© Journal of the Indian Academy of Applied Psychology
Jan 2022, Vol. 48, No. 1, 144 - 150

Effect of Arousal and Cerebral Preference on Time Estimation

Triveni S.
Karnatak University, Dharwad

The present experiment is conducted to study the effect of different levels of arousal and the role of cerebral preference on time estimation. The arousal level is manipulated by exposing pictures which can arouse at different levels in the sample which consist of 74 post graduate students (34 are male and 40 females) who were willing to participate in the experiment and met the inclusion criteria. Three levels of arousal i.e- neutral , moderate and high state were manipulated with two pictures each. The pictures were displayed in two durations of exposure - for 60 seconds and 120 seconds and participants were instructed to estimate the time followed by responding to Wagner's preference inventory form II (WAPI-II; 1985) which was used to assess the hemispherical preference of the participants. The data was subjected to descriptive statistics, repeated measures ANOVA, independent sample t test. The obtained results reveals a significant effect of arousal and gender on time estimation under two durations of exposure. The participants have significantly overestimated the time under all the three levels of arousal. Between subject effects for gender is also significant under both the conditions. Female participants have significantly overestimated compared to male participants in all the three levels of arousal. The results of t test reveals insignificant difference in estimation of time by right preferred and left preferred in both the conditions. Accurate estimation of time facilitates time management and hassle free activities in one's life. Hence the present findings contribute significantly to the knowledge resource.

Keywords: Arousal, Cerebral preference, Time estimation, Time Perception

Time perception refers to a person's subjective experience of the passage of time, or the perceived duration of events, which can differ significantly between different individual and/ or in different circumstances. Time perception is conceptualized in two ways as Succession and duration by Paul Fraisse (1984), he referred the experience of change from one event to another i.e present becoming past -as *Succession*. Whereas the interval between the two successive events as *duration*. Estimation of time is done in prospective (the subject estimates the intended duration before the exposure) or retrospective (after the intended duration has elapsed). The cognitive model (Block, 1990) suggest that in prospective time estimation the opening of the attentional gate is responsible for time perception whereas in retrospective estimation - cognitive load of the amount of information processed by the subject during the period leads to the impression of time span. Measuring judgement of the time involves subjects to judge the duration of presented stimulus by comparing to the standard stimulus as to whether the stimulus is 'shorter' or 'longer' than the standard one. Estimation of time involves subjects to report the perceived time of the event using a button press or reproduce the same duration on a devise (Wittmann,1999).

Time perception and Emotions: Dienstbier in 1989 and Hoehn-Saric and McLeod, in 2000 found that individuals with social anxiety experience a high level of arousal in social situations due to fear of negative evaluation from others. Angrilli et al. (1997) proposed that emotional stimuli exert different effects on the judgement of time according to the arousing and emotional aspect of stimuli and suggested that the effect of arousal on time perception is modulated by the valence of the stimulus. Studies have suggested that affective states and arousal levels can influence the way we perceive passed time. Relating to the common phrase "time flies when you're having fun", numerous studies have

shown that stimuli evoking positive affective states result in decrease of perceived time when compared to negative affective states. With decreased temporal processing, misperception can result in both under and overestimations of time, depending on the content of the non-temporal information to which attention is focused. Study by Brunot, and Niedenthal (2004) showed that pictures of faces expressing emotion were judged to be of longer duration than neutral ones, supporting activation-based models of time perception. Gil and Droit-Volet (2012) found that viewing negative emotional pictures lengthened perceived time duration when compared to neutral photos, and this effect increased with the emotion's arousal level in the picture. In the study by Noulhiane et al. (2007) Negative sounds were judged to be longer than positive ones, indicating that negative stimuli generate a greater increase of activation. High-arousing stimuli were perceived to be shorter than low-arousing ones. They attribute it to decreased amount of attention devoted to time for underestimation of time, consistent with attentional models of timing.

Time Perception and brain: Studies have revealed the role of brain function involved in time perception, Lateral cerebellar hemispheres is found to have a wide participation on time perception (Rubia K, Smith A. 2004). Eagleman D.M. (2008) observed assumed that the human brain possess some kind of "internal clock" , distinct from biological or circadian clock or several clocks working together but independently that may dictate our time perception depending on the particular. Gooch et al. (2011) conducted a study with patients who had cerebellar lesions and observed a biggest effect on activities related to milliseconds. Their findings suggested the damage on left hemisphere represents changes on perception of milliseconds and minutes of perceptual tasks (Ivry and Spencer 2004). To evoke memory, time perception is essential in the processing of sequential events and includes the participation of the hippocampus for organization and recruitment of episodic memory (Eichenbaum H. 2014). The frontal cortex is associated with temporal information processing in short term and long term memory (Genovesio A. et al.2009), especially in allocation of attention for the tasks that are done and to be done (prospective memory) that is when time perception is triggered for accurate estimation of time (McFarland CP et. al 2009). Fontes, R. et al (2016) Concluded from their review that the theories of time perception and its modeling support the existence of multiple clocks, but the minute functionality of the brain in time perception is still needs to be studied. The present study is an attempt to see if the level of arousal has any effect on time estimation and also the role of cerebral preference in accuracy of time estimation i.e whether right preferred individuals are accurate or left preferred in estimating time. The common complaint people have about women that 'women have poor time sense' is put to test experimentally.

Objectives:

1. To study the effect of different levels of arousal on Time perception
2. To see the role of cerebral preference in time perception

Problem:

1. Do different levels of arousal have differential effect on Time perception?
2. What is the role of cerebral preference in time perception?

Hypothesis:

1. Ha1: High arousal state facilitate underestimation of time whereas low arousal state tend to overestimate
2. Ha2 : There could be significant gender difference in estimation of time
3. Ha3 There could be significant difference in estimation of time between Right brain dominant and Left brain dominant individuals

Method

Design:

Single group experimental design is followed where in Arousal and cerebral dominance are independent variables. Arousal is manipulated at three levels, cerebral dominance in two categories i.e. Right and left. Time perception in

terms of estimation of duration at two exposure periods are considered as dependant variables.

1. V- 1. Arousal - 3 levels -1. Low 2. Moderate 3.High

2. Cerebral Preference - 1. Left dominant 2. Right Dominant

D.V. 1 Time estimation -

1. Exposure for 60 seconds
2. Exposure for 120 seconds

Tools:

1. Pictures for Arousal levels: Arousal levels were manipulated by pictorial presentation of the stimuli through Power Point Show. The pictures were selected from internet search with key words- high arousing, moderate arousing and low arousing pictures. 21 pictures of neutral emotions were shortlisted and given to experts to rate on 3 levels of arousal. Based on the ratings, top 2 ranked pictures in each level of arousal were retained from the pool of pictures. Two pictures which do not arouse were selected for low arousal conditions (Parrot and Child) two for moderate arousal (Military camp and Guard of honor) and two for High arousal (dancing peacock and pastry). A rating was obtained from the participants to ensure that the pictures indeed arouse them. A 20 minutes power point show was prepared in MS office software, to display the selected pictures set for each picture 60 seconds (3 pictures of Parrot, Military camp and Pasrty) and 120 seconds (3 pictures of Child, Guard of honor and dancing Peacock) exposure which was arranged in counter balanced (for ordinal effect) ABBA sequence. One minute gap was given between each picture for estimating time where only instructions were presented on slides. one minute break was given before the next exposure for the participants to be ready.

2. Time Perception Task: Participants were instructed to switch off their mobile phones and remove their watch till the experiment is over. Care was taken that time is not displayed anywhere in the room while conducting the experiment. Without giving any clue about the time the participants were asked to estimate the exposure time of the picture presented on screen using PPS . Then immediately after the picture was disappeared, they were supposed to write in a sheet provided - the time they think the picture was displayed on screen. At each level of arousal participants were expected to estimate time twice i.e. Once for 60 seconds of exposure period and second for 120 seconds of exposure period. In all they estimated 6 times.

3. Wagner preference inventory Form: II (1985): (WAPI: II,) developed by Wagner & wells (1985) which assess neuro-behavioral left/right dominance which is divided into 2 sub categories i.e. Left – Logical and Verbal, Right – Manipulative and Creative.. It consist 12 items with 4 response options in each that reflect right and left brain activity. The participants has to choose only one -the most preferred- activity among the 4 options. The score ranging from 0 to 12 for right or left dominance. The score of 6 each indicates balanced, higher score towards left indicate left dominance and towards right indicate right dominance.

Participants:

Convenient sampling procedure is followed to select participants for this expeiriment. P.G students studying in Karnatak University Dharwad in the dept. of Psychology and open elective students from other subjects were encouraged to participate in the experiment after a brief introduction about the objective of the experiment. Informed consent was sought. Only those who were willing to participate in the Experiment were selected. The data was retained following the inclusion criteria -

Inclusion criteria:

1. Healthy subjects who were not on any medication
2. Those who slept well the previous night
3. Those who do not consume alcohol or any other drugs

Exclusion Criteria:

1. Those who are Having health problems and on any medication
2. Who were deprived of sleep
3. Those who were bothered about any emotional issues

4. Those who consume caffeine more than 5 cups per day
5. Those who consume alcohol
6. Those who used physical measure of time during the experiment.

Data Collection:

After introducing the objective of the experiment, the participants were given time to decide if they are willing to participate in the experiment. Those who responded positively were given consent form and Bio-data sheets. The experiment was conducted in four separate sessions with 15 -20 participants in each. The pre planned Power Point Show was shown and responses were obtained. The time estimation tasks were recorded in a separate sheet provided at each condition of arousal. WAPI-II was administered after the time estimation task. The purpose of the experiment was debriefed and assured of sharing the report if they were interested.

Analysis of Data:

The obtained responses were scrutinized and entered in to SPSS-20 for statistical analysis. Descriptive statistics are worked out for all the variables. Ha1 and Ha2 were tested with two -way ANOVA Repeated measures. Ha 3 was tested through independent sample t test.

Results

Time estimation under three levels of Arousal: The results shows that in 3 levels of arousal mean estimated time by the participants is more than the actual time, indicating over estimation. We can note that though in all the three conditions participants have overestimated the time, the maximum is observed under moderate arousal condition and under low arousal condition minimum estimation is seen.

Table 1. Mean time estimated under three conditions of arousal (N=74)

Arousal level	Exposure time 60 sec		Exposure time 120 sec	
	Mean	SD	Mean	SD
Low arousal	78.56	58.45	150.10	101.0
Moderate arousal	107.19	78.19	159.81	84.89
High arousal	87.39	53.15	149.21	94.3

Effect of Arousal on Time estimation: The obtained results from repeated measures ANOVA reveal that under 60 seconds exposure the obtained F ratio for the main effect of arousal and gender together have yielded a F- Ratio of 162.15 (P= 0.001) indicating a significant effect of arousal and gender on time estimation. The mean time estimated under neutral condition is by male participants is 58.22 seconds whereas females estimated as 117.12 seconds. Under moderate level of arousal the mean time estimated by male is 84.14 seconds and by female it is 125.95 seconds. Under high level of arousal the mean time estimated by male is 76.11 and by females it is 97.55 seconds. The maximum overestimation is seen in moderate level of arousal. The F- ratio obtained for Gender alone is 7.94 (P=0.006) which indicate that the effect of arousal is differing for male and female participants in estimating time. Under 120 seconds exposure condition the obtained F ratio for main effect of arousal and gender together is 266.36 (P= 0.00) The mean time estimated is 157.78 seconds under moderate level of arousal followed by 155.91 seconds under neutral arousal and 148.08 seconds under high arousal condition.

Gender difference in estimation of time: Under 60 seconds exposure condition between subject effects shows that F-ratio for gender alone is 7.93 (p=0.006).Female participants have significantly overestimated (mean=114.20 seconds) compared to male participants (mean=72.82) in all the three levels of arousal. Under 120 seconds exposure the obtained F ratio for gender alone is 9.56 (P=003) is highly significant, that means to say there is a significant difference between male (mean 124.771 seconds) and female (mean 183.083 seconds) participants in estimation of time.

Cerebral preference and Time estimation: out of 76 participants 33 are right dominant (15 male, 18 female), 29 left dominant (16 male and 13 female) and 14 participants are balanced (5 male and 9 female). Only the right and left

Table 2 : Time estimated in two conditions of exposure by Right and Left Dominant subjects.

Condition	Group	N	Mean	SD	t- Value	Significance
Exposure 60 sec	Right preferred	33	104.27	66.34	-.046	0.96
	Left preferred	29	105.24	95.88		
Exposure 120sec	Right preferred	33	143.1	78.45	-.683	0.49
	Left preferred	29	157.45	86.36		

dominant are compared for their time estimation by computing independent sample t test. The results of t test reveals insignificant difference between right preferred and left preferred participants in estimating time in both 60 second exposure and 120 second exposure conditions.

Discussions

The aim of the present experiment is to find out the effect of different level of arousal , gender and cerebral dominance on time estimation.

Effect of arousal on time estimation: The results reveal a significant effect of arousal and gender on time estimation. Though time is overestimated in all the three levels of arousal the highest is seen in moderate level condition followed by high arousal and low arousal condition. The arousal level in the present experiment is restricted to neutral emotion as the earlier studies clearly indicate the effect of positive and negative emotions on time estimation (Brunot, and Niedenthal (2004), Gil and Droit-Volet (2012)) Consistent with the arousal based time perception overestimation increases with the duration of the emotional state. Since the present experiment used only neutral emotions like patriotism, temptation and affection were chosen to manifest arousal through pictures, the effect of positive or negative emotions are ruled out and can be solely attributed to the state of arousal. However, it couldn't be ensured the internal state of the participants during the experiment through physical measures rather its dependent on self report of the participants. Hence Ha1 that is high arousal state facilitate underestimation of time whereas low arousal state tend to overestimate time- is rejected as the participants have overestimated in all the three conditions of arousal

Effect of Gender: Female participants have significantly overestimated compared to male participants in all the three levels of arousal. Since the retrospective time estimation is considered the exposed duration of the pictures had minimal attentional load, that might have led to overestimation for male participants whereas for female participants paying attention on one thing requires minimal attentional load as they are usually engaged in many activities simultaneously or multi tasking, where their attention will be distributed over several tasks. As one of the participants expressed during debriefing after experiment that since she was doing no other activity than observing picture she felt that the exposed time is really long. Thus the effect of arousal is more prominent for female than for males in estimating time. This finding reconfirms the outcome of the famous study by Loftus E.F. (1987). What makes females overestimate time is still not clear. Ha2 there will be significant gender difference in estimation of time irrespective of the arousal level –is accepted.

Cerebral preference and Time perception: The results of t test reveals insignificant difference between right preferred and left preferred participants in estimating time in both 60 second exposure and 120 second exposure conditions. Hence, Ha3 is rejected. Though, earlier studies have tried to understand the various parts of the brain involved in time perception, clear cut distinction of whether it is right brain process or left brain is not known. However, the role of neurotransmitters dopamine is seen in the study by Eagleman D.M. (2008) which are spread throughout the brain. Ivry and Spencer (2004) noted the role of cerebellum and right hemisphere in time perception in patients, however the precise responses couldn't be elicited in the behavioral self report measures used with the normal subjects in the present

experiment. It is possible that time estimation is not a preferred activity for either right or left dominant individuals in the present study. Most participants reported that they are not really aware of the time they spend on specific activities.

Conclusions

Arousal level have an effect on time estimation of the participants in one direction. Participants have overestimated time in all the three conditions though the difference in overestimation is significant. Females significantly highly overestimated time compared to their male counterparts. Cerebral preference has no role in estimation of time. Limitation: The duration of how long the state of arousal last for each participant could not be measured. It is solely dependent on self reported data.

Implication and Suggestions:

Time perception is an important cognitive function which is key for planning, prioritizing and organizing ones activities. Being aware of the time spent on a particular activity enables accurate estimation of time for various activities in our day to day life which is crucial for planning, organizing, sequencing and goal setting which can be practiced consciously. Accurate estimation of time facilitates time management and hassle free activities in one's life. Hence the present findings contribute significantly to the knowledge resource as there is dearth of systematic research on time perception in the recent years. More such research is required to help people understand the cognitive mechanism involved in time perception, the factors affecting it as well as its importance in time management.

References

Angrilli, A., Cherubini, P., Pavese, A., & Manfredini, S. (1997). The influence of affective factors on time perception. *Perception & Psychophysics, 59,* 972–982.

Droit-Volet, S., Brunot, S., & Niedenthal, P. M. (2004). Perception of the duration of emotional events. *Cognition and Emotion, 18*(6), 849–858. https://doi.org/10.1080/02699930341000194

Eagleman D. M. (2008). Human time perception and its illusions. *Current opinion in neurobiology, 18*(2), 131–136. https://doi.org/10.1016/j.conb.2008.06.002)

Eichenbaum H. (2014). Time cells in the hippocampus: a new dimension for mapping memories. Nature reviews. *Neuroscience, 15*(11), 732–744. https://doi.org/10.1038/nrn3827

Fontes, R., Ribeiro, J., Gupta, D. S., Machado, D., Lopes-Júnior, F., Magalhães, F., Bastos, V. H., Rocha,

K., Marinho, V., Lima, G., Velasques, B., Ribeiro, P., Orsini, M., Pessoa, B., Leite, M. A., & Teixeira, S. (2016). Time Perception Mechanisms at Central Nervous System. *Neurology international, 8*(1), 5939. https://doi.org/10.4081/ni.2016.5939

Genovesio, A., Tsujimoto, S., & Wise, S. P. (2009). Feature- and order-based timing representations in the frontal cortex. *Neuron, 63*(2), 254–266. https://doi.org/10.1016/j.neuron.2009.06.018

Gil, S., & Droit-Volet, S. (2012). Emotional time distortions: the fundamental role of arousal. *Cognition & emotion, 26*(5), 847–862. https://doi.org/10.1080/02699931.2011.625401

Gooch, C.M., Wiener, M., Hamilton, A.C., & Coslett, H. B. (2011). Temporal discrimination of sub- and suprasecond time intervals: A voxel-based lesion mapping analysis. *Frontiers in Integrative Neuroscience, 5,* Article 59. https://doi.org/10.3389/fnint.2011.00059

Ichikawa, M., & Miyoshi, M. (2020). Perceived Duration Depends Upon Target Detection in Rapid Serial Visual Presentation Sequence. *i-Perception, 11*(6), https://doi.org/10.1177/2041669520981996

Ivry, R. B., & Spencer, R. M. (2004). The neural representation of time. *Current opinion in neurobiology, 14*(2), 225–232. https://doi.org/10.1016/j.conb.2004.03.013

Jones ,Catherine R. G. , Lambrechts Anna, Gaigg Sebastian B. (2017) Using Time Perception to Explore Implicit Sensitivity to Emotional Stimuli in Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders, 47*(7), 2054–2066. https://doi.org/10.1007/s10803-017-3120-6

Loftus, E.F., Schooler, J.W., Boone, S.M., & Kline, D.W. (1987). Time went by so slowly: overestimation of event duration by males and females. *Applied Cognitive Psychology, 1*, 3-13. January/March https://doi.org/10.1002/acp.2350010103

Marinho, V., Lima, G., Velasques, B., Ribeiro, P., Orsini, M., Pessoa, B., Leite, M. A., & Teixeira, S. (2016). Time Perception Mechanisms at Central Nervous System. *Neurology international, 8*(1), 5939. https://doi.org/10.4081/ni.2016.5939

McFarland, C. P., & Glisky, E. L. (2009). Frontal lobe involvement in a task of time-based prospective memory. *Neuropsychologia, 47*(7),1660–1669. https://doi.org/10.1016/j.neuropsychologia.2009.02.023

Paul Fraisse (1984), Perception and Estimation of Time, *Annual Review of Psychology , 35*:1, 1-37

Rubia, K., & Smith, A. (2004). The neural correlates of cognitive time management: a review. *Acta neurobiologiae experimentalis, 64*(3), 329–340.

Wagner, Rudolph F. & Wells, Kelly A. (1985). A Refined Neurobehavioral Inventory of Hemispheric preference. *Journal of Clinical Psychology; 41*(5, 671–676

Watts, F. N., & Sharrock, R. (1984). Fear and time estimation. *Perceptual and Motor Skills, 59*(2), 597-598. https://doi.org/10.2466/pms.1984.59.2.597

Wearden J. H., Todd N.P.M. and Jones L.A. (2006) When Do Auditory/Visual Differences in Duration Judgements Occur? *The Quarterly Journal of Experimental Psychology, 59* (10), 1709 –1724 DOI:10.1080/17470210500314729

Wittmann Mark (1999) Time Perception and Temporal Processing Levels of the Brain. *Chronobiology International 16*(1):17-32 DOI:10.3109/07420529908998709

Triveni S. Ph.D.,P.G.D.Y.S. Assistant professor, Dept. of Psychology, Karnatak University Dharwad-580003. Email: trivenis@kud.ac.in