Time Perception and Emotion: The Effect of Task Difficulty

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IN PSYCHOLOGY

SUBMITTED BY:

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UNDER THE SUPERVISION OF

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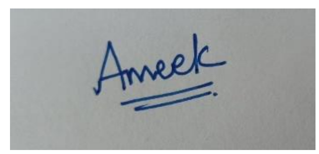
CERTIFICATE

This is to certify that the thesis entitled ‘Time Perception and Emotion: The Effect of Task Difficulty’ submitted by Ameek Kaur (Regd. No. 862102002) for the partial fulfillment of the degree of Master of Arts in Psychology,submitted in Thapar School of Liberal Arts and Sciences, Thapar Institute of Engineering & Technology, Patiala is a bonafide work completed under the oversight of Dr.Anuj Shukla, Assistant Professor, Thapar School of Liberal Arts and Sciences, Thapar Institute of Engineering & Technology, Patiala and that no piece of this venture has been submitted for the honor of any other degree.



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This is to certify that the above statement made by the student concerned is true and correct to to the best of my knowledge.

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DECLARATION

I ,Ameek Kaur (862102002),student of M.A. Psychology (2021-2023), declare that the work being presented in the thesis entitled, **“Time Perception and Emotion: The Effect of Task Difficulty”** in the partial fulfillment of the degree of Master of Arts in Psychology, Thapar School of Liberal Arts and Sciences, Thapar Institute of Engineering & Technology, Patiala, is an original record of my own research work carried out under the guidance and supervision of Dr. Anuj Shukla, Assistant Professor, Thapar School of Liberal Arts and Sciences, Thapar Institute of Engineering & Technology, Patiala. The content in the dissertation has not been submitted to any other university or institute for the award of any other degree.

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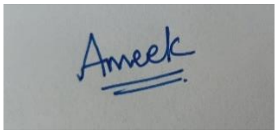
Place: Patiala



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ABSTRACT

Time perception refers to an individual's subjective experience of the passage of time. It is measured by their own perception of the duration of an event. While physical time is relatively objective, psychological time is subjective. Task difficulty refers to a person's subjective judgment of the complexity of a task, while task complexity represents the cognitive demands of a task. Although the influence of stimulus properties (such as emotion, color, sound, magnitude and so on) on temporal perception has been extensively studied, it remains unclear whether task-related properties can modulate temporal processing. In other words, how does the inherent task demand (in this case discrimination) affect the subjective experience of time. Whether the subjective judgement of time is affected by the task-demand or by the stimulus properties such as emotion. Therefore, the present study examines the influence of emotion on temporal perception across different task conditions (easy discrimination vs difficult discrimination). The hypothesis states that if stimulus properties always affect temporal perception, we would not observe a differential effect of emotion on different task conditions (easy discrimination vs difficult discrimination). The results suggest that in the easy temporal task, emotion does not modulate our temporal judgment. However, when the temporal task condition is difficult, stimulus affectivity becomes apparent, leading to an overestimation of time for angry stimuli than that of neutral stimuli. Thus, we can conclude that it is the temporal task condition (easy or difficult) that primarily controls our temporal perception in this experiment.

The attentional gate model is discussed as a theoretical framework to explain these findings and provide a conceptual understanding of the relationship between task conditions, emotion, and temporal perception.

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CHAPTER 1

INTRODUCTION

1. Time and time perception

Time is the measurement of the duration during which events or activities occur. It can be represented by specific instances like school starting at 7:30 am or lunchtime at noon on a Sunday. Scientifically, time is defined as an ongoing and quantifiable concept where events unfold in a timeline that moves from the past, through the present, and into the future. Time perception, on the other hand, refers to the subjective experience or sense of time that individuals have. It is influenced by how long they perceive an event to last and how they perceive the unfolding of time. Even when people are in the same place at the same time, their perception of time can vary. Several factors contribute to this individual experience of time perception.

Different age groups, such as children and older individuals, have varying experiences of time. Time is measured in various units, such as seconds, minutes, years, or even millennia(Pati 2001). People also conceptualize time in terms of the past, present, and future. Time is taken into consideration in everyday activities like eating, school schedules, bedtime, and waking up. Our memories of past events, their occurrence, and their duration also influence our perception of time. Additionally, we often associate time with seasons, such as recalling a trip to the Himalayas in the previous summer or the anticipation of exams starting next month. Time perception plays a role in all these aspects.

Our sensory experiences provide us with information about the passage of time. These sensory stimuli persist for a duration and shape our sense of time. Our thought processes change continuously, triggering our perception of time. Subjective experience plays a significant role in time perception. Each person's perception of time is unique and is influenced, at least partially, by the sensory information received from the external world. The feeling of time flying by or passing slowly can vary depending on the context. Spending a minute with your hand on a hot burner may feel like an hour, while an hour spent with someone attractive may pass quickly. This relativity of time was famously described by Einstein. Perceived duration refers to the observed time delay between two successive events. Time perspective and time orientation are based on the duration or intervals, which can be labeled as present, past, or future. Psychological time arises from the intervals between occurrences. Perceived duration represents the perceived span of time between two subsequent events. While it is impossible to directly experience or fully comprehend another person's perception of time, it is possible to infer and objectively study this perception through scientific experiments (Gibbon et al. 1984; Terman et al. 1984; Block et al. 1998; Pouthas 1999), Time perception is commonly categorized into three ranges: sub-second/millisecond timing, interval/seconds-to-minutes timing, and circadian timing. Different brain regions are responsible for processing durations within these ranges. Interval timers track time within seconds to minutes, while circadian clocks regulate physiological phenomena over a period of approximately 24 hours. Multiple brain regions, including the frontal cortex, basal ganglia, parietal cortex, cerebellum, and hippocampus, are involved in time perception.Even some fMRI technique demonstrates that the areas of the basal ganglia are one of the important regions of the time-perceiving machinery for keeping track of the passage of time (Harrington et al. 1998; Pouthas et al. 1999).These regions receive, associate, and process information on millisecond, second, and minute scales. Memory, attention, and emotional states also contribute to the complete perception of time. However, time can be overestimated or underestimated in various situations. For instance, when eagerly anticipating a significant event, like a vacation, time may seem to move more slowly, while the passage of time speeds up as the vacation comes to an end.

A slower internal clock or a lengthening of the interval between ticks or pulses of a clock leads to an overestimation of time. Conversely, a faster internal clock or a shorter interval between ticks results in an underestimation of time(Block et al. 1999, 2000;Klein et al. 2003).

In conclusion, the production or estimation of the target duration can be influenced by the speed of the internal clock, leading to either overestimation or underestimation of real time.

Factors such as memory, attention, and emotional states also play a role in our perception of time.

Time overestimation- Overestimating time means when it appears as though time is passing more quickly than it actually is. [SIR YOU TAUGHT ME THIS DIFFRENCE]

Time underestimation- A clock's time is being underestimated, which means that time seems to be passing more slowly than it is.

The two most influential models of time perception are the internal clock model and the attentional gate model.

1.2 Internal Clock Model

Treisman put forth the internal clock theory in 1963 to describe timing behavior in people. The model consists of a pacemaker, a counter, and a comparative mechanism. There is a constant flow of pulses coming from the pacemaker. The pacemaker's rate was initially assumed to vary according to an organism's particular arousal state, which was influenced by outside events. A calibration unit that can alter the pacemaker's constant pulse rate as a result of changes in arousal level was later added to the model by Treisman (1990, 1993). The constant rate of pulses released by the pacemaker due to the variation in arousal level was then modulated by a calibration unit that Treisman (1990, 1993) added to a later version of the model. The number of pulses that arrive at the counter from the calibrator is counted. The comparator mechanism uses this count, which is stored in a store. The store, which is assumed to be a long-term memory store containing knowledge of connections between specific counts of pulses and verbal labels, is accessed with the help of a verbal selective mechanism, which facilitates the retrieval of important information. As a result, a biological stopwatch is formed by the unconscious counting of pulses over a certain period of time. According to this theory, the brain can independently control several biological stopwatches, depending on the task being tracked. According to this theory, the brain has designated several areas for implementing a time estimation system. The basic idea is that certain stimuli can cause neurons in a specific area of the cortex to synchronize, effectively acting as a starting sign. Each interval is associated with a distinct pattern of activation because each neuron produces its own unique pattern of activation over time. These patterns can then be interpreted by other brain areas in the basal ganglia (Matell & Meck, 2000). In such a system, errors in time estimation are primarily caused by noise. Thus, this model suggests a centralized system for determining time across stimuli and tasks (Allman, Teki, Griffin, & Meck 2014), with a representation of time involving the accumulation of pacemaker pulses or the detection of coincident activity among a group of oscillators with various periods (Matell & Meck 2004). But it needs to be clarified what the pulses are made of and where they come from (Falk 2013).

1.3Attentional Gate Model

Dan Zakay and Richard A. Block proposed the attentional gate model in 1995. They believed the internal clock model, while effectively predicting animal behavior, needed to be more extensive in explaining human time perception (Block 1990). It was necessary to develop a model with scalar-timing properties that also considered the role of cognitive factors. As a result, they proposed a model based on Treisman's internal clock model, to which they added the cognitive module of the attentional gate. The gate is defined as a cognitive mechanism governed by the allocation of attention to time. When you pay more attention to a task, the gate opens wider and more pulses from the pacemaker are transferred to the counter. As a result, when the task is deemed important, the gate allows more pulses to pass through, such as when favorable conditions exist. The gate is closed, and no pulses can pass through when time is not considered relevant. Most attentional sources are assigned to important non-temporal tasks, as in retrospective conditions. Attending on time raises the level of activity at the gate. A pacemaker generates pulses at a constant rate, a counter counts the pulses coming out of the gate, and a switch opens or closes the counter. The switch operates in an all or none manner and is controlled by the temporal meaning given to the stimuli. The switch opens, the counter is reset to zero, and the flow of signals is counted when we detect a stimulus that indicates the beginning of a relevant or significant interval. The switch is closed, preventing more pulses from entering the counter. The count is simultaneously transferred to short-term memory when we perceive a stimulus that signals the end of such a relevant and significant interval. The model is unable to pinpoint the switch's precise location.

In two conditions, participants in a Zakay (1993) experiment had to estimate a 12-second interval. Participants in the first condition had to estimate the interval while performing a second task and then replicate it while not performing anything else. In the alternative condition, participants had to estimate the interval while completing nothing else but reproducing it while working on a side task. The complexity of these extra tasks varied from none to more complex. In the relatively simple task conditions, it was seen that the secondary task had no impact on time estimates;

however, in the more challenging task conditions, it did. This perspective claims that when participants had to complete a time-consuming secondary task during the interval's presentation, they focused less on keeping track of the passage of time, which resulted in a lower cognitive count and a shorter reproduced interval, as opposed to when participants completed the time-consuming secondary task during the reproduction, which caused their cognitive counting to slow and result in a longer interval. The cognitive timer that counts subjective time events is what the attentional gate model assumes to be present. Since this counter requires attention to increase, it cannot be increased as frequently when other processes are vying for the same attention, which gives the impression that time is "stretching."

To elicit emotions in the laboratory, researchers used material from tested, verified databases of normative stimuli, including images from the well-known International Affective Picture System (IAPS; Angrilli et al., 1997; Lang et al., 2008; Grommet et al., 2010). Po and her colleagues also used sounds from the International Affective Digital Sounds (IADS) collection (Bradley and Lang, 1999; Noulhiane et al., 2007; Mella et al., 2011). These studies on the use of extraordinary emotional stimuli have consistently demonstrated that the presentation period of negative high-arousing emotional stimuli was judged to be longer than that of neutral control stimuli. They logically defined this lengthening effect in terms of these emotional stimuli that physiologically activated the critical apprehensive device and increased the mechanisms that support the internal clock.

1.4 Past research on time perception

Our ability to perceive time is essential to our existence and is at the heart of almost all of our activities. It is one of the foundational areas of experimental psychology and has received a great deal of attention for well over a century. This research has had many successes, including the finding that timing across many species exhibits a scalar property in the sense that temporal representational variability increases linearly with time durations ranging from hundreds of milliseconds to tens of milliseconds for intervals between one and ten minutes. Even more, many species take advantage of timing, which is roughly scale-invariant, meaning that the entire response distribution directly increases with the length of the interval being timed. It is clear, however, that it contradicts the wishes of the early Psychophysicists because the brain is not like the gauge of classical physics. There is no such thing as an invariant mapping between an external quantity and an internal sensation that can be captured in a simple math function. In reality, time perception is a series of unique challenges. For example, no time organs or individual pathways carry time information from the periphery to the brain. Instead, sensory channels aid in time perception, though it is unclear to what extent these expressions are mediated by a common structure and mechanism.

In everyday life, the experience of a mood alters our relationship with time. When we are sad or depressed, we believe that time slows down. Every hour seems to drag on indefinitely as if time had stopped. Stress, on the other hand, seems to hasten the passage of time. One hour appears to be insignificant. Despite the fact that mood-related fluctuations in our perception of time have been extensively described, they have rarely been experimentally studied. Finally, we don't know whether these explicit time judgments correspond to a reality felt in our bodies or brains. It is also clear that arousal and attention both influence time perception and that emotion influences both of these variables. From an arousal standpoint, emotional stimuli may lead to an overestimation of time perception via a faster pacemaker rate. On the other hand, attentional models suggest that emotional stimuli may distract from temporal information processing, resulting in a reduction in the number of temporal pulses emitted and an underestimation of time perception.

Previous research has found that when comparing emotionally arousing events to neutral events, the perceived duration of emotionally arousing events is typically distorted by valence. When emotional stimuli are presented, time estimations generally increase as arousal increases. Overestimation is linked to negative valence but not positive valence. The extent to which attention is directed to the flow of time influences the duration of the experience (e.g., Fraisse, 1984; Frankenhaeuser, 1959). This increased awareness of the passage of time has been described as "the experience of time passing."(1977, Hicks, Miller, Gaes, & Bierman). Situations that necessitate increased temporal awareness, such as boredom, impatience, and anticipation, frequently appear to result in an apparent lengthening (or slowing) of external time. A classic example of this effect is the "watched pot phenomenon" (Fraisse, 1963), in which time appears to slow down. The passage of time is slow. When on the other hand, one is involved in. Temporal awareness is reduced as a result of the absorbing activity. Minimized and reduced perceived duration.

1.5 Emotions and time perception

Emotion is "a state of physiological arousal and of cognition appropriate to this state of arousal," according to Schachter & Singer (1962, p. 380). This definition makes a distinction between mental arousal, which is characterized by the subjectively experienced intensity of emotions, and physiological arousal, which is sometimes referred to as activation. Our sense of time is influenced by our emotions to such an extent that time appears to fly by when we are having fun and to drag when we are bored. Recent research using standardized emotional fabric offers a completely unique opportunity to gain expertise in the neurocognitive mechanisms that underpin the effects of emotion on timing and time perception in the milliseconds-to-hours range. A study describes how these new findings can be explained within the framework of inner-clock models, as well as how emotional arousal and valence interact to supply both increased and decreased attentional time-sharing.

Physiological activation and attention, two components of emotion, would have opposing effects on time estimation within the framework of internal clock models of timing. It has been demonstrated that physiological activation accelerates the pacemaker's rate, producing a longer perceived duration. The activation brought on by emotion has only been the subject of a few studies. Droit-Volet et al.(2004) demonstrated that pictures of faces expressing emotion were judged to be of longer duration than neutral ones, supporting activation-based models of time perception. They did this by using emotional visual stimuli (of less than 2 s) as standards in a temporal bisection task.

In contrast, emotion may cause people to lose track of time, which, in accordance with attentional models of timing, would cause people to perceive time as lasting less. In fact, from the perspective of the internal clock, a distraction from time would either cause the switch to close more slowly (an absolute effect) or more quickly while estimating a duration (a proportional effect), which in both cases would cause the timer to lose pulses and shorten the perceived duration (Lejeune, 1998, 2000; Meck, 1984).

Research has suggested that affective states may shift cognitive mechanisms of attention toward or away from key information (e.g., stimulus duration, bodily states, temporal processing), which may lead to a hastened or slowed perception of time (Hawkins & Tedford, 1976).

CHAPTER 2

2.1 Motivation for the Present Study

In a bisection task, the one used by Droit-Volet et al. (2016) with neutral and angry facial expressions, the influence of stimulus properties (emotion) on temporal perception was used. However, whether the task-related properties can modulate temporal processing needs to be clarified. Another aspect we wanted to explore was that they took different levels of task conditions and compared them, even though the durations had different PSE points, so how they reach the conclusion of their study was an interesting aspect and to see if the results are still valid if we change the task conditions with similar PSE point was of interest.

Therefore, we formulated that if stimulus properties would always affect temporal perception, we would observe the differential effect of emotion on different task conditions (Easy and Difficult). Difficult task conditions will use more attentional resources than easy task conditions. Thus, the question arises will the task conditions affect the processing of the duration of emotional stimuli? Therefore, the present study looks at the influence of emotion on temporal perception across different temporal task conditions (Easy and Difficult). In other words, previous studies have looked at the influence of different stimulus related properties such as emotion, color, magnitude, motion and so on. However, it is still unknown whether the inherent task properties like task-demand (difficult vs easy discrimination) itself affects temporal processing.

2.2 Research Gap

Influence of stimulus properties (emotion, magnitude etc.) on temporal perception have not been studied extensively. However, it is not clear whether the task related properties can modulate temporal processing. Therefore, the present study looks at the influence of emotion on temporal perception across different temporal task conditions (Easy and Difficult).

2.3 Objective

To study the influence of task-difficulty on temporal processing using emotional stimuli.

2.4 Hypothesis

H1: If stimulus properties would always affect the temporal perception, we would not observe the differential effect of emotion on different task conditions (Easy and Difficult).

CHAPTER 3

METHODOLOGY

3.1. Participants

A sample was collected using convenience sampling that consisted of 30 students, 15 Males and 15 Females (mean age=20.72 years). They were all from Thapar Institute of Engineering & Technology, Patiala. All participants were volunteers and signed informed consent to participate in this study.

3.2 Design

The present study employed a within-subject design. The independent variables manipulated were the levels of task difficulty (easy and difficult) and emotions (anger, neutral). The dependent variable of interest was time perception or perceived duration, specifically measured using the point of subjective equality (PSE). The PSE refers to the point at which participants perceive two durations (short and long) as equal in length.

3.3 Material

The participants were individually tested in a quiet room at the university. They were seated 50 cm away from a 17-inch PC screen with a resolution of 1024×768 and a refresh rate of 100 Hz. The presentation of stimuli and data recording were managed using OpenSesame software.

During the training phase 1, a yellow oval stimulus was used, and participants were presented with 10 short and 10 long durations to familiarize themselves with timing. Following this, we moved to the Feedback Phase, which consisted of ten trials to assess the participants' ability to differentiate between long and short durations when stimuli were presented randomly at two different durations. In testing phase 1 and testing phase 2, the temporal stimuli comprised women's faces and men's faces expressing anger and neutrality. These stimuli were selected from The NimStem Set of Facial Expressions database (Tottenham et al., 2009). All stimuli were presented at the center of the screen against a yellow background. Participants indicated their responses by pressing the 'S' and 'L' keys on the keyboard.

Training Phase 1	**Feedback Phase**	**Easy Block**		**Training Phase 2**	**Feedback Phase**	**Difficult Block**
20 trails **Colored Ovals as stimuli**	**20 trials** **Colored Ovals as stimuli**	**120 trials** **Neutral and anger stimuli as faces in ovals**	**B** **R** **E** **A** **K**	**20 trails** **Colored Ovals as stimuli**	**20 trials each** **Colored Ovals as stimuli**	**168 trials** **Neutral and Anger stimuli as faces in ovals**
10 short and 10 long durations	**Presented the two durations randomly**	**Time Durations 100ms, 300ms, 500ms, 700ms, 900ms**	**5 Mins**	**10 short and 10 long durations**	**Presented the two durations randomly**	**Time durations 100ms, 233.3ms, 366.6ms, 500ms, 633.3ms, 766.6ms and 900ms**

These facial expression pictures are taken from the database named The NimStem Set of Facial Expressions (Tottenham et al., 2009)

So, we used two pictures from each gender and randomly presented them to participants to judge the duration of the emotional and neutral pictures.

We use only one male and female picture in each condition to refrain participants developing habituation with the two photographs and lose the emotional content.

3.4 Procedure

The subjects were assigned in an experimental group in which the function of temporal discrimination tasks: (1) Easy , (2) Difficult were given. The respective short and long standard durations were 100 ms and 900 ms for easy and difficult temporal task.The durations for easy task were; 100, 300, 500, 700, 900 ; and 100, 233.3, 366.6, 500, 633.3, 766.6 and 900 for the difficult task condition. Easy condition had 5 time durations set and 7 set of temporal duration for difficult. The current task was a temporal bisection task. Each trial involved an oval shown on the screen the duration of which had to be judged by the participants. The task began with a training phase which was further divided into an observation phase and a feedback phase. The observation phase involved the participants merely observing two anchor durations—one long and one short—and then tested on a range of durations, usually within the range of the anchor durations, and asked to determine whether the comparison stimulus is more similar to the short anchor duration or the long anchor duration.

In the feedback phase participants ‘had to respond indicating if the duration presented was closer to short or long and received “correct” or “incorrect” as feedback. They all were able to understand the task and maintained 90-100% accuracy in the feedback phase.

It consisted of 10 trials. After this phase the testing phase began.

Then there were two experimental conditions- In the first one(easy) the ovals were presented with picture in them of angry and neutral faces for 120 trials for different five set of temporal durations that were set for easy condition(2 emotions on 5 durations for 12 times each).In this the subjects had to give their responses by pressing the ‘S’ and ‘L’ keys on the keyboard to tell which duration is closer to the short anchor duration or the long anchor duration. After this a break was given to participants for 5 mins, and then the training and feedback phase were repeated again. Then the last part of testing, the second condition (difficult) started. The subjects were again presented with ovals that had pictures of angry and neutral faces and consisted of 168 trials (2 emotions on 7 durations for 12 times each). Each picture was shown on seven different temporal durations that were set for the difficult condition. The faces were presented on the computer screen for the duration between S and L for each temporal discrimination task condition. A total of 288 trials were used in this experiment.

CHAPTER 4

RESULTS

The participants provided responses indicating whether they perceived the stimuli as long or short, and this data was collected for analysis. Using the collected data, we calculated the Point of Subjective Equality (PSE) for each condition of the task. The PSE is a point on a psychometric plot where 50% of the times participants perceived the duration to be longer and shorter. The PSE was estimated using a MATLAB toolbox called Psignifit-4. The estimated PSE values were then utilized for subsequent statistical analysis to examine the effects of the experimental conditions.

4.1 Table 1

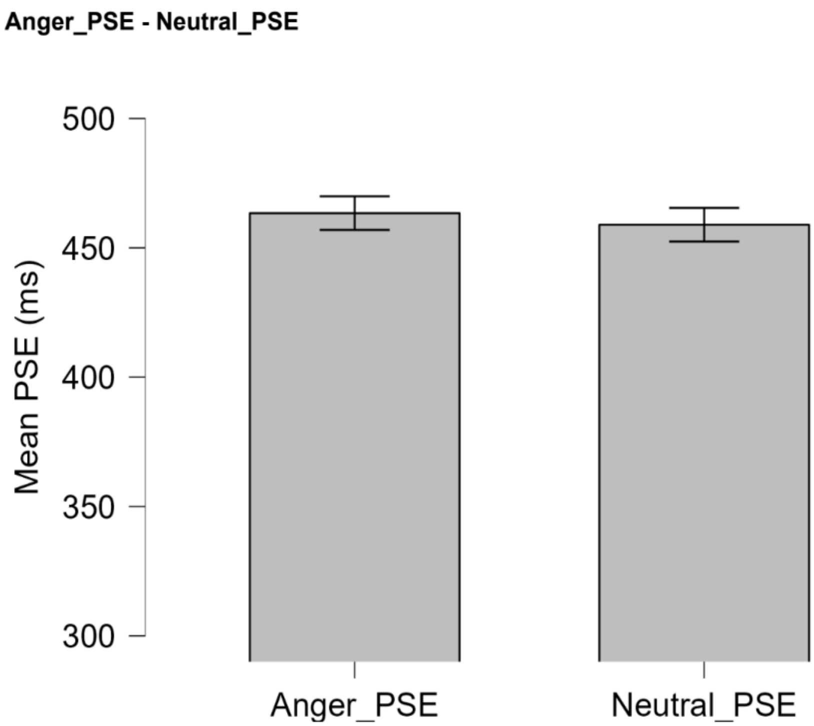
Descriptive Statistics of easy task condition

	N	Mean	SD	SE	Coefficient of variation
Anger_PSE	30	463.405	100.367	18.324	0.217
Neutral_PSE	30	458.933	105.934	19.341	0.231

The above table shows the descriptive statistics for the total number of participants (n=30) in the easy task condition. The mean for PSE Neutral is 458.933ms (105.934) and for PSE Anger is 463.405ms (100.367).

Figure 1

Mean PSE plots for Neutral and Angry faces for easy task condition.



The above figure represents the mean PSE for neutral and angry in easy temporal conditions.

Table 2

Paired t test of PSE of easy temporal task condition

Paired Samples T-Test

Measure 1		Measure 2	t	df	p	Cohen's d	SE Cohen's d
Anger_PSE	-	Neutral_PSE	0.487	29	0.630	0.089	0.089

Note. Student's t-test.

Table 2 shows results of paired t-tests which shows that there is no significant difference in point of subjective equality for neutral and angry emotion in easy conditions.

The paired t test was used to test whether the estimated PSE from the two different emotion condition is different for easy task condition. The P value of the paired t test analysis turns out to be insignificant [t (29) = 0.487, p= 0.630], suggesting that the temporal processing for the different emotional pictures is not different.

Table 3: Descriptive *Statistics of difficult task temporal condition*

Descriptive Statistics

	Anger_PSE	Neutral_PSE
Valid	28	28
Missing	0	0
Mean	469.182	494.907
Std. Deviation	104.062	102.978
Minimum	329.995	345.798
Maximum	703.755	741.060

The above table shows the descriptive statistics for the difficult task condition for the total number of participants (n=28). The mean for PSE Neutral is 494.907ms (102.978) and for PSE Anger is 496.182 ms (104.062).

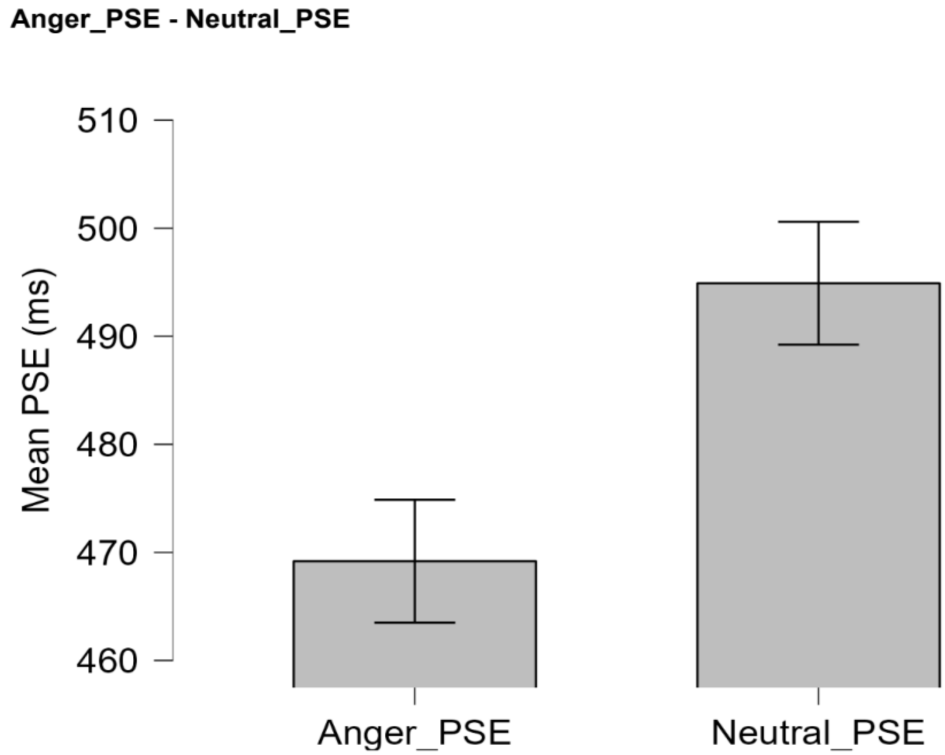


Figure 2: Mean PSE value *for Neutral and Angry faces for difficult task condition:* The figure represents the Mean PSE plot for neutral and angry pictures in difficult task conditions.

Table 4: *Paired t test of PSE of Difficult task condition*

Paired Samples T-Test

Measure 1		Measure 2	t	df	p	Cohen's d	SE Cohen's d
Anger_PSE	-	Neutral_PSE	−3.199	27	0.004	−0.605	0.084

Note. Student's t-test.

To test whether the PSE of the two different emotional stimuli is statistically different, we used paired t test on the estimated PSE. The results of the paired t test suggest the temporal processing difference across the two emotional condition [$t(27) = 3.199$, $p = 0.004$].

CHAPTER 5

DISCUSSION

The objective of this research was to investigate whether stimulus properties consistently influence temporal perception and if the impact of emotion on time perception varies across different task conditions (Easy and Difficult). Our findings suggest that the emotional effect on time perception is observed primarily when the temporal task becomes challenging. This aligns with the notion that individuals can process emotional stimuli effectively only when they have sufficient cognitive resources available (Van Dillen & Koole, 2009; Okon-Singer et al., 2007).

During the difficult task phase, participants tended to overestimate the duration of angry stimuli. This could be attributed to attentional gate mechanisms, where participants allocate more attention to stimuli and require more cognitive resources in challenging situations. The temporal task difficulty influenced our temporal judgments, indicating that task difficulty interferes with our perception of time. In the difficult condition, participants allocated more attention to time, leading to a wider opening of the attentional gate and more pulses from the pacemaker being transferred to the counter.

In the realm of time and emotion studies, our research outcomes offer valuable insights into the interplay between emotion and time perception, particularly in the context of task difficulty and cognitive resources. We discovered that the influence of emotion on time perception is contingent upon the level of difficulty in the temporal task and the cognitive load it imposes.

When participants were engaged in a difficult temporal task that required substantial cognitive resources, we observed a diminished impact of emotion on time perception, specifically for angry stimuli. This suggests that, contrary to expectations, emotion did not enhance the processing of time in a challenging task. The findings indicate that when individuals are faced with a cognitively demanding task, their ability to perceive time accurately is less influenced by emotional stimuli. Interestingly, our findings are in line with a study conducted by S. Droit-Volet et al. (2016) in the field of Timing & Time Perception. In their research, they also observed similar results, where emotional stimuli had a reduced effect on time perception in difficult temporal task conditions among adult participants. These consistent findings across studies underscore the robustness of the relationship between task difficulty, cognitive resources, and the impact of emotion on time perception. Additionally, we found no significant difference in duration judgment between neutral and angry stimuli in the easy task condition. This implies that affectivity (emotion) does not modulate our temporal judgment in an easy task condition. This finding aligns with the study conducted by Gil and Droit-Volet in 2009, which demonstrated that arousal and attention processes are independent yet interconnected. In the easy task condition, participants did not require substantial attention as the task was straightforward and did not demand significant cognitive resources. Previous studies (Eagleman et al., 2005; Karmarkar & Buonomano, 2007; Ivry & Schlerf, 2008) have proposed that various mechanisms are responsible for different durations.

Overall, these findings highlight the intricate dynamics involved in the relationship between emotion and time perception. They suggest that the processing of time can be influenced by various factors, such as task difficulty and cognitive demands, which in turn modulate the effect of emotion on our subjective experience of time. Further exploration of these mechanisms will contribute to a more comprehensive understanding of how emotions and cognitive processes shape our perception of time.

This challenges the current internal clock model and raises questions about how a simple pacemaker system can effectively track and adjust to these diverse times. The effect of emotion on time perception is associated with a mechanism that promotes attentional alertness (early closure of the clock switch) and/or accelerates the internal clock due to increased arousal. The internal clock model remains the most widely accepted theoretical explanation of time (Buhusi & Meck, 2005; Droit-Volet et al., 2007).

CHAPTER 6

CONCLUSION, IMPLICATIONS, LIMITATIONS, AND SCOPE FOR FUTURE RESEARCH

6.1 Conclusion

Based on our study, we discovered that temporal perception is significantly influenced by the temporal task conditions. In our experiment, we implemented two different temporal task conditions while using the same set of emotional stimuli. We found compelling evidence that as the level of task difficulty increased, participants tended to overestimate the duration of angry stimuli compared to neutral stimuli. However, this pattern was not observed in the easy temporal task conditions.

These findings underscore the impact of task difficulty on our perception of time, particularly when emotional stimuli are involved. When faced with a challenging temporal task, individuals tend to allocate more attention and cognitive resources, which can lead to an overestimation of the duration of emotionally arousing stimuli, specifically those associated with anger. Conversely, in easier temporal task conditions where cognitive demands are lower, the influence of emotion on time perception appears to be less pronounced.

Overall, our study highlights the dynamic nature of temporal perception and its susceptibility to variations in task difficulty. It suggests that the interaction between task demands, emotional stimuli, and our perception of time is a complex phenomenon worthy of further investigation.

6.2 Implications

The present research provides valuable insights into the impact of temporal task conditions on our temporal perception, even when presented with the same emotional stimuli. This study represents a unique within-group design, which has not been explored extensively in previous research. By examining the effects of temporal judgment and task conditions on emotions, our study contributes to the existing body of knowledge in this field.

One of the key findings of our research is that cognitive resources play a crucial role in identifying and processing emotions, as demonstrated in our difficult temporal condition. We observed that when the temporal task became more challenging and demanded greater cognitive resources, the influence of emotion on temporal perception was more pronounced. This highlights the intricate interplay between emotions and cognitive processes in shaping our perception of time.

By shedding light on the relationship between temporal judgment, temporal task conditions, and emotions, our work offers a fresh perspective in this domain. It underscores that emotions have an arousing impact, but their recognition and integration into our temporal perception are contingent upon the availability and allocation of cognitive resources. This novel perspective contributes to a deeper understanding of the intricate mechanisms underlying the interaction between emotions and temporal processing.

In summary, our study advances the current knowledge by exploring the effects of temporal task conditions on temporal perception with consistent emotional stimuli. It underscores the role of cognitive resources in identifying and integrating emotions, particularly in challenging temporal contexts. These findings broaden our understanding of how emotions and cognitive processes interact in shaping our subjective experience of time.

6.3 Limitations

Several limitations should be taken into consideration when interpreting the findings of the present study. Firstly, the sample used in this study was obtained through convenience sampling, which may limit the generalizability of the results. The participants were predominantly drawn from the university population, and therefore, caution should be exercised when extending the findings to a broader population.

Secondly, another limitation of our study is the relatively small sample size. A small sample size can restrict the statistical power and limit the generalizability of the findings. Therefore, it is important to replicate this study with a larger and more diverse sample to validate the results and enhance their robustness.

These limitations highlight the need for further research in this area. Future studies should aim to overcome the limitations by employing more representative sampling methods and increasing the sample size. Additionally, exploring the effects of temporal task conditions and emotions across different populations and contexts would provide a more comprehensive understanding of the phenomenon. By addressing these limitations and expanding the research scope, a more comprehensive body of knowledge can be developed in this field.

6.4 Scope for Future Research

In this study, we examined the impact of two temporal task conditions on our ability to predict time. However, there is still a need for further investigations to gain a deeper understanding of how emotions influence time perception in different task conditions. Future studies could explore different duration ranges (sub vs supra second) or employ alternative tasks to expand our knowledge in this area.

Additionally, it would be beneficial for future research to consider alternative study designs such as discrimination tasks. While our study utilized a within-group design, employing a between-subject design in subsequent studies could provide valuable insights by comparing different individuals' responses to temporal task conditions and emotions.

By conducting future research with diverse designs and exploring various aspects of time perception, we can advance our understanding of the intricate relationship between emotions and the perception of time. This will contribute to a more comprehensive and nuanced comprehension of this fascinating phenomenon.

REFERENCES

Lake, J. I., LaBar, K. S., & Meck, W. H. (2016). Emotional modulation of interval timing and time perception. *Neuroscience & Biobehavioral Reviews, 64,* 403–420. https://doi.org/10.1016/j.neubiorev.2016.03.003

Gable, P. A., Wilhelm, A. L., & Poole, B. D. (2022). How Does Emotion Influence Time Perception? A Review of Evidence Linking Emotional Motivation and Time Processing. *Frontiers in Psychology, 13.* https://doi.org/10.3389/fpsyg.2022.848154

Droit-Volet, S., & Gil, S. (2009). The time–emotion paradox. *Philosophical Transactions of the Royal Society B: Biological Sciences, 364(1525),* 1943–1953. https://doi.org/10.1098/rstb.2009.0013

Droit-Volet, S., & Meck, W. H. (2007). How emotions colour our perception of time. *Trends in Cognitive Sciences, 11(12),* 504–513. https://doi.org/10.1016/j.tics.2007.09.008

Droit-Volet, S., Fayolle, S., & Gil, S. (2016). Emotion and Time Perception in Children and Adults: The Effect of Task Difficulty. *Timing & Time Perception, 4(1),* 7–29. https://doi.org/10.1163/22134468-03002055

Noulhiane, M., Mella, N., Samson, S., Ragot, R., & Pouthas, V. (2007). How emotional auditory stimuli modulate time perception. *Emotion, 7(4),* 697–704. https://doi.org/10.1037/1528-3542.7.4.697

Tipples, J. (2008). Negative emotionality influences the effects of emotion on time perception. *Emotion, 8(1),* 127–131. https://doi.org/10.1037/1528-3542.8.1.127

Noulhiane, M., Mella, N., Samson, S., Ragot, R., & Pouthas, V. (2007b). How emotional auditory stimuli modulate time perception. *Emotion, 7(4),* 697–704. https://doi.org/10.1037/1528-3542.7.4.697

Gil, S., Rousset, S., & Droit-Volet, S. (2009). How liked and disliked foods affect time perception. *Emotion, 9(4),* 457–463. https://doi.org/10.1037/a0015751