

A Study on the Relationship between Creativity and Chronotype in Engineering Students

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ABSTRACT

As humans we all like to be creative and break any kind of monotony; Chronotype and Creativity influence our performance and makes life more enjoyable. An individual's chronotype has been linked with their personality, cognitive abilities, and performance. However, the link between chronotype and creativity is not well established. Despite there being research analyzing the effect on sleep on creativity, conclusive data linking chronotype and creativity is sparse. A sample of engineering students (N=100), were administered self-assessment questionnaires to measure their creativity and chronotype. Chronotype was measured using the Morningness-Eveningness Questionnaire (MEQ), while creativity was assessed using Kaufman's Domains of Creativity (K-DOCS). The data obtained were then analyzed. The study found no significant correlation between chronotype and creativity except in the domain of Performance creativity. Performance creativity was found to be positively correlated with morning-type individuals. No significant gender difference was observed.

Keywords: *Creativity, Morningness, Eveningness, Chronotype, Engineering Students, Kaufman's Domains of Creativity, Morningness-Eveningness Questionnaire*

Creativity, as defined by Robert Sternberg, is the production of "something original and worthwhile". In today's competitive, fast-paced world, the ability to think creatively is a valuable asset. From ancient times to the modern day, defining and studying the creative process is something which has caught the fancy of thinkers and researchers alike. Present-day theories of creativity include Kaufman and Beghetto's Four-C model and Guilford's Convergent and Divergent thinking. Creativity has been linked to intelligence as well, but as per the Threshold Theory the correlation holds true till a certain point only. Studying the neuroscience behind creativity has found linkages between creativity and the cerebellum and the effect of REM sleep on the creative process. What hasn't been widely researched is the link between creativity and chronotype. Chronotype which has been linked to factors such as personality and disease is yet to be concretely linked to intellectual domains like creativity.

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Received: May 11, 2019; Revision Received: June 22, 2019; Accepted: June 30, 2019

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A Study on the Relationship between Creativity and Chronotype in Engineering Students

However, there have been a few studies exploring this relationship. A landmark study was the one conducted in 2005 by M. Giampietro and G. M. Cavallera in Milan to explore the relationship between morningness and eveningness with creative thinking. A sample of 120 adults with an age range from 19 to 76 years was taken. The participants were administered Reduced Morningness-Eveningness Questionnaire (r-MEQ) to determine chronotype and Torrance Test of Creative Thinking to measure creativity. The study found that eveningness disposition correlated with the ability to apply divergent thinking strategies to visual content. While there was no significant variation due to gender, variation due to age was observed in the participants. On the other hand, a study conducted in 2015 by Roeser, Riepl, et al., which studied the effect of chronotype and synchrony/asynchrony on creativity, found that morning-type individuals were more creative in their solutions than evening types. The participants in this study were administered the Composite Scale of Morningness to determine chronotype and subtests of the Berlin Model of Intelligence Structure (BIS) Test to measure creativity. A sample of 163 participants was tested in the morning or the evening. No significant effect of testing time or synchrony/asynchrony was observed.

But studies such as the one conducted by Simor and Polner in 2016 found no direct association between creativity and chronotype. The study aimed to find out the influence of early and late chronotypes on convergent thinking and the effect of asynchrony. It found that in a convergent thinking task a relation between chronotype and asynchrony emerged. The study tested a sample of 36 evening type and 36-morning type young adults. They were administered the Hungarian version of the Morningness-Eveningness Questionnaire (MEQ-H) to determine their chronotype and the Compound Remote Associates (CRAs) as a convergent thinking task and the Just suppose subtest of the Torrance Tests of Creative Thinking as a divergent thinking task. The study found that divergent thinking was not correlated with chronotype, asynchrony or their interaction.

A 2006 study on circadian topology and style of thinking differences consisted of 1254 undergraduates was conducted by Fabbri, Antonietti, et al. The participants were administered the reduced version of the Morningness-Eveningness Questionnaire (r-MEQ) to measure chronotype and the Style Of Learning And Thinking (SOLAT) questionnaire, conceived as a tool to measure the tendency toward the right, integrated, and left thinking. The study found that morning types scored higher in the left thinking scale while evening types scored higher in the right-thinking scales than other chronotypes. Díaz-Morales and Escribano's 2013 study on circadian preference and thinking styles also found that a greater percentage of left-thinkers were morning types and a greater percentage of right-thinkers were among evening types. Preadolescents and adolescents aged 11-14 were taken for the sample. The sample consisted of 1134 participants who were administered the Morningness-Eveningness Scale for Children (MESFC) for determining chronotype and the Hemispheric Preference Test (HPT) for measuring thinking styles.

Díaz-Morales had also conducted a study in 2006. This study explored the personality styles of morning and evening type individuals. Participants were administered the Composite Scale of Morningness (CSM), and Millon Index of Personality Styles (MIPS) to measure chronotype and personality styles respectively. The sample consisted of 360 university students from the ages of 18-30 years. The study found that morning types are realistic/sensing, thought-guided, conservation-seeking and dutiful/conforming. Evening types, on the other hand, were imaginative/intuiting, innovation-seeking and unconventional/dissenting.

A Study on the Relationship between Creativity and Chronotype in Engineering Students

Given that creativity is aided by sleep, a 2016 study by Ram-Vlasov, Tzischinsky, et al., sought to study the creativity and habitual sleep patterns among art and social sciences undergraduate students. The sample consisted of 14 visual arts and 16 social sciences undergraduates. The instruments used were Polysomnography (PSG) to measure sleep structure, Pittsburgh Sleep Quality Index (PSQI) and Actigraphy to assess habitual sleep patterns, Munich Chronotype Questionnaire (MCTQ) to determine chronotype and Torrance Tests of Creative Thinking (TTCT) to measure creativity. The study found that higher verbal creativity was associated with later sleep timing, and the visual arts students tended to lean towards the later chronotypes.

In the process of understanding the various aspects of chronotype and the human mind, we stumble onto fluid intelligence and chronotype. A 2006 study was conducted by Goldstein, Hahn, et al., wherein a sample of 259 adolescents from the ages of 11-14 years was taken to study the effect of synchrony of chronotype on time of day, intellectual performance and behavioral problems. Participants were administered tests for fluid and crystallized intelligence and tested during a morning or an afternoon session. It was found that for fluid intelligence there was a synchrony effect; participants performed better at times which matched their chronotype preferences. The participants were administered Child Behavior Checklist (CBCL) to assess social competence and behavioral problems, Children's Morningness-Eveningness Preferences (CMEP) scale to determine chronotype and WISC-III Subtests as fluid and crystallized intelligence measures.

As seen above, the relationship between creativity and chronotype remains ambiguous. The studies which looked at creativity from various differing perspectives were unable to establish a definitive relationship or lack thereof between creativity and chronotype. Also, all the studies mentioned here have only explored creativity as being domain-general. Domain-specific creativity as defined by the Amusement Park Theoretical Model (Baer and Kaufman, 2005) has not yet been explored in correlation with chronotype. Hence, the present study aims to understand the relationship of chronotype with domain-specific creativity, in order to better understand the neuroscience behind the creative process.

Hypotheses:

Hypothesis 1: Levels of creativity of an individual is influenced by their chronotype.

Hypothesis 2: There is no significant correlation between chronotype and creativity.

Research Questions:

1. Is there a significant correlation between chronotype and creativity?
2. Are individuals belonging to a particular chronotype more creatively inclined?
3. Does gender have a bearing on an individual's creativity?

Objectives:

- To find out whether the creativity of an individual is influenced by either their chronotype or their gender.

METHODOLOGY

Sample

For the objectives of this study, students pursuing engineering were selected through purposive sampling. The sample consists of 100 engineering students, both male (N=50) and female (N=50), between the ages of 19-22 years. Through the sampling techniques of

A Study on the Relationship between Creativity and Chronotype in Engineering Students

purposive sampling and snowball sampling, the students were selected from various engineering colleges in India.

Inclusion criteria of the sample

1. Students between the ages of 19 and 22.
2. Students who were currently pursuing engineering.
3. Students are willing to sign an informed consent form.

Exclusion criteria

1. No students below the age of 19 or above the age of 22 were selected for this study.
2. Students pursuing other fields of study.
3. Incomplete and incorrectly filled forms were excluded.

Instruments

For the purposes and data analysis of this study, data were collected using two questionnaires. The particular questionnaires were chosen by the researcher as they measured the specific variables relevant to the objectives of this study.

1. ***Kaufman Domains of Creativity Scale:*** The scale developed by Kaufman (2012), was used to measure students' domains of creativity. It consisted of 50 items which ask people to rate themselves with their peers comparatively on creativity. The scale measures five domains of creativity: 1. Self/Everyday, 2. Scholarly, 3. Performance, 4. Mechanical/Scientific, and 5. Artistic. The participants are asked to rate themselves on a 5-point scale which ranges from 1- Much Less Creative to 5- Much More Creative. The scale has internal consistency reliabilities of .86, .86, .87, .86, and .83 for Self/Everyday, Scholarly, Performance, Mechanic/Scientific, and Artistic domains and two weeks test-retest reliabilities of .80, .76, .86, .78, and .81 for Self/Everyday, Scholarly, Performance, Mechanic/Scientific, and Artistic subscales respectively. All the items of the scale are significant at a level of 0.05, exhibiting good criterion and construct validity.
2. ***Morningness-Eveningness Questionnaire:*** The questionnaire was used to assess whether a person's circadian rhythm produces peak alertness in the morning, evening or in between. The scale consists of 19 items. The participants are asked to choose from four or five options. Based on their responses, a composite score is calculated and the individuals are classified as either morning or evening chronotypes. The scale was developed in 1976 by Horne and Ostberg. The scale has internal consistency reliability of .83 and criterion validity of .87.

Procedure

Participants who met the inclusion and exclusion criteria were approached. Those who granted their permission were included in the study. Participation in the study was with the informed consent of all participants and was voluntary. The participants were assured of the confidentiality of their responses and were briefly explained the intent and objectives of this study, before the administration of the questionnaires on them. The participants were given a set of the two questionnaires each and were instructed to read each statement carefully and choose the options most preferred by him/her as per the instructions in the questionnaire, i.e., either by picking one among a list of options or giving a rating as per a given scale. The participants were also encouraged to ask questions and clarify their doubts if any, and the contact details of the researcher were given to them. There was no time limit or any right or

A Study on the Relationship between Creativity and Chronotype in Engineering Students

wrong answer specified to the participants. As per the instructions on the instruments, the questionnaires were completed and gathered back for analysis of the data.

RESULTS

The present study aims to find out whether an individual's creativity can be predicted by their chronotype. It also seeks to find out whether a person's gender influences their creativity. For the purpose of this study, a sample of 100 third-year engineering students was taken which consisted of 50 males and 50 females. Pearson's product moment correlation was used to analyze the relationship between chronotype and creativity while the differences in gender were assessed using a t-test.

Table 1: Showing means and standard deviations for domains of creativity among males and females

	Male		Female	
	M	S.D	M	S.D
Self/Everyday	42.48	5.53	40.46	6.45
Scholarly	36.90	6.18	36.08	6.52
Performance	30.46	6.83	31.50	7.19
Scientific	30.02	6.84	28.36	6.19
General Health	9.87	3.37	8.63	3.49
Artistic	29.10	5.67	31.20	6.20

To examine whether levels of creativity are influenced by gender, a t-test was conducted. As per the data are seen in Table 2, it can be inferred that there is no significant difference in creativity in various domains due to gender.

Table 2: t-test showing the difference in the levels of creativity of an individual on the basis of gender

Measures	Men n(50)		Women n(50)		t- ratio	Sig.
	Mean	SD	Mean	SD		
Self/Everyday	42.48	5.53	40.46	6.45	1.68	0.12
Scholarly	36.90	6.18	36.08	6.52	0.17	0.77
Performance	30.46	6.83	31.50	7.19	0.74	0.46
Scientific	30.02	6.84	28.36	6.19	1.27	0.58
Artistic	29.10	5.67	31.20	6.20	1.77	0.57

Table 3: Correlation between chronotype and creativity in engineering students

	Chronotype	Self/Everyday	Scholarly	Performance	Scientific	Artistic
Chronotype	1	0.179	0.171	0.204*	0.184	0.082
		0.074	0.089	0.042	0.067	0.415
		100	100	100	100	100
Self/Everyday		1	0.650**	0.235**	0.479**	0.290**
			0.000	0.019	0.000	0.003
			100	100	100	100
Scholarly			1	0.381**	0.513**	0.366**
				0.000	0.000	0.000
				100	100	100
Performance				1	0.419**	0.396**
					0.000	0.000
					100	100
Scientific					1	0.412**
						0.000
						100
Artistic						1
						100

Note: * - correlation is significant at the level of 0.05

** - correlation is significant at the level of 0.01

Pearson’s product moment correlation was conducted to find out this relationship between chronotype and creativity. The results tabulated in Table 3 show no significant correlation between chronotype and creativity except in the domain of Performance Creativity. Performance Creativity was found to be weakly correlated with chronotype (significant at the 0.05 level) with a positive correlation score of 0.204.

DISCUSSION

The present study sought to explore the relationship between creativity and chronotype. The study aimed to find out whether individuals of a certain chronotype were more creatively inclined than other chronotypes. Given that in today’s world creativity is an important but undervalued resource, the study sought to delve deeper into creativity’s relationship with sleep, especially chronotype, in order to better understand it. Through purposive, snowball sampling, a sample of 100 third-year engineering students was taken for the study. The participants were administered the Morningness-Eveningness Questionnaire (MEQ) to assess their chronotype and the Kaufman Domains of Creativity Questionnaire (K-DOCS) to measure their creativity. Only the data which met both the inclusion and exclusion criteria of the study were taken into consideration.

The analysis of the data showed no correlation between chronotype and creativity except in the case of Performance creativity. Performance creativity was found to be weakly positively correlated (at $p < 0.05$) with chronotype. This implies that morning-type individuals are more inclined towards Performance creativity than evening type individuals. The relationship between chronotype and creativity has always been ambiguous. Past studies (Giampietro & Cavallera, 2007; Roeser et al., 2015; Bertalan & Simor, 2016) have yielded inconsistent results. An assumption which can be drawn from this is that the relationship between chronotype and creativity is far more complex than what is assumed. Sleep is a contributing factor to creativity (Wagner et al., 2004) and sleep loss has been linked to a loss in divergent

A Study on the Relationship between Creativity and Chronotype in Engineering Students

thinking ability (Horne, 1988). However, the extent to which creativity is influenced by chronotype is not yet established. As the present study finds no significant gender difference in creativity, it can be speculated that while factors like sleep and personality influence creativity, it still remains a highly personal attribute which is influenced by factors unique to the individuals.

To speculate on why morning-type individuals were more creatively inclined in the domain of performance creativity, the sample and the socio-cultural environment must be taken into consideration. The Indian education system is more favorable to morning-type individuals as most of the classes and activities take place in the morning. As the sample consists only of students, they are more inclined and encouraged to take part in extracurricular activities. Activities like singing, dancing, and acting which come under performance creativity are a part and parcel of a student's college experience. The various fests and competitions students take part in allowing them to express and explore their creativity in the domain of performance. Since most of these activities take place in the morning, morning-type individuals naturally record higher creativity in this domain as the environment is more conducive to their creative expression and growth.

The transition from school to college is a major one in an individual's life. Not only in terms of their academics but also the environment they encounter is miles apart than what the students were previously used to. This is both taxing and exhilarating. In such a scenario, creativity would aid students to not only excel in their academic life but also to better navigate their new environment. This holds especially true for engineering students who deal with heavy academic subjects and strict environmental structures in their college lives.

Limitations

Few of the limitations of the present study are discussed here. First, the study has only taken individuals belonging to a certain age group into consideration. Moreover, the sample consists of individuals belonging to a specific geographical location with a specific educational qualification. Also, the present study uses self-report questionnaires which can limit the objectivity of the data. For a more comprehensive analysis, future studies may take up different age groups with more diverse backgrounds and tools which are more objective in their assessment.

Applicative Value:

In Indian society, creativity as a resource is undermined and underdeveloped. The findings of this study can be used as a base for future creativity research in India and also for the development and encouragement of creative behavior in individuals, especially students and young adults.

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A Study on the Relationship between Creativity and Chronotype in Engineering Students

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Acknowledgment

Special thanks to my parents for supporting. Next to the supervisor who has guided and directed this research, as well as all respondents who have been willing to be participants during the research process.

A Study on the Relationship between Creativity and Chronotype in Engineering Students

Conflict of Interest

The authors carefully declare this paper to bear not a conflict of interests

How to cite this article: Singh. S. (2019). A Study on the Relationship between Creativity and Chronotype in Engineering Students. *International Journal of Indian Psychology*, 7(2), 761-769. DIP:18.01.092/20190702, DOI:10.25215/0702.092