Student Morningness-Eveningness Type and Performance: Does Class Timing Matter?

Abstract
Circadian rhythms have often been linked to people's performance outcomes, although this link has not been examined within the context of University students. We therefore sought to test whether students' perceptions of their morning-evening (ME) type had an influence on their performance on modules. We tested this hypothesis using students from a number of modules at two UK Universities. Results indicated that, contrary to our hypothesis, the further the discrepancy between a student's ME type and the teaching time of the class, the better the student's performance. These results have implications for teaching as student ME type could be taken into account for timetabling especially if modules need to be taught multiple times. We also provide implications for those seeking to measure ME, as our results are consistent with a 5-item ME scale, a 3-item ME scale, and a single-item ME scale.

Keywords: *Morningness-Eveningness type, circadian rhythm, student performance*

Track: *Marketing Education*

1. Introduction

More and more students are studying in UK institutions and due to higher student numbers, many classes are taught multiple times to different streams of students, often scheduled at different times of the day. Hence, depending upon his or her proclivity for morning or evening study, the time at which a lecture is scheduled could have an impact on the learning ability, and subsequent performance, of a student, Such circadian rhythms have often been linked to people's performance outcomes, although this link has not been examined within the context of university students.

We therefore examined whether students' morning-evening (ME) type had an influence on their performance on modules. This has important implications for higher education institutions, as the impact of lecture scheduling times could have an impact upon their subsequent performance. This work also has implications for higher education researchers, adding another variable to the student performance equation, and thus the important theoretical domain of student performance research (Hacker, Bol, Horgan, & Rakow, 2000). Finally, this study contributes to the measurement of ME type, as we found similar results using a 5-item, a 3-item, and a single-item measure of ME type. The remainder of this article is structured as follows. First, the literature on circadian rhythms is outlined, followed by the presentation of the research hypotheses. The method employed to test the hypotheses is then delineated, followed by the analysis and results of the study. Finally, the results are discussed, together with implications, limitations, and directions for future research.

2. Literature Review

2.1 Circadian rhythms

An important interindividual difference between people is their ME type (Randler, 2008), also known as the circadian or chronological typology (Beşoluk, 2011). People who have an evening type circadian rhythm prefer later than average bed and rise times and function at their peak later in the day than do morning or intermediate types (Horne & Östberg, 1976). Conversely, morning types prefer early rising and achieve their maximum of mental and physical activity soon after rising, yet become tired early in the evening, while intermediate types occupy a position somewhere between the two dichotomous groups (Horne & Östberg, 1976). ME type is not necessarily a trait, and can change during the span of an individual's life (Beşoluk, 2011) where evening types tend to be more prevalent among adolescents and young adults (Košćec et al., 2001).

Circadian rhythms influence many physiological and psychological processes among individuals, from cognitive tasks (May et al., 1993), to implicit and explicit memory retrieval (Baddeley et al., 1970; May et al 2005) and attention (Goldstein et al 2007) and thus can have implications on academic performance (Beşoluk, 2011; May et al., 1993; Smith et al., 2002). In education, the time of day when tests or exams are administered is argued to have an impact upon academic performance (Callan, 1995; Dunn et al., 2002; Klavas, 1994). Additionally, it has been argued that evening type students could be negatively affected by early morning schedules (Callan, 1995; Dunn et al., 2002; Klavas, 1994). Despite this, circadian rhythms of students are not taken into account when scheduling classes or exams. It is this line of reasoning which will be applied in this particular study, namely that a mismatch between ME type and the time of day at which lectures are scheduled could have an adverse influence on student performance.

2.2 Circadian rhythms and academic performance

Previous studies have investigated the impact of ME type on performance in tests (see Beşoluk, 2011; Callan, 1995; Dunn et al., 2002; Gupta, 1991; Klavas, 1994; Randler & Frech, 2006). However, this work has typically examined the time scheduling of examinations and its impact upon students. Moreover, high-school-age students (i.e. between 10 and 17 years of age) have been the focus of much of this work (see Dunn et al., 2002). Similarly, a review of 17 studies investigating university students reported that only two articles examined time of day and academic performance, although there is no mention of morning-evening type (Gomes et al., 2002). We are interested in the scheduling of higher education classes and its potential impact on overall student performance in light of students' ME type.

2.3 Hypothesis

In line with previous work (Goldstein et al., 2007; McElroy & Mosteller, 2006), we propose a single hypothesis. We expect that the higher the congruence between the ME type of the student, and the time of the class, the better the student's performance should be – the so-called synchronicity effect. Thus, students who are labelled as morning types should perform better in classes scheduled in the morning, and students labelled as evening types should perform better in classes scheduled in the evening. In addition, students with a mid-level of congruence between their ME type and class time are expected to perform at a level between those of the high and low congruence students. We expect these differences because circadian rhythms give an indication of a time of day when people are more "functional", and this we would expect to lead to a greater capacity for learning, information retention, attention, and other such factors commonly associated with academic performance. In summary, we posit the following:

H1: Students with high congruence between their Morning-Evening type and their class time will perform better than students with mid-level congruence between their ME type and their class time, who will perform better than students with low congruence between their ME type and their class time.

3. Methodology

In order to test our hypotheses, we surveyed students from a range of classes at two UK Universities. Classes surveyed were undergraduate and/or postgraduate students from Marketing Research, Consumer Behaviour and International Marketing. Respondent numbers on each module ranged from 23 to 79, and class times were a mix of morning, midday and evening classes. Table 1 contains more detail on the classes' descriptive statistics. In total, 253 students completed questionnaires measuring their Morning-Evening type. Since we collected unique student identifying numbers from each participant, we were able to match students' ME scores with their overall module grade.

3.1 Measures

Authors have discussed the advantages of the Horne and Östberg (1976) scale over other circadian rhythm scales, such as the Folkard et al. (1979) and Torsvall and Akerstedt (1980) morningness scales (Chelminski et al., 2000; Ogińska, 2011; Smith et al., 1989). However, the Horne and Östberg morningness-eveningness questionnaire (MEQ) has also been

criticized for its length (Smith et al., 1989), although it does demonstrate adequate psychometric properties (Smith et al., 1989; Taillard et al., 2004). As a result, certain authors have proposed short forms of the MEQ (Adan & Almirall, 1991; Hornik & Miniero, 2009; Smith et al., 1989). In particular, Adan and Almirall (1991) reduced the original 19-item format to a shorter, 5-item version. This version contains items 1, 7, 10, 18 and 19 of the original scale, and has been found to have adequate psychometric properties (Adan & Almirall, 1991; Chelminski et al., 2000; Natale et al., 2006). Hornik and Miniero (2009) used a 3-item version of the scale, containing items 7, 17 and 19. This scale also possesses adequate psychometric properties. Finally, in the interests of parsimony, we used a single-item measure (item 19 from the original ME) to see if this would cause our results to differ. Thus, we report our results using a 5-item (Adan & Almirall, 1991), a 3-item (Hornik & Miniero, 2009) and a single-item ME type measure. This enables us to test the stability of our results, in case the type of measurement scale has an influence. Student performance was measured using the overall grade that the student achieved for the module in question.

4. Analysis and Results

Due to the small number of students per class, and due to the nature of the analysis, we combined all 253 students into one overall sample. In Stage 1 we coded students as either morning or evening type, based on their responses to the respective ME scale. Students were split into groups based on their responses to the 5-point, the 3-point, or the single-item ME type scales. Those scoring above the mid-point of the respective scale were coded as evening types, and those scoring below the mid-point were coded as morning types. In Stage 2, we coded students into further groups, based on their lecture times. The groups were high congruence (e.g. a morning/evening student in a morning/evening class), mid-level congruence (i.e. a morning/ evening student in a midday class), and low congruence (e.g. an evening/morning student in a morning/evening class). It was these congruence groups that were compared on student performance. The analysis will now report on the psychometric properties of the three scales, followed by results for each scale type used.

4.1 Overall scales

All three scales (5-item, 3-item, single-item) correlated well with each other, and with the overall 19-item MEQ of Horne and Östberg (1976). During Stage 1, students provided us with an overall sum score of their ME type, which we then coded as either morning or evening. The overall sum scores for the three different scales correlated well with the original 19-item MEQ: 5-item (.887, $p = .000$), 3-item (.804, $p = .000$), and single-item (.661, $p = .000$). The morning or evening coded values for each student also correlated well with the original 19-item MEQ: 5-item (.544, $p = .000$), 3-item (.584, $p = .000$), and single-item (.638, $p = .000$). During Stage 2, we compared the congruence groups with congruence groups calculated using the original 19-item MEQ. Again, these correlations were favourable. Correlations were as follows: 5-item (.694, $p = .000$), 3-item (.497, $p = .000$), and single-item (.655, $p = .000$). The results of these correlations gave us confidence that our short-form versions of the MEQ were adequately capturing the information contained in the original 19-item MEQ. For analyses, we used a one-way ANOVA, with Hochberg's GT2 test because there are three groups to be compared, and the group sizes are different, and Hochberg's GT2 is found to be reliable when group variances are equal (Field, 2009). All group variances are assumed to be equal (Levene Statistics = $p > .05$). Table 2 contains descriptive statistics and results for all scale types.

Due to an incomplete questionnaire, the 5-item results refer to a sample of 252 students. Students with low congruence between their ME type and lecture time performed the best out of the three groups (overall grade = 63.72). Students with a mid-level or high level of congruence performed about the same (mid-level grade = 59.24; high level grade = 59.70).

The 3-item results refer to the full sample of 253 students. Students with low congruence between their ME type and lecture time performed the best out of the three groups (overall grade = 63.76). Students with a mid-level or high level of congruence performed about the same (mid-level grade = 59.29; high level grade = 60.67).

The single-item results refer to the full sample of 253 students. Students with low congruence between their ME type and lecture time performed the best out of the three groups (overall grade = 64.53). Students with a mid-level or high level of congruence performed about the same (mid-level grade = 59.29; high level grade = 60.31).

5. Discussion, Limitations, Future Research Directions

This study investigated whether students' circadian rhythms have an influence on their performance in higher education modules, based upon the scheduling of classes. The descriptive statistics in Table 2 show a pattern that students with a low level of congruence outperform those with a high level of congruence, who in turn outperform those students with a mid-level amount of congruence between their ME type and their class time. All of these results are statistically significant. The difference in performance can be as much as 5% on their overall grade for a module. This result directly contradicts our hypothesis, but offers a particularly interesting finding.

It appears as though a mismatch between a student's ME type and their class time actually results in the student performing better. This may be because attending classes at a time outside of the student's "comfort zone" might cause them to put more effort into the module, as they realise that they might struggle if they fail to apply themselves. Student's displayed a definite awareness of their ME preferences, and it is plausible that this awareness could carry over into study strategies to cope with modules which students recognise as falling outside of their ME comfort zone. It might be that recognition of class scheduling incongruence leads students to change their study habits. Of course, the results could be due to teacher ability, student general level of ability, or class size. However, by sampling from five different modules and two different UK Universities, we would hope that such differences are ironed out during the sampling process.

This result has implications for those charged with class scheduling in higher education institutions, not least of all because it appears counterintuitive. As class sizes increase, and streams are created to which students are allocated, it could actually be better for students' performance if their class scheduling was at odds with their ME preferences. Many classes seem to be split into a morning and an afternoon/evening session, as this benefits the teachers who need only be present on one day. However, it might be better to split a class into, for example, two morning sessions over two days, or two evening sessions over two days, depending on the ME types that are represented in the cohort. A potential danger could be that one particular lecture time is necessary due to cohort composition. If ME types present in a cohort indicate that lectures are better taught in the morning, this could require Universities to find other uses for classrooms/resources during afternoon/evening times. This could create resourcing issues for higher education institutions.

Our results hold, irrespective of how many items are used to assess students' ME type. This is an additional insight that could prove useful to researchers and higher education administrators. Our reduced form scales all correlated well with the original 19-item MEQ, and the use of a single-item measure of ME type provided substantively identical results to

those using 5-item or 3-item scales. This is an important finding, as it means that information on student ME type that is statistically useful can be collected through the administration of only a single question. Perhaps this question can be included on application forms, or administered to students at the start of each academic year.

Of course, with any study, it is prudent to consider limitations of the work. The nature of the work is such that samples were predominantly collected from evening lectures, although there is at least some representation of a morning class and a so-called neutral class occurring in the middle of the day. Confidence in statistical results is, however, quite high, as sufficient numbers were generated by the combining of the different classes into an overall sample. Confidence in the results is also high because the use of different ME scales (5-item, 3-item, single-item) yielded essentially the same results. Respondents were students within Business Schools, which could possibly bias the results, although at the same time it could control for extraneous influences. Study habits of students in other faculties could be better (or worse) developed, which could nullify or magnify the results presented here. One obvious course of future research would be to expand the current study to incorporate students from other schools or faculties within the University system. A second course of future work could involve the specific comparison of double-taught modules, so that it is perhaps easier to consider students as being part of a morning or evening scheduled lecture as part of the same module (here we only had one running of each module, so were unable to provide comparisons across different teaching times for the same module). Finally, it would be interesting to investigate the influence of circadian rhythms on other student outcome variables, such as satisfaction. This is especially pertinent given the importance placed on the current National Student Satisfaction Survey in the United Kingdom, although the link between satisfaction and performance in students is not always clear (Bean & Bradley, 1986; Howard & Maxwell, 1980). In any case, the results presented in this study should be of great interest to both academics and practitioners, and should generate further work in this interesting area of study.

6. Selected References

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TABLE 1: Class Descriptions and Descriptive Statistics – Module Grade

Module	Year	Number of Students	Module Time	Class Type	Mean Module Grade	S.D.	Min	Max
Market Research	PG	23	9:00-12:00	Morning	61.97	5.83	54.2	76.0
Market Research	UG	47	16:00-17:00	Evening	58.97[a]	9.37	29.1	69.8
Consumer Behaviour	UG	66	16:00-18:00	Evening	64.82[a,b]	8.81	44.0	64.8
Consumer Behaviour	PG	38	16:00-18:00	Evening	61.13	9.92	33.0	75.0
International Marketing	UG	79	12:00-13:00	Midday	59.29[b]	9.36	23.0	77.0

[a] Mean mark is significantly different, p = .007
[b] Mean mark is significantly different, p = .003

TABLE 2: Statistics for 5-Item, 3-item, and Single-Item ME Scales – Module Grade

Scale Used	Congruence Level	N	Mean Grade	S.D.	Min	Max	Differences		
							High-Mid	High-Low	Mid-Low
5-item ME	High	72	59.701	8.7535	29.1	75.0	n.s.	**	***
	Mid-Level	78	59.244	9.4060	23.0	77.0			
	Low	102	63.720	9.0817	39.3	67.0			
	Total	252	61.186	9.2961	23.0	87.0			
Scale Used	**Congruence Level**	**N**	**Mean Grade**	**S.D.**	**Min**	**Max**			
3-item ME	High	96	60.674	9.3391	29.1	87.0	n.s.	*	***
	Mid-Level	79	59.291	9.3550	23.0	77.0			
	Low	78	63.759	8.6465	39.3	86.0			
	Total	253	61.193	9.2783	23.0	87.0			
Scale Used	**Congruence Level**	**N**	**Mean Grade**	**S.D.**	**Min**	**Max**			
Single-item ME	High	102	60.313	9.1027	29.1	75.0	n.s.	**	****
	Mid-Level	79	59.291	9.3550	23.0	77.0			
	Low	72	64.528	8.6670	39.3	87.0			
	Total	253	61.193	9.2783	23.0	87.0			

Congruence Level: High (morning student in a morning class, evening student in an evening class)
Mid-Level (morning or evening student in a midday class)
Low (morning student in an evening class, evening student in a morning class)
N = number of students in that congruence category
S.D. = Standard Deviation
Differences: * p < .1, ** p < .05, *** p < .01, **** p < .001, n.s. = non-significant