higher educational levels had children more identified in the chronotype 'morningness'. Also, the chi-square showed that older children (10 years old) are mostly morning type, and females tend to have more morning tendency when compared to males. Details are found in Table 6.

Table 6
Relationship between Chronotype, Age, and Gender

		Morning type		Intermediate type		Evening type	
		N	%	N	%	N	%
Gender	Female	16	22.5	39	54.9	16	22.5
	Male	16	36.4	16	36.4	12	27.3
Age	5	0	0	1	100	0	0
	6	7	30.4	14	60.9	2	8.7
	7	4	17.4	8	34.8	11	47.8
	8	7	25.9	14	51.9	6	22.2
	9	7	26.9	15	57.7	4	15.4
	10	7	77.8	1	11.1	1	11.1
	11	0	0	0	0	1	100

In conclusion, morning children have more oppositional behaviours in the classroom, and they are older; academic achievement did not suffer from the influence of chronotype in both semesters; morning children presented as being more agitated and excessive in movements when controlled for gender variables; inattention was not observed with significant differences within groups; parental education has an influence on oppositional behaviours when age is entered as a covariate in the interaction model with chronotype. Along with the testing procedure, covariates and interaction models were important in identifying the effect of chronotype for the two constructs: opposition and agitation. Impulsivity (agitation) is seriously affected by chronotype when controlled for age.

Discussion

When considering the results obtained and the four hypotheses of this empirical study, it is seen that the reliability of the instruments used was positive, with a better Cronbach index for Conner's scale. The first highlight is the fact that morning children were the group with more disruptive behaviours, specifically regarding opposition and psychomotor agitation. The second highlight is identified in the chronotypes evaluated: Portuguese children were mostly intermediate and evening types. Thirdly, gender was more influential than the chronotype effect in the disruptive behaviours in the classroom. Age only showed an effect on the educational level of parents when referring to the chronotype impact on impulsivity in the classroom.

This study showed evidence that enhances new insights into the traditional statement about young children with the morning chronotype. Against that traditional evidence, we also should add the observation that females were more evening than morning type. Sleep habits and behaviours are more negative for the evening chronotype, which will have consequences for the behaviour of young children (i.e., from 1st to 4th grades) in school (Kim et al., 2002). The contribution of this study supports the understanding of regulation in childhood development and how sleep patterns may affect school behaviour in the age group of 4–11 years old.

The cut-off points observed after the percentile analyses indicated that the new generation of children in the first grades of school is changing with regard to sleep behaviour. This refers to wake-up and bedtime schedules that are becoming different. Young children tend to be more evening chronotype than in the morning, as expected. Later times of sleeping and wakefulness are different, which may explain more agitated behaviour in classrooms. The acrophases (optimal periods to learn and to be evaluated concerning academic performance) will also change when the sleep hours become later (Lara et al., 2014; Dorrian et al., 2017; Hahn et al., 2012). The synchrony effect could be disrupted with prejudice for mood and academic balance (Goldstein et al., 2007; Hahn et al., 2012; Kolomeichuk et al., 2016).

Regarding Hypothesis 1, differences between chronotypes confirmed the impact on oppositional behaviour. Morning chronotypes were more disruptive in the classroom, specifically for the construct of oppositional behaviour. Morningness presented fewer less positive behaviours that, normally, were attributed to eveningness (indiscipline or negative response to teacher demand, easy irritability related to high cortisol levels; Martínez-Lozano, 2020). Sleep deprivation, associated with eveningness, causes disruptive behaviours in several settings and social jetlag. The latter is profoundly associated with poor relationships with peers at school. If young children in our study present characteristics of intermediate and evening types, social jetlag will be a problem. This evidence is not supported by recent studies by Jafar et al. (2017), Kivela et al. (2018) and Martínez-Lozano (2020) that found oppositional problems in young children with the evening chronotype.

We believe that the main argument in this conflict of evidence is the poor examination of the chronotype of children. The instruments used are not quite reliable, and parents (the respondents of the children's chronotype questionnaire) do not seem to have knowledge about chronotype, sleep patterns, and the importance of identifying them to regulate the synchrony of their children with the school schedules. Very scarce literature is found regarding the

examination of children's chronotype and its impact on classroom behaviour in different countries and populations. To summarise, Hypothesis 1 was confirmed, but with prejudice for morning children.

In regard to Hypothesis 2, it was rejected. No differences were observed when comparing morning and evening children for academic achievement. These data are in line with those of Roeser et al. (2013) and Randler et al. (2016) because the chronotype was not directly related to the children's academic achievement.

As for Hypothesis 3, it was not confirmed. Eveningness was not correlated to high levels of inattention and agitation. The morning chronotype was associated with those behaviours, which is new evidence for investigation in the educational policies and psychology of sleep. The evidence of Kang et al. (2015) is no longer supported when evening children are constantly associated with negative behaviours and offences in a classroom setting. Evening children are commonly related to poor mental health, and this scenario is not necessarily supported by the current data (Fabian et al., 2016). Regarding current scenarios, we should consider that these instruments were administered during the Covid-19 pandemic in Portugal. At that time, children and families remained at home and in isolation, which required school classes and working to be online (Figueiredo et al., 2022). The transition from and to in-person/online classrooms between waves of Covid-19 had serious implications. These implications were met immediately, for example, in sleep changes of children, including later hours of bedtime, later schedules of being awake and disruptive schedules. Morning and evening types are not the same as had been known. Examination of the chronotype during and after Covid-19 implies new evidence and educational and psychological support in the current global situation (Pickren et al., 2022; Türkoğlu et al., 2020).

Hypothesis 4 was partially confirmed. Age only has a significant effect as a covariate in the interaction model, including the chronotype and parents' educational level. This evidence is congruent with recent studies (Karan et al., 2021; Haldar et al., 2021) that attested to the academic skills of the parents as a determinant for the chronotype variance of children. According to Haldar et al. (2021), evening-type children come from families with high levels of academic qualifications, which impacts the sleep hygiene of children. On the contrary, in the present study, evening children have parents with high qualifications. This contradiction between studies may be due to the Covid-19 outbreak and the sleep changes in families during lockdowns. Further studies should examine this variable for the children's chronotype and respective sleep habits (Sládek et al., 2020). The current context is a main covariate to be taken into account. In contrast, other studies

focused on the chronotype of adolescents and not children, with default for examining the covariates' influence on sleep and classroom behaviour (Druiver et al., 2021). Contextual factors such as the Covid-19 outbreak and the current war conflict affecting different populations and continents affect sleep and children's behaviours at school. The age variable was the main predictor as addressed by previous investigations and by the main authors in the field of chronotype identification (Werner et al., 2009). However, in our study, age was not so predictive; other factors, as mentioned, emerged to explain the results for oppositional and agitation in children in the first grades of school.

Acknowledgements

This work was funded by national funds through FCT – Fundação para a Ciência e a Tecnologia (Foundation for Science and Technology) – as part of the project CIP/UAL – Ref. UIDB/04345/2020; and the Psychology Research Centre (CIP) of Universidade Autónoma de Lisboa/Universidade do Algarve.

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