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Research Paper

Effect of Tunneling and Broadening of Frequency on Ability of Unfilled Time Judgment

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ABSTRACT

The present study examined the effect of tunneling and broadening of frequency on ability of unfilled time judgment. Twenty male post graduate students were participated, it was asked to estimate the time of tone which was randomly presented to the participants with different frequency. The stimuli in this experiment were basically a series of consecutive two stimuli of the same sound / intensity [Control Condition 440Hz-440Hz]. The stimuli were presented in low to high intensity in Experimental Condition One [220Hz-660Hz] and high to low frequency in Experimental Condition Two [660Hz-220Hz].The underestimation of time has occurred more in the Control Condition than the other two Experimental Conditions. But the underestimation of time has occurred accurately in Experimental Condition Two than Experimental Condition One. The tunneling effect has affected more on time estimation than the broadening effect of the participants.

Keywords: *Tunneling and Broadening, Ability, Unfilled Time Judgment.*

Time perception is a field of study within psychology, cognitive linguistics and neuroscience that refers to the subjective experience, or sense, of time, which is measured by someone's own perception of the duration of the indefinite and unfolding of events. The perceived time interval between two successive events is referred to as perceived duration. Time perception is a construction of the sapient brain, but one that is manipulable and distortable under certain circumstances. These temporal illusions help to expose the underlying neural mechanisms of time perception. Fraisse (1963) sets up certain definitional boundaries for the area of perception of unfilled time: So far we have dealt with intervals between successive stimuli; these are usually known as unfilled duration. If a sound continues for some time we cannot perceive its duration unless the end succeeds the beginning quickly enough to demarcate one unit of perception. The temporal limits of this perception are the

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same as in the case of unfilled intervals: 1.5 to 2 sec. If a sound continues longer than this, there is no organized succession and in the end we reach the point where we perceive no change. In experimental psychology, the tunnel effect is the perception as a single object moving beyond an occluding object and then reappearing after a suitable amount of time on the other side of it. This phenomenon has been studied by Burke (1952), who discovered that the optimal amount of time for giving the impression of a single object is shorter than what is actually needed to cross the occlusion at that speed. The "tunnel effect", when talking about long stretches of road, refers to the environment surrounding the driver that begins to merge towards the central point of the horizon. This effect can be noted at high speeds, when driving on straight smooth roads. The effect is amplified if the environment surrounding is monotonous. The "tunneling effect" can cause nausea, confusion to drivers as well as letting fatigue settle in at a higher rate, making it one major cause in sleep related accidents. Broadening is the process by which the meaning of a tone becomes broader than the other tone. Duration discrimination performance is sensitive to some aspects of the stimulus ensemble. The result clearly show that a qualitative change in how the stimuli are perceived changes duration discrimination performance(Woods.DD,1979).In this study a more simple form of the tunneling effect has been used where the pitch of the two beats of an unfilled time span has been narrowed from 660Hz to 220Hz. A more simple form of broadening effect has been used where the pitch of the two beats of an unfilled time span has been broadened from 220Hz-660Hz. The fixed effect has been used where the pitch of the two beats of an unfilled time span has been fixed from 4400Hz to 440Hz. From several studies, it has been known the mapping of frequencies to pitches is frequently regarded to be trivial, assuming the mid frequencies of the pitches to be tuned with reference to a standardized tuning frequency of 440Hz for the pitch A4. The correct classification rate increased from 70.8% at a fixed tuning frequency of 440Hz to 76.9% with adaptive tuning frequency estimation. Its frequency, the tuning frequency, is standardized internationally to 440Hz (Lerch.A, 2006). An individual sound produced by speech or a single musical tone consists of a fundamental and many harmonics, and the pitch of such everyday sounds is often the frequency of the fundamental like striking the middle A on a piano keyboard that is tuned to standard concert tuning produces a complex of harmonics with a fundamental frequency of 440 Hz, which is this note's pitch (Yost.W.A, 2009).

METHODOLOGY

Hypotheses

Ho = There is no effect of tunneling or broadening of stimulus frequency on unfilled time judgment.

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Plan of the experiment

This was a small scale experiment with a sample size of 20.All the participants of this experiment were male, have a graduate degree and currently pursuing Post- graduate education. Participants were taken from the Department of Sanskrit, Department of Statistics,

Department of Journalism, and Department of Mathematics in West Bengal State University. The subjects had no marked hearing deficits and were assumed to have a normal attention span. In the present experiment the type of sampling SED is Purposive Sampling as the participants in this experiment all are handpicked and it is believed that the sample is truly represent the population. Types of variables which used in this experiment were participants' response as a dependent variable, tone as an independent variable and time as a continuous variable.

Designs of the experiment

This experiment was conducted using a Within Group Design, Where all the participants belonged to the same group and all levels of the experiment were conducted on all of them.

Control Condition	Experimental Condition One	Experimental Condition Two
440Hz-440Hz	220Hz-660Hz	660Hz-220Hz

The participants used estimation method of time unfilled judgment / estimation.

The stimuli in this experiment (Control Condition) were basically a series of consecutive two stimuli of the same sound / intensity [440Hz-440Hz]. In (Experimental Condition-One) the stimuli were presented in different intensity, low to high [220Hz-660Hz] and in (Experimental Condition -Two) the stimuli were also presented in different intensity, that was high to low [660Hz-220Hz].

Procedure

The experiment was a group experiment but the data were taken from each subject individually. A comfortable place was chosen and tried to minimize the other effects (Noise, Temperature, and Illumination) as much as possible. The subject was seated in a desk and an earphone was given to the subject. At first a few tones were presented to the subject with saying what was the actual time (in terms of milliseconds) of the tone. It was instructed to the subject to estimate the time in between 20-200 milliseconds. After that, for better performance few trials were taken before going to the final data that was the Practice Set. Then another set of tones with normal effect were presented to the subject that was the Control Condition (440Hz-440Hz) and instructed in a same way to perceive the tone and give judgment by himself. After that another set of tones were presented to the subject with the broadening effect that was the Experimental Condition One (220Hz-660Hz) and other was a set of tones with tunneling effect that was the Experimental Condition Two (660Hz-220Hz). In both cases instructions were same to the subject to estimate the time of the tone in milliseconds. After collecting the data Standard Error of the Constant Error was calculated to get the results of the experiment.

RESULTS AND DISCUSSION

From the result, it can be seen that there is a significant difference between the Control Condition, Experimental Condition One and Experimental Condition Two. The C.E of

Control Condition, and Experimental Condition One and Experimental Condition Two are 0.33, 0.29 and 0.72 respectively. So, there is an explanation that the deviation has occurred more in Experimental Condition Two and less in Experimental Condition One than Control Condition. But the Standard Error of Constant Error is more in Control Condition than Experimental Condition One and less in Control Condition than Experimental Condition Two. From the score of Median, It can be seen that all the three conditions are in underestimation. The underestimation of time has occurred more in the Control Condition than the other two Experimental Conditions. But the underestimation of time has occurred accurately in Experimental Condition Two than Experimental Condition One. The Repeated Measure ANOVA was conducted to compare the effect of tunneling and broadening of frequency of tone on unfilled time judgment in Control Condition, Experimental Condition One and Experimental Condition Two. Table: 2 contains the result of Repeated Measure ANOVA of data collected in an experiment with one within-subjects factor with T = 3 repeated measurements of n = 20 participants. For instance, if examining the effect tunneling and broadening of frequency of tone on unfilled time judgment, , this data structure is similar to collecting a measure of the time judgment for 20 different individuals over 3 relevant intervals of conditions (i.e., Control Condition, Experimental Condition One and Experimental Condition Two). The p value is calculated as the area beyond F =2.17 in an F distribution with T – 1 = 2 and (n – 1) (T – 1) degrees of freedom, apparently indicating no significant effect of broadening and tunneling of frequency of tone (p = 0.05). The significant value for alpha= 0.05 level is 3.2317, so it can be said that the null hypothesis has been accepted. In other words, there is no significant difference within the subjects. It has been seen if there is any significant effect of tunneling and broadening on the change of frequency of tone of unfilled time judgment. After responding to the practice data, the participants were asked to respond to the final data. As the stimulus were presented randomly and with different frequency. It may become little difficult for the participants to match the actual time of the stimulus with their notion of time. The notion of time to an individual is dependent on the pace of subjective time, which surely differs from that of objective time, and different stimulus types or conditions surely alter the pace of subjective time further. (García-Pérez.MA, 2004). The role of internal clock within the individual to respond properly to the given stimulus is important. Internal clock plays an important role in judgment of time perception but the representation of time is easily distorted by the context such as emotional state and the activity of others (Teki S et. al, 2011). The internal clock is basically based on subjectivity not the objectivity. A subject perceives time subjectively and that involves the participation of internal clock to measure the objective time without the external stimuli (Meck W et. al, 2004). In terms of an individual's estimation of a given time period the role of the prefrontal cortex relates to the storage and recovery of memory (Coull.JT et. al, 2011). Some other brain regions the pre supplementary motor area, the anterior cingulate cortex, the right inferior frontal gyrus (homolog to Broca's area), the bilateral premotor cortex, and the right caudate nucleus are involved in duration estimation which supports different aspects of processes like clock mechanism, decision and response-related processes and maintenance of temporal information (Pouthas.V et. al, 2005).There could be an effect of attention during listening to the stimulus and to perceive the exactness of the time. To produce an accurate

judgment of time, one has to pay intense attention to the stimulus to be perceived. There is a relation between the frontal lobe and the prospective memory activation which can predict and monitor the exactness of the time estimation (McFarland CP, 2009). The two parts of frontal lobe has significance in perception of time, the activity of the right frontal lobe ceases when task duration is memorized, while frontal left activity helps to maintain attention until this point (Pfeuty.M, 2003). For a task like perception, the less attention is paid to task, the greater the reduction in subjective time perception (Block RA et. al, 2014). The related brain regions of these functions may have affected by the external stimuli than the actual stimuli, that's why there could be an attention issue to perceive the stimulus properly. And also in a perception task, less the attention is paid to the task, the subjective time perception is greatly reduced. We have examined randomly organized stimulus which contains shorter to longer range of milliseconds (20-200miliseconds). The millisecond range, timing of intervals lasting one second or longer appears consistent with mechanisms that generate a linear metric of time (Karmakar.UR, 2007).As the stimulus were in milliseconds, there are specific brain regions which are important for the activities related to milliseconds. The impairment on left hemisphere represents changes on perception of milliseconds (Ivry RB et al, 2011). To assess millisecond time intervals, the cerebellum can be considered as an internal timing system (Koch.G et. al, 2007). The representation of time depends on the integration of multiple neural systems, in the range of milliseconds to minutes the interval of timing is affected in a variety of neurological and psychiatric populations which involves disruption of the frontal cortex, hippocampus, basal ganglia, and cerebellum. The distortions in timing and time perception must be aided by the analysis of the sources of variance attributable to clock, memory, decision, and motor-control processes (Meck.WH, 2004).As the task was on the effect of frequency of tone, there is an effect of frequency in the brain regions which clearly demonstrates what happens when we listen to tones with different frequencies and what effect does it cause to produce an exact response. The effect of low and high frequency can occur while perceiving the tones as the local domains of cortical processing reflects by the brain activity of high frequency and the brain rhythms of low frequency are dynamically entrained across distributed brain regions by both external sensory input and internal cognitive events. (Canolty et. al, 2010).

CONCLUSION

Hence, it can be concluded that there is an effect of broadening and tunneling in time perception. The tunneling effect has affected more on time estimation than the broadening effect of the participants.

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Conflict of Interest

The authors colorfully declare this paper to bear not conflict of interests

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