DOI: 10.22616/REEP.2023.16.020

Psychological Correlates of Time Perception

Valerijs Makarevičs[1], Dr. psych.; **Dzintra Iliško**[2], PhD;
Deniss Andruškevičs[3], Mg.psych.
Daugavpils University, Latvia
valerijs.makarevics@du.lv[1]; dzintra.ilisko@du.lv[2]; D.Andrushkevich@outlook.com[3]

Abstract: A person exists in space and time. His or her life and work are subject to a temporal rhythm. Each of us has his/her own psychological time, which is different from the objective, physical time measured by the chronometer. The perception of time is a part of human experience, which is important for everyday behavior and for the survival of an individual organism. The purpose of this study was to explore the relationship between the accuracy of perceived time intervals and the specifics of the activity, age and functional state of an individual. One's functional state of being is understood as a level of well-being, activity and a mood of a person. In the experiment, respondents were offered to watch two videos of different lengths. At the end of the demonstration, they had to estimate the duration of video. Before demonstration, all participants filled in a SAN test form, which determined the level of their functional state. The results of the study indicate that there are no relationship between the accuracy of perception of the duration of the demonstration of video films, age, as well as the specifics of the professional activities of respondents. The accuracy of perception is influenced by the well-being and level of activity of respondents.

Keywords: adult education, accuracy of time perception, specifics of activity, functional state, person's age.

Introduction

The driver of the train, actor, teacher, the operator of the interplanetary station. What do these professions have in common? The driver needs to bring the train to the station exactly according to a schedule. When pronouncing the line, the actor needs to be able to keep a pause just long enough that is necessary to keep public's attention so that the viewer does not have a suspicion that the actor has forgotten his or her speech. The teacher finishes the his or her presentation before the bell rings from the lesson. The operator must take into account the time delay of the signal reaching to the station. In other words, their actions are subject to some internal clock. Dawson & Sleek pointed to a critical importance of accurately estimating the time for the eyewitnesses of events whose testimony can be used in the process of reconstructing what has happened or in historical documents (Dawson, & Sleek, 2018). The inability to plan one's actions in time adds an anxiety of not having this skill. This increases the level of stress, which in turn causes employee turnover (Olsson, & Sundh, 2019). A person exists in space and time. The person's life and work are subject to a temporal rhythm. Each of us has his/her own psychological time, which is different from the objective and physical time measured by the chronometer. Almost every person can estimate the duration of the time interval with a small error.

The perception of time is a part of the human experience; it is important for everyday behavior and for the survival of an individual organisms (Wittmann, 2009). This explains active interest of researchers about the problem of time perception. As by Cappon & Banks argue, contemporary studies has a wide spectrum of focus to begin with defining the features of perception of time by an ordinary person to the ratio of perception of real and surreal time by mentally ill people who lived in the historical and personal past (Cappon & Banks, 1964). However, the researchers argue that there is still no answer to the question how person does it (Block, 1990; Skylark & Meck, 2014; Foley & Matlin, 2019 et al.). Current theories on a time perception can be divided into two large groups. On the one hand, these are theories that assume the existence of one center, a certain internal chronometer that is responsible for counting internal, psychological (as opposed to physical, objective) time. On the other hand, there are theories that claim that there is no single center responsible for the perception of time. The localization of the zones of activity of the cerebral cortex during the process of perception of time depends on many factors. According to the authors of theories of the first group, there is an internal timekeeper, a kind of biological chronometer in the human brain, which accelerates or slows down under the influence of

emotions and the situation (Grondin, 2010; Skylark & Meck, 2014; Lehockey et al., 2018). This internal chronometer is activated in the moments when attention is directed to the countdown of time (Taatgen et al., 2007). In this case, the perceived time intervals are compared with the standard stored in a long-term and episodic memory (Pouthas and Perbal, 2004; Noulhiane et al. 2007b). Thus, the internal timekeeper is related to the cognitive sphere of personality.

Within this group of theories, there are two main models of time perception: attention-based models and memory-based models (Brooks, 2012). Montare stated that the perception of time is disturbed if the activity accompanying the countdown of time requires large amount of attention (Montare, 1985).

The leading role of attention in the processes of time perception has been convincingly demonstrated by the experiments of Block, Hancock & D. Zakay and others (Block, et al., 2010; Droit-Volet et al., 2010). At the same time, not less convincing evidence was obtained in the experiments confirming the connection of time perception and memory (Kellaris & Kent, 1992). Theories of the internal chronometer suggest the presence of a sensory channel connecting the chronometer with the outside world.

There is no single pathway that transmits information about time to the human brain does not exist. Skylark & Meck suggest that all sensory channels support the perception of time. However, this assumption does not provide the answer to the question what are the common mechanisms that mediate these processes (Skylark & Meck, 2014).

The authors of the theories of the second group had an attempt to find the answer to this question and they have focused on the methods of neurophysiology. Their reference to the neurophysiological explanations of time perception ranges from simple fixation of pupil dilation (Kruijneet al., 2021) to complex measurements of local activation of excitement in the cerebral cortex**.**

The studies of recent decades show that when time is perceived, excitation of pupil appears in the insular cortex. At the same time, the location of the foci depends on the conditions of perception and the task (Bamiovu et al., 2003). It has also been found that there is a some kind of connection between individual differences in the perception of time and the peculiarities of neural connections in the cerebral cortex (Grahn & McAuley, 2009). With the emergence of a new point of view on the mechanisms of perception of time, it is suggested that the term "perception of time" itself is not accurate. Thus, Le Poidevin argues that the concept of time perception is not accurate, since a person perceives not time, but changes in the surrounding world occurring in time (Le Poidevin, 2019). Philosophers also offer their own solution to the problem of person's perception of time. According to Bergson, the perception of time is a function of the Self that can only exist in time (Bergson, 1913). The self is the integrating center of a human psyche in its deepest meaning.

The dependence of time perception on the emotional state of the person is also confirmed by the experiments of Thayer & Schiff, as well as Rudd, Vohs & Aaker. They studied the perceived duration of an event that was pleasant or unpleasant. Researchers have concluded that the waiting time for the unpleasant events subjectively flows faster than the waiting time for pleasant events (Thayer & Schiff, 1975; Rudd et al., 2012).

The influence of negative emotions on distortions of perception of time is reported in other studies (Angrilli et al., 1997; Everhard et al., 2003; Droit-Volet et al., 2004; Hancock &Weaver, 2005; Campbell & Bryant, 2007; Gil, et al., 2007; Droit-Volet et al., 2011; Droit-Volet, 2013; Johnson &MacKay,2019). The influence of negative emotions on distortions of perception of time is confirmed by other studies (Angrilli et al., 1997; Everhard et al., 2003; Droit-Volet et al., 2004; Hancock &Weaver, 2005; Campbell & Bryant, 2007; Gil, et al., 2007; Droit-Volet et al., 2011; Droit-Volet, 2013; Johnson &MacKay, 2019) as well.

The most convincing results confirmed the connection between emotions and the perception of time that were obtained in experiments with depression. As depression rates have increased, respondents' time perception error increased (Gil & Droit-Volet, 2009). However, there may be exceptions. In the study by Stetson and others, the subjects jumped from the 31 meters hight and landed on a grid. The subjective time of fall of subjects exceeded the objective time. But when they began to be supplied with the chronometers (the authors do not explain what they are), and they were monitored during the fall, the difference between subjective and objective time practically disappeared (Stetson, Fiesta & Eagleman,

2007). Effects related directly to perception has been found. Thus, the experiment of W. Matthews confirmed the manifestation of the effect of novelty in the perception of time. In this experiment, the participants were presented with photographs.

The exposure time was the same in all cases. At the same time, the exposure time of new photographs was subjectively perceived as longer than the exposure time of already known ones (Matthews, 2011). The subjective time of perception of moving objects increases compared to the perception of stationary objects (Sysoeva et al., 2010). Age and specificity of activity are in direct connection with the perception of time (Kozlova, 2009; Vasile, 2015). Personality traits can influence perceptions of time, but there is little research in this area to be mentioned (Skylark & Meck, 2014).

Taking into account the existing studies on perception of time, the authors have set the purpose of the study: to study the relationship of time perception in relation to extra psychological (age, profession) and intra psychological (well-being, activity, mood) phenomena.

The method and the research sample

The authors used two videos. One lasted 15 minutes and the other lasted 10 minutes. By genre, it was a cartoon and a popular science film. After demonstration of video, respondents were asked to rate the duration of each video. The second test (SAN test) designed to assess a psycho-emotional state of the respondent: well-being, activity and mood (the technique was named according to the first letters of functional states).

Prior to testing, all respondents were asked to relate their condition with a number of signs in a multi-stage scale. The scale consisted of indices (3 2 1 0 1 2 3) and was arranged between thirty pairs of words of opposite meaning, reflecting mobility, speed and pace of functions (activity), strength, health, fatigue (well-being), as well as characteristics of the emotional state (mood).

The subject had to choose and mark the figure that most accurately reflects his or her condition at the time of examination. When processing the respondents' scores they were recoded as follows: index 3, corresponding to unsatisfactory well-being, low activity and bad mood, marked by 1 point; the index following it as 2 by 2 points; index 1 by 3 points and so on until index 3 on the opposite side of the scale, which was respectively marked by 7 points. Below is a fragment of the test:

Feeling good 3 2 1 0 1 2 3 Feeling bad

Feeling strong 3 2 1 0 1 2 3 Feeling week

For the positive feeling the individual receives points higher than 5, for negative - less than 5 (Doskin et al.,1973). The experiment involved 45 respondents in the age group from 18 to 67. Before watching the film, participants filled in the SAN test forms. Afterwards, they watched videos. First video lasted 15-minutes, the next was 10-minutes long.

Research Findings

The entire sample was divided into three subgroups: teachers, students and the representatives of other professions. Teachers were included because their professional activities are directly related to the perception of time. Table 1 shows the characteristics of each of the three subgroups**.**

Table 1

Characteristics of subgroups of respondents

The name of a subgroup	Average age	σ	Average result of perception of time 1	σ	Average result of perception of time 2	σ
Teachers (n=15)	39.7	12.2	18.3	3.8	12.5	4.8
Students (n=15)	23	2.5	17.5	4.2	11.5	3.5
Others (n=15)	40.5	15	17.6	4.2	13.1	3.2
All (n=45)	34.2	13.9	17.7	4.1	12.4	3.9

In Table 1, and in the subsequent ones, the average age is provided in years. The average result of the perception of time is in minutes. The number 1 refers to the first experiment when respondents watched a video that lasted 15 minutes. Number 2 - the second experiment, when the participants watched a video that lasted 10 minutes. The average result is the sum of all the results of a group divided by the number of members of that group σ is the mean quadratic deviation.

Table 2

Coefficients of the Mann-Whitney criterion

Groups	1st experiment	2nd experiment
Teachers - Ctudents	103.5 (p>0.05)	96 (p>0.05)
Teachers - Others	103 (p>0.05)	105 (p>0.05)
Students - Others	107.5 (p>0.05)	80 (p>0.05 for $p_{0.05}$ = 72)

Table 2 shows that only the difference in outcomes in groups of students and others reaches the boundary of statistically significant quantities. The rest of the results are not statistically significant.

One of our assumptions was that professional activity affects the accuracy of time perception. Teaching refers to professions where time control is necessary. Therefore, let's examine the group of teachers and the influence of their work experience (experience) on the accuracy of perception of time intervals.

Table 3

Perception of time by the teachers with the experience up to 10 and more than 10 years

Groups	Average result of time perception	σ	Average result of perception of time 2	σ
Teachers with work experience up to 10 years (n=7)	19.9	4.5	12.9	3.8
Teachers with work experience mere than 10 years (n=8)	17.1	2.9	11	3

The Mann-Whitney criterion, as calculated from the bases of the results of two experiments, was equal to U1 = 25 (at U0.05 = 13), respectively: U2 = 22 (at U0.05 = 13). But, despite the absence of statistically significant indicators, there is a tendency for a more accurate perception of time among teachers with more than 10 years of experience. The authors also have studied the influence of age on the accuracy of perception of time.

Table 4

Characteristics of subgroups of respondents of different ages

Age	Average age	σ	Average result of perception of time 1	σ	Average result of perception of time 2	σ
Until 30 (n=26)	24.4	2.8	17.8	4.5	12.2	3.5
30-50 years old (n=11)	41.5	5.1	18.3	4.1	12.8	5.2
Older than 50 (n=8)	57.4	4.8	17.5	3.4	12.4	3.0

To answer the question of whether there are differences in the perception of time by respondents of different ages, the authors have calculates the Mann-Whitney coefficient.

Table 5

Coefficients of the Mann-Whitney criterion for groups of respondents of different ages

Groups	1st experiment	2nd experiment
Until 30 – 30/50	137 (p>0.05)	141 (p>0.05)
Until 30 – Older than 50	100.5 (p>0.05)	99 (p>0.05)
30/50 – Older than 50	42 (p>0.05)	43 (p>0.05)

The results of the study indicate that age does not affect the accuracy of time perception. The authors also have gained the results by the use of the criterion of well-being of the SAN Test. Group characteristics and Mann-Whitney coefficients were presented in Tables 6 and 7.

Table 6

Characteristics of subgroups of respondents with different levels of well-being

Well being	Average indicator	σ	Average indicator of perception of time 1	σ	Average result of perception of time 2	σ
Lowered (lower than 4) (n=6)	3.1	0.6	19	4	15.8	5.6
Neutral zone (4-5.99) (n=24)	4.9	0.5	17.8	4.7	11.75	3.6
Promoted(more than 6) (n=15)	6.4	0.3	17.5	3.4	12.4	3.0

Table 7

Coefficients of the Mann-Whitney criterion for groups of respondents according to the subscale of the SUN test "Well-being"

Groups	1st experiment	2nd experiment
Well-being is reduced/lowered – Neutral zone	54 (p>0.05)	37.5 (0.05>p>0.01)
Well-being is lowered – Well-being is increased	36.5 (p>0.05)	25 (p>0.05, $p_{0.05}$ = 23)
Neutral zone – well-being increased	166.5 (p>0.05)	166 (p>0.05)

The maximum of points that can be obtained on this scale is 8. The sum of points less than 4 indicates to a low level of well-being, namely, a fatigue of the respondent. In order to obtain a more detailed information about the relationship between well-being and the accuracy of time perception, the authors have identified a transition zone from 4 to 5, 99, which we call neutral. The same principle of division into zones was applied to the "Activity" and "Mood" subscales. Tables 6 and 7 indicate that the respondents with a reduced level of well-being tend to exaggerate the time of the event. The result is statistically significant.

The results of the study on the criterion of well-being of the SAN test indicate that the characteristics of the groups and the Mann-Whitney coefficients are presented in Tables 8 and 9.

Table 8

Characteristics of subgroups of respondents with different levels of activity

Activity	Average indicator	σ	Average result of perception of time 1	σ	Average result of perception of time 2	σ
Lowered (lower than 4) (n=14)	3.5	0.5	18.3	4.8	10.9	3.8
Neutral zone (4-5.99) (n=23)	5.1	0.5	17.5	4.2	12.3	3.2
Increased (more than 6) (n=8)	6.3	0.3	18.4	3	15	4.8

Table 9

Coefficients of the Mann-Whitney criterion for groups of respondents on the subscale of the SUN test "Activity"

Groups	1st experiment	2nd experiment
Activity reduced – Neutral zone	144.5 (p>0.05)	120.5 (p>0.05)
Activity reduced – Activity increased	53 (p>0.05)	25 (0.05>p>0.01)
Neutral zone – Activity is increased	76 (p>0.05)	59.5 (p>0.05 при $p_{0,05}$=55)

With a reduced level of activity when evaluating event that was10 minutes long, respondents made fewer mistakes than individuals with an increased level of activity.

Now let’s consider the results obtained from the "Mood" subscale of the SUN test.

Table 10

Characteristics of subgroups of respondents on the scale "Mood" of the SUN test

Mood	Average indicator	σ	Average result of perception of time 1	σ	Average result of perception of time 2	σ
Lowered (lower than 4) (n=5)	3.6	0,3	16.2	4	14.4	4.6
Neutral zone (4-5.99) (n=27)	5.3	0.5	18.4	4.5	11.7	3.3
Increased (более 6) (n=13)	6.4	0.3	17.4	3.4	12.9	4.5

Table 11

The coefficients of the Mann-Whitney criterion for groups of respondents on the subscale of the SUN "Mood" test

Groups	1st experiment	2nd experiment
Decreasing Mood – Neutral Zone	53.5 (p>0.05)	42 (p>0.05)
Decreasing Mood – Elevated mood	23.5 (p>0.05)	25 (p>0.05)
Neutral zone – Elevated mood	154 (p>0.05)	153.5 (p>0.05)

As it is seen from Table Nr. 11, no statistically significant differences were found between the groups.

Discussion

The assumption that a professional activity has an impact on the perception of time has not been confirmed. Moreover, the mistakes in assessing time intervals were made by students who are just preparing for a professional career. The assumption that pedagogical activity contributes to a more accurate perception of time intervals has also not been confirmed. Both young teachers and experienced teachers made similar mistakes.

Despite the fact that some studies show that aging leads to errors in the perception of time (Graf, & Grondin, 2006; Fereira et al., 2016), our results do not support findings of this research.

Statistically significant results confirming differences in the assessment of time intervals were obtained in groups of respondents with low indicators on the well-being scale (compared with respondents with neutral indicators on the well-being scale) and with low indicators on the activity scale (compared with respondents with high indicators on the activity scale).

In addition, near the boundary of statistical significance are the results of respondents with low indicators on the scale of well-being (compared with a group of respondents with high scores on the scale of well-being) and the results of respondents with neutral indicators on the scale of activity (compared with the results of respondents with high indicators on the scale of activity).

Respondents with a low scores on a well-being scale make more mistakes compared to respondents with neutral indicators on the well-being scale. At the same time, respondents with low scores on the activity scale make fewer mistakes compared to respondents with neutral and high scores on the activity scale. Low indicators of well-being of respondents indicate fatigue. It is more difficult for a tired person to focus on the task, which explains the errors in assessing the time intervals of these respondents.

It was discovered that a low activity contributes to concentration on the task. Low activity is a characteristic of the state of contemplation, when the individual is fully concentrated on his or her cognitive processes. It seems that with an increasing activity, an indicative reflex begins to manifest itself, distracts an individual from solving the problem.

The results obtained indirectly confirm the correctness of researchers who believe that the perception of time by an individual is associated with attention. The differences described above refer to the second experiment, when the duration of the estimated video watching event was equal to 10 minutes. With the increasing of the duration of the event up to 15 minutes, no differences were recorded in all respects.

This phenomenon can be associated with the amount of attention of a person, which, as you know, is equal to 5-9 units of information. A time interval of 10 minutes corresponds to these parameters. The amount of short-term memory is also equal to 5-9 information units.

Therefore, in regards to long periods of time, perception errors are associated with peculiarities of cognitive sphere of an individual and his/her functional state.

Conclusions

In this study, the respondents were asked to retrospectively estimate the timing of two events lasting 15 and 10 minutes.

The results of the study did not confirm the relationship between the accuracy of the perception of time intervals, the professional activities and age of the respondents.

Respondents with neutral and high scores on the well-being scale made fewer mistakes in perceiving the timing of the event than respondents with low scores on a well-being scale.

The respondents with low scores on the activity scale made fewer mistakes in perceiving the timing of the event than respondents with neutral and high scores on the activity scale.

The above results apply only to a temporary estimate of a 10-minute event.

According to the results of the study, this can be argued that when perceiving long periods of time, perception errors are associated with the peculiarities of the cognitive sphere of the individual and his or her functional state.

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