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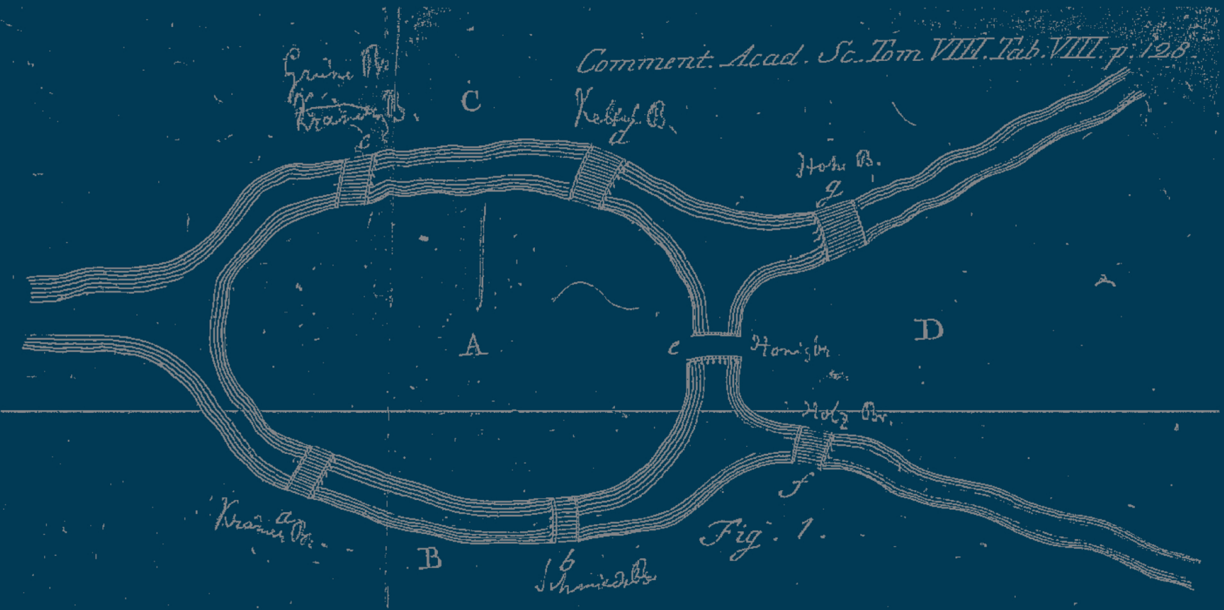

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Chapter 12
Positive and negative affect in daily and weekly variations from the physiological and social perspective

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Abstract: Regularity of emotional functioning of a human in specific time can be determined by cycles characterised by psychophysiological and social changes. The objective of the research was to establish whether the population subjected to the research-related tests experienced circadian and circaseptan mood variability and, if this relation has been confirmed, describe the latter. Mood was tested by means of Positive and Negative Affect Scale (Watson, Clark & Tellegen, 1988). Subjects judged their mood by means of two indicators (positive and negative affect), for one week, on a daily basis, at 3-hour intervals. Circadian and circaseptan variability was assessed by comparing averaged results obtained from all measurements carried out at specific times of the day and days of the week. The assessment of internal group differences was performed with the repeated measures analysis of variance. The result obtained in the tests indicated the existence of circadian differences of positive affect as well as circaseptan differences in relation to positive and negative affect.

Keywords: negative affect, positive affect, circadian, circaseptan.

Introduction

Regularity of an individual's psychosocial functioning is determined by cycles being characterised by social and psycho-physiological changes of different origin and diverse frequency. Due to recurrence one can distinguish the following cycles: circadian, circaseptan, monthly and annual (Clark, Watson & Leeka, 1989; Cornelissen et al., 2005; Mitsutake et al., 2001; Murray, Allen & Thinder, 2002).

The relation of changes in the intensification of positive and negative affect as well as cognitive efficacy in circadian and circaseptan rhythms have been studied before. It was already in the 30s of the 20th century that Otto Graf presented as a result of his research 'a physiological labour curve' ('physiologische Leistungskurve') showing changes in a man's efficiency at certain times of the day. The research conducted by Bo Bjerner and collaborators (1955) showed that a psychological and physical efficiency of most people reaches the lowest point at 12-hour intervals, i.e. around 3 a.m. and 3 p.m.

A discipline of science dealing with the analysis and description of repetitive life phenomena as well as identification of biological rhythms has been named chronobiology, whereas the science using such knowledge to boost health and life quality has been called chronomics (Halberg et al., 2009). Psychological aspects of the rhythms are dealt with by chronopsychology (Sędek & Bedyńska, 2010).

Affectivity is one of the most essential aspects of human functioning, yet the least explored. The researchers find it difficult to define affect (Murphy & Zajonc, 1993), however, they are agreed on the issue that affectivity may be considered as a positive and negative type of arousal within two orthogonal dimensions having their own physiological correlates (Watson et al., 1988).

The course of most psycho-physiological rhythms has been encoded in the human cells and is controlled by nervous structures, which are popularly called a 'biological clock'. These structures are suprachiasmaticus nucleei located symmetrically in the anterior part of the hypothalamus. The biological clock manages the rhythms regulating, among other things, the increase of the sympathetic nervous system tension during the day and its decrease at night. It also regulates secretion of hormones, such as: cortisol, melatonin, serotonin, testosterone at certain times of the day. It regulates in this way the body temperature as well as changes of mood and cognitive efficacy, in an individual way in each human being (Furlan et al., 1990; Halberg et al., 2000, 2009). Individual differences in the course of circadian rhythms have been reflected also in the description of a chronotype which orients an individual to have a more effective evening affectivity ('owls') or morning affectivity ('larks') (Horne & Ostberg, 1976; Matthews, 1988).

Among a lot of research emphasising the importance of circadian rhythms for an individual's functioning there are also analyses of mood changes dependent on the time of the day (Clark et al, 1989; Cornelissen, et al., 2005).

Various factors contribute to the adaptation of an individual to their life environment. These factors influence the biological clock and are called synchronisers or time markers. Circaseptan rhythms are synchronised mainly by social and cultural factors, among which the most important is the organisation of the social life, working hours of schools and institutions, opening hours of shops, etc. (Terelak, 2008). For the social synchronisers to be considered the source of the exogenous rhythms in the human body – they need to be characterised by their own, relatively stable, rhythm and occur regularly with a certain frequency. The circaseptan rhythm is the only rhythm reflecting almost exclusively the influence of social synchronisers. Circaseptan rhythms similarly to circadian rhythms, may be registered by means of recording psycho-physiological functions of the body, such as fluctuation of heart parametres, temperature and hormones (Halberg, et al., 2000).

Temporal aspect of human functioning has been highlighted by Lawrence A. Pervin's definition (2002). According to this scientist, personality consists of structures and processes which reflect not only a mutual operation of genes and environment but also encompass a temporal aspect of human functioning, including 'the memories of the past, mental representations of the presence as well as conceptions and expectations concerning the future' (Pervin, 2002).

The research of the changeability of positive and negative affect in a circaseptan rhythm conducted by Germaine Cornelissen and collaborators (2005) showed the regularity of affective cycles both within 24 hours (day and night) and within a week.

A high intensity of positive affect is connected with smaller secretion of stress hormones (such as adrenaline, noradrenaline and cortisol). The researchers explain that this effect concerns people who are characterised by psychological flexibility and more often use their positive resources when confronted with stress-generating situations.

The objective of the research was to establish whether the population subjected to the research-related tests experienced circadian and circaseptan mood variability and, if this relation has been confirmed, describe the latter.

Positive and Negative Affectivity

Nico H. Frijda (1986) shares this cognitive approach by defining affect as a basic pleasant or unpleasant feeling aroused by cognitive interpretation and attribution of significance to a stimulus situation. Evaluation of the situation is made by an individual on the basis of the criteria, such as: pleasantness, predicted easiness or difficulty of achieving a goal, possibility of controlling the situation, human agency, certainty of the outcome or predictability of the consequences. Frijda's concept emphasizes the functional aspect of emotions and their adaptive functions. The level of adaptation and the vision of the future constitute a frame of reference for generated emotions.

Watson and collaborators (1999) use the term of dispositional affect in order to differentiate the notion of affect from the notion of mood. The researchers describe affect as a relatively permanent disposition of personality regulating our reactions. Positive affect (PA) is distinguished irrespective of negative affect (NA). The type of occurring emotion or mood may depend on the preceding affect (Frijda, 1986; Lazarus, 1991). Many papers emphasize the influence that affect has on cognitive and motivational processes in human behaviour.

Method

The differences between positive and negative affect were tested by means of PANAS (Positive Affect Negative Affect Scale) developed by David Watson, Lee Anna Clark & Auke Tellegen (1988). The scale can be applied in various aspects of subjectively perceived time. By means of this tool the subjects may specify how they feel at the moment, how they felt in a specific situation or how they tend to feel (Crawford & Henry, 2004).

The scale makes it possible to test positive and negative affect in the context of a specific situation or to test the affectivity as a personality characteristic (Crawford & Henry, 2004). The subscales (PA and NA) are negatively correlated with each other on the level $r\sim -.30$ and individual test items within their scale are positively correlated with each other on the levels $r\sim .70/.80$, which confirms the accuracy of the scale (PANAS). The negative correlation between PA and NA scales may indicate that these affects are relatively independent from each other. In addition, this tool is characterised by good psychometric properties. The reliability of PA and NA of the PANAS test assessed using Crobach α amounts to .89 (95% CI = .88-.90) for the PA scale and .85 (95% CI = .84-.87) for the NA scale respectively. The scale contains 20 various affect-related states (20 test items). 10 of the test items are indications used to measure positive affect (PA scale), whereas the remaining items are used to measure negative affect (NA scale). Low, average and high results are determined on the standardisation basis. The minimum raw result in a given scale is 10 points, whereas the maximum raw result amounts to 50 points. On the basis of the standard tests carried by John R. Crawford and Julie D. Henry (2004), separate standards for PA and NA scales were developed; in doing so the percentile scale was applied. Filling out a questionnaire takes only a few minutes.

Participants and way of data analysis

The tests engaged 117 participants. The subjects assessed their mood by means of the two aforementioned indicators (NA and PA) 6 times a day, seven days a week i.e. The first measurement took place directly after waking up, with successive measurements timed every 3 hours i.e. 3h, 6h, 9h, 12h and 15 hours after waking up. The tests were three months in duration.

Circadian variability was assessed by comparing averaged results obtained on each day of the week, at specified times of the day. Circaseptan variability was assessed by comparing averaged results obtained from all measurements carried out on a given day. As averaged measurements on successive days and averaged measurements at specified times of the day collected from one group are obviously interdependent (correlated), the intergroup differences were subjected to repeated-measures analysis of variances. Two backgrounds were developed for each affect sign. In the first background, the factor of analysis was a day of the week; the factor having 7 levels. In the second background, the factor of analysis was a time of the day; this factor had 6 levels.

Results

Circaseptan variability of positive affect

Below presented are the results of repeated-measures analysis of variances for the variable of positive affect. The results are illustrated in Figure 1.

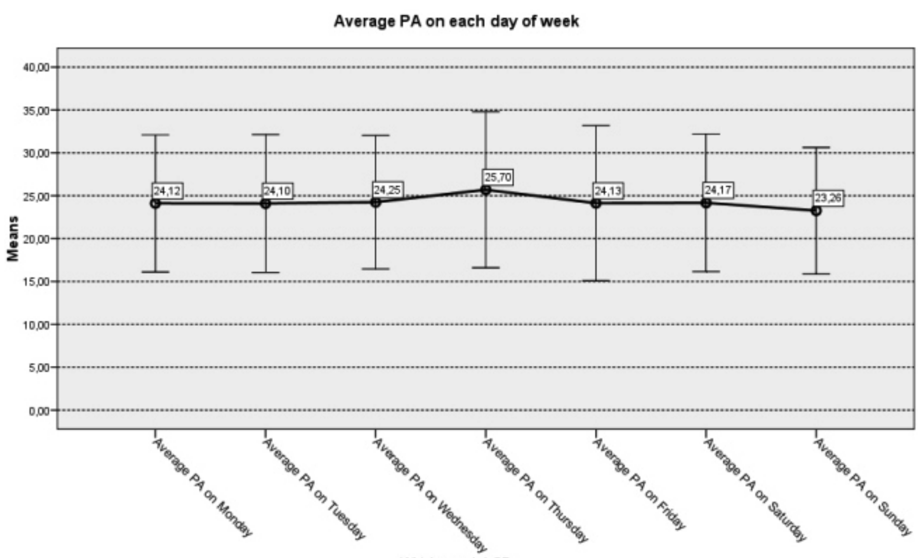

Figure 1. Level of positive affect averaged on successive days of the week.

Table 1 presents the results of the tests of intra-object effects, revealing that various days are statistically significantly differrent to one another with reference to positive affect intensity of the same test participants. One should note, however, that the value of Eta^2 is very low, which means that the dependence is rather weak.

Table 1 – *Results of tests of intra-object effects of positive affect – day of the week*

Source		Sum of squares	df	Average square	F	Sig.	Partial Eta^2
Day	Assumed sphericity	362.025	6	60.337	3.547	.002	.030
	Greenhouse-Geisser	**362.025**	**4.484**	**80.731**	**3.547**	**.005**	**.030**
	Huynh-Feldt	362.025	4.689	77.211	3.547	.005	.030
	Lower-bound	362.025	1.000	362.025	3.547	.062	.030
Error	Assumed sphericity	11738.817	690	17.013			
	Greenhouse-Geisser	11738.817	515.701	22.763			
	Huynh-Feldt	11738.817	539.212	21.770			
	Lower-bound	11738.817	115.000	102.077			

Table 2 – *Comparisons of pairs of successive days of the week in relation to positive affect*

(I) day	(J) day	Average difference (I-J)	Standard difference error	**Sig.**	95% range of difference confidence	
					Lower limit	Upper limit
Monday	Tuesday	.022	.430	**.960**	-.831	.874
	Wednesday	-.129	.473	**.785**	-1.066	.808
	Thursday	-1.576*	.573	**.007**	-2.712	-.441
	Friday	-.014	.594	**.981**	-1.192	1.163
	Saturday	-.050	.477	**.916**	-.994	.894
	Sunday	.855*	.391	**.031**	.080	1.629
Tuesday	Wednesday	-.151	.428	**.725**	-.999	.697
	Thursday	-1.598*	.530	**.003**	-2.647	-.548
	Friday	-.036	.678	**.958**	-1.378	1.306
	Saturday	-.072	.524	**.891**	-1.111	.967
	Sunday	.833	.503	**.100**	-.163	1.829
Wednesday	Thursday	-1.447*	.493	**.004**	-2.423	-.470
	Friday	.115	.629	**.855**	-1.131	1.360
	Saturday	.079	.527	**.881**	-.966	1.124
	Sunday	.984	.511	**.057**	-.028	1.996
Thursday	Friday	1.562*	.719	**.032**	.137	2.987
	Saturday	1.526*	.594	**.012**	.348	2.703
	Sunday	2.431*	.633	**.000**	1.177	3.685
Friday	Saturday	-.036	.536	**.947**	-1.097	1.025
	Sunday	.869	.567	**.128**	-.254	1.993
Saturday	Sunday	.905*	.424	**.035**	.065	1.745

In order to assess which days differ in positive affect, the former were compared in pairs. The results, presented in Table 2, reveal that on Thursday the intensity of positive affect is significantly higher than on the other days, whereas on Sunday it is lower than on the other days – on the level of significance or at least on the level of a statistical trend. The remaining days do not differ from one another.

Circaseptan variability of negative affect

Below presented are the results of repeated-measures analysis of variances for the variable of negative affect. The results are illustrated in Figure 2.

Table 3 presents the results of the tests of intra-object effects related to the circaseptan variability of negative affect. The results reveal that on various days of the week, the intensity of negative affect is statistically significantly different among the same test participants. One should note, however, that, again, the value of Eta is very low, which means that the dependence is rather weak.

In order to assess which days differ in negative affect, the former were compared in pairs. The results, presented in Table 4, reveal that on Friday and Saturday the average intensity of negative affect is significantly lower than on the other days except for Sunday, yet Friday and Saturday do not differ significantly from each other. The remaining weekdays do not significantly differ from one another. In case of Sunday, the results are lower than on the other days, yet the difference is significant only on the level a statistical trend.

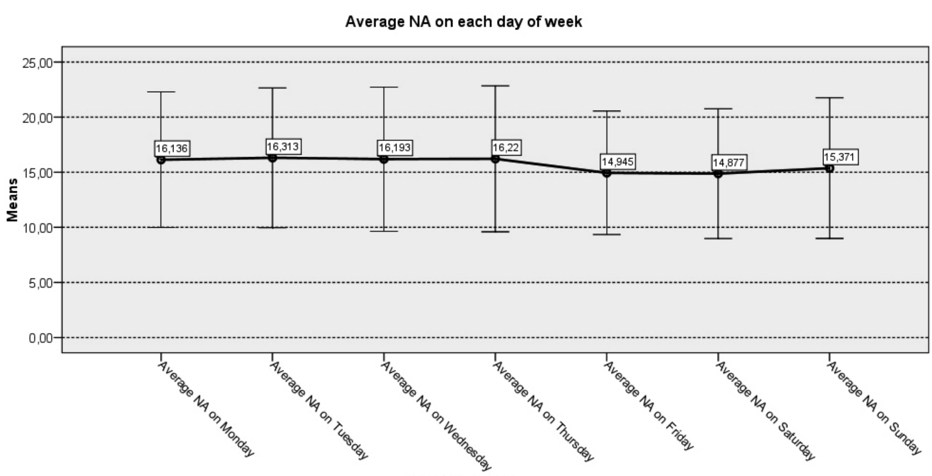

Figure 2. Level of negative affect averaged on successive days of the week.

Table 3 – *Results of tests of intra-object effects of negative affect – day of the week*

Source		Sum of squares	df	Average square	F	Sig.	Partial Eta^2
Day	Assumed sphericity	276.540	6	46.090	3.464	.002	.029
	Greenhouse-Geisser	**276.540**	**5.248**	**52.691**	**3.464**	**.004**	**.029**
	Huynh-Feldt	276.540	5.529	50.017	3.464	.003	.029
	Lower-bound	276.540	1.000	276.540	3.464	.065	.029
Error	Assumed sphericity	9182.019	690	13.307			
	Greenhouse-Geisser	9182.019	603.555	15.213			
	Huynh-Feldt	9182.019	635.820	14.441			
	Lower-bound	9182.019	115.000	79.844			

Table 4 – *Comparisons of pairs of successive days of the week in relation to negative affect*

(I) day	(J) day	Average difference (I-J)	Standard difference error	**Sig.**	95% range of difference confidence	
					Lower limit	Upper limit
Monday	Tuesday	-.158	.405	**.697**	-.961	.644
	Wednesday	-.095	.517	**.855**	-1.118	.929
	Thursday	-.078	.482	**.872**	-1.032	.877
	Friday	1.194*	.473	**.013**	.258	2.130
	Saturday	1.227*	.571	**.034**	.096	2.358
	Sunday	.754	.458	**.102**	-.153	1.662
Tuesday	Wednesday	.063	.460	**.891**	-.849	.975
	Thursday	.080	.431	**.852**	-.773	.934
	Friday	1.352*	.453	**.003**	.455	2.249
	Saturday	1.385*	.480	**.005**	.434	2.336
	Sunday	.912*	.460	**.050**	.001	1.823
Wednesday	Thursday	.017	.427	**.968**	-.828	.862
	Friday	1.289*	.442	**.004**	.414	2.164
	Saturday	1.322*	.575	**.023**	.184	2.460
	Sunday	.849	.490	**.086**	-.121	1.820
Thursday	Friday	1.272*	.507	**.014**	.267	2.276
	Saturday	1.305*	.512	**.012**	.290	2.319
	Sunday	.832	.479	**.085**	-.117	1.781
Friday	Saturday	.033	.474	**.944**	-.905	.971
	Sunday	-.440	.466	**.347**	-1.362	.483
Saturday	Sunday	-.473	.462	**.308**	-1.388	.442

Circadian variability of positive affect

Below are presented the results of repeated-measures analysis of variances for the variable of positive affect. The results are illustrated in Figure 3.

Table 5 presents the results of the tests of intra-object effects, revealing that positive affect is significantly and statistically different depending on a time of the day. One should also note that the value of Eta is significantly higher than in case of the so-far dependences, which means that the dependence/relation is significantly stronger. Circadian differences of positive affect are significant.

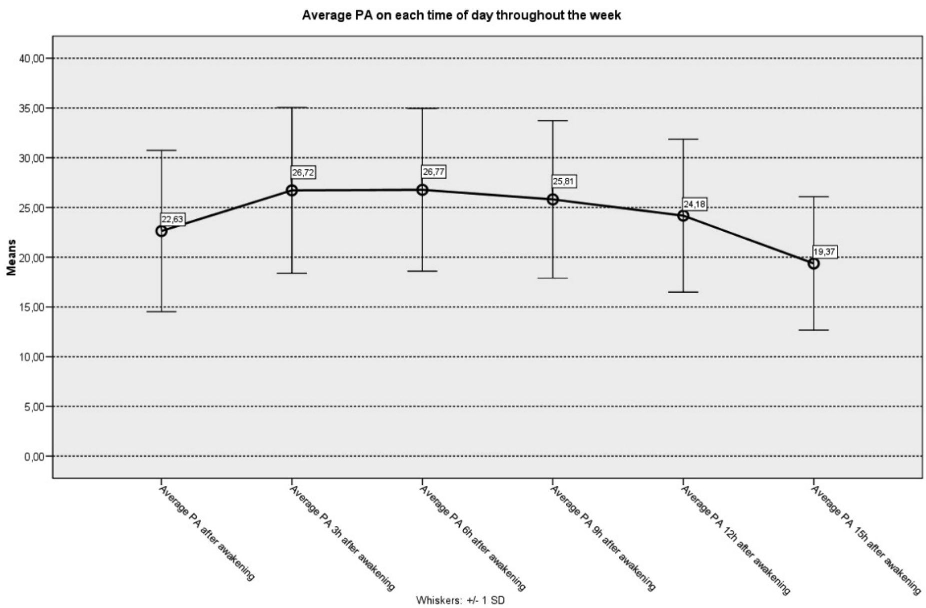

Figure 3. Level of positive affect averaged at successive times of the day.

Table 5 – *Results of tests of intra-object effects of positive affect – time of the day*

Source		Sum of squares	df	Average square	F	Sig.	Partial Eta^2
Day	Assumed sphericity	4793.033	5	958.607	94.085	**.000**	.450
	Greenhouse-Geisser	**4793.033**	**3.261**	**1469.654**	**94.085**	**.000**	**.450**
	Huynh-Feldt	4793.033	3.368	1423.189	94.085	**.000**	.450
	Lower-bound	4793.033	1.000	4793.033	94.085	**.000**	.450
Error	Assumed sphericity	5858.542	575	10.189			
	Greenhouse-Geisser	5858.542	375.053	15.621			
	Huynh-Feldt	5858.542	387.298	15.127			
	Lower-bound	5858.542	115.000	50.944			

In order to assess which times of the day differ in positive affect, the former were compared in pairs. The results are presented in Table 6.

Table 6 – *Comparisons of pairs of successive times of the day in relation to positive affect*

(I) time	(J) time	Average difference (I-J)	Standard difference error	**Sig.**	95% range of difference confidence	
					Lower limit	Upper limit
after awakening	after 3h	-4.085*	.370	**.000**	-4.817	-3.353
	after 6h	-4.142*	.405	**.000**	-4.943	-3.340
	after 9h	-3.175*	.419	**.000**	-4.005	-2.345
	after 12h	-1.544*	.520	**.004**	-2.574	-.515
	after 15h	3.262*	.543	**.000**	2.186	4.339
after 3h	after 6h	-.057	.228	**.804**	-.508	.395
	after 9h	.910*	.311	**.004**	.293	1.527
	after 12h	2.541*	.433	**.000**	1.683	3.398
	after 15h	7.347*	.521	**.000**	6.315	8.380
after 6h	after 9h	.967*	.239	**.000**	.493	1.441
	after 12h	2.597*	.412	**.000**	1.782	3.413
	after 15h	7.404*	.509	**.000**	6.396	8.412
after 9h	after 12h	1.631*	.329	**.000**	.978	2.283
	after 15h	6.437*	.454	**.000**	5.538	7.337
after 12h	after 15h	4.807*	.430	**.000**	3.955	5.659

Table 7 – *Results of tests of intra-object contrasts of positive affect – time of the day*

Source	dependence	Sum of squares	df	Average square	F	**Sig.**	Partial Eta^2
hour	linear	1027.465	1	1027.465	47.437	**.000**	.292
	square	**3621.059**	**1**	**3621.059**	**256.602**	**.000**	**.691**
	cubic	18.376	1	18.376	2.493	**.117**	.021
	4-th degree	126.108	1	126.108	22.860	**.000**	.166
error	linear	2490.861	115	21.660			
	square	1622.834	115	14.112			
	cubic	847.662	115	7.371			
	4-th degree	634.400	115	5.517			

The analysis of the results in the table indicates that all the times of the day differ as to the intensity of positive affect, except for the measurements after 3 and 6 hours, which in the group under discussion are insignificantly different. The intensity of positive affect proves low shortly after the awakening to rapidly grow after 3 hours and remain on this level after 6 hours, to gradually decrease after 9 and 12 hours not reaching, however, the level observed immediately after the awakening. After 15 hours the intensity of positive affect falls sharply to all-day low (lower than after the awakening).

The results clearly indicate curvilinear dependence, best described by a second-degree polynomial and a parabolic curve; this being confirmed by the tests of intra-objects contrasts presented in Table 7. The effect described by the second-degree curve reaches the highest value of test F.

Circadian variability of negative affect

Below presented are the results of repeated-measures analysis of variances for the variable of negative affect. The result of the test of intra-object effects is presented in Table 8.

Table 8 – *Results of tests of intra-object effects of negative affect – time of the day*

Source		Sum of squares	df	Average square	F	Sig.	Partial Eta^2
Day	Assumed sphericity	34.038	5	6.808	1.579	**.164**	.014
	Greenhouse-Geisser	**34.038**	**3.306**	**10.297**	**1.579**	**.189**	**.014**
	Huynh-Feldt	34.038	3.415	9.967	1.579	**.188**	.014
	Lower-bound	34.038	1.000	34.038	1.579	**.211**	.014
Error	Assumed sphericity	2479.022	575	4.311			
	Greenhouse-Geisser	2479.022	380.149	6.521			
	Huynh-Feldt	2479.022	392.744	6.312			
	Lower-bound	2479.022	115.000	21.557			

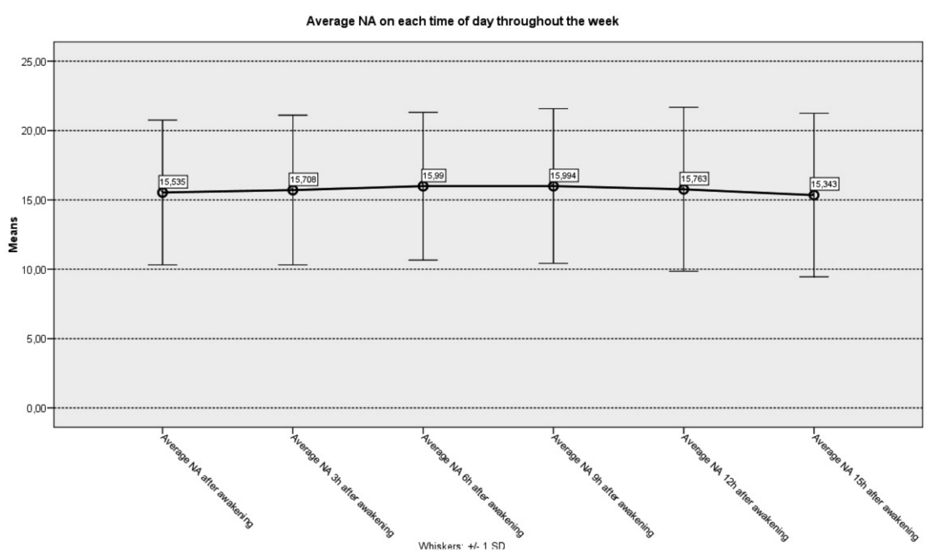

Diagram 4. Level of negative affect averaged at successive times of the day.

It is clearly visible that the time of the day does not significantly differentiate the intensity of negative affect. Therefore, the comparisons of pairs were not carried out due to their groundlessness. Figure 4 illustrates the course of negative affect in case of circadian variability.

Discussion

The objective of this research was to describe circadian and circaseptan changes in experiencing positive and negative affects. Positive affect (PA) was taken into consideration as a factor independent of negative affect (NA). The so-far research showed that the researchers using various testing methods recognize the circadian rhythm for both PA and NA. Also the latest analyses of circaseptan rhythms (Cornelissen et al. 2005) provide evidence for the rhythmicality of affective experiences. Although such analyses still require confirmation in further research.

The results revealed that subjects experience significantly higher positive affect on Thursday rather than on others six days. Positive affect is the lowest in Sunday. The result confirms the data gathered by other authors stating that the most intense positive emotions may be experienced during the working week as these are attached to social interactions. The researchers indicated that people tend to experience their highest well-being, reported as high level of happiness, energy and enthusiasm, when they are socially and physically active. The analysis of the results also justifies reasoning that Sunday as a day off, is not characterised by the highest indications of positive affect. Data gathered in other tests confirm that on Sunday many people report an increase in sadness and disengagement, which still remains unclear and is subject to further research (Watson, 2000). Possibly, the sense of being involved and included gives people the sense of belonging and being needed (Baumeister & Leary, 1995). Research on the society of today indicate that in most countries the pace of life revolves around work; in western Europe being more intense than in Brazil, Indonesia or Mexico. On this list Poland occupies the twelfth position, being several places higher than the United States. Human activity is increasingly characterised by higher intensity of professional tasks carried out under time pressure and subject to growing requirements. While trying to reconcile professional challenges with their role in the family, humans may experience psychological tension and sense of discomfort. While observing circaseptan changes Americans researchers also noticed a weekly mood rhythm characterised by gradually growing positive affect from Sunday until Tuesday followed by its fall on Thursday and a slight growth towards the end of the week(Clark et al., 1989; Cornelissen et al., 2005). The weekend seems to be less characterized by positive affect due to the fact that anticipation of events is connected with more positive emotions than experiencing of the actual events. It has been established that negative affect remains on a similar level on all weekdays except Friday and Saturday, when it slightly drops, only to start climbing again on Sunday and stay the same for the subsequent days of the week. The obtained results have shown that during the week a negative affect is slightly increased in comparison with the weekend, which may indicate that in spite of experiencing many positive emotions, we still experience independent negative emotions connected, for instance, with stress or tiredness.

The results of circadian analyses show distinct differences within the scope of positive affect experienced at different times of the day. They confirm the presence of the circadian variability of positive affect. Similar data with reference to negative affect were not confirmed in the group subject to testing. The so-far affect-related tests including 3-hour intervals (Clark & Watson, 1988; Clark et al., 1989; Cornelissen et al., 2005; Murray et al., 2002) confirm circadian variation in positive affect. Researchers studied American population (Clark et al., 1989; Cornelissen et al., 2005). indicated that positive affect grows during the day until afternoon to fall at night-time. Researchers analyse individual human potential by testing rhythms e.g. circadian ones. The obtained result allow a conclusion that a daily emotional state regulated by a biological clock (Mitsutake et al., 2001). In the surveyed Polish population, one has observed that positive affect is increasing until afternoon hours, then it reaches its peak and starts to decrease after nine hours after the awakening to reach its lowest range at night – fifteen hours after the awakening. What is interesting is that one has not observed any essential circadian changes within the scope of negative affect, which proves that negative emotions remain on the same steady level throughout the day.

Conclusion

Statistical results have indeed confirmed the rhythmic variability of positive affect in an individual in their circadian activity as well as circaseptan rhythmicality within the scope of positive and negative affect. The analysis of the circadian rhythm confirms the influence of the biological clock on the psycho-biological functioning of a human being (endogenous influence). Social synchronizers, such as periods regulated by social activity (professional or educational one), are most likely to have influence, too. The observed circaseptan changeability of positive and negative affect occurs mainly as the consequence of social synchronizers. The knowledge about the affect rhythmicality may be used in preparation of social and occupational activities in the periods of the highest index for positive affect and avoidance of planning any activities in the periods of the highest negative index. The awareness of PA and NA rhythmicality allows planning the time of rest in the periods of the lowest positive affect index and the highest negative affect index.

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