e-ISSN: 2319-9865
p-ISSN: 2322-0104
Research and Reviews: Journal of Medical and Health Sciences

Effect of Music on Visual and Auditory Reaction Time: A Comparative Study.

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Research Article

Received: 10/12/2013
Revised: 22/12/2013
Accepted: 27/12/2013

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Keywords: VRT, ART, Cognitive-motor performance, Music

ABSTRACT

Music is now an important aspect of living. Various studies examined the effects background music on different aspects of cognitive processing. The present study examined the effects of type of background music on speed of cognitive-motor performance using visual reaction time for different colors and auditory reaction time for different pitch sounds. To note the effect of background music on Visual and Auditory Reaction Time (VRT & ART). 30 subjects aged between 20-40yr having normal vision and hearing ability participated in the study. VRT and ART was recorded using Reaction time apparatus in a quiet room. Each type of stimulus was given 10 times randomly and the average reaction time for each type of stimulus was considered. Initially the recording was done without music and later with music in the background. Music played were rock of a bollywood song and instrumental. Paired t test applied showed statistically significant improvement ($p<0.05$) in VRT for yellow and green with music in the background either heavy metal or instrumental.. Significant improvement ($p<0.05$) in ART was noted to low and medium pitch sound with music in background. VRT improves with background music. ART for medium pitch sound improve with background music.

INTRODUCTION

Music has become part and parcel of our life. Listening to music seems to have soothening effect and change the emotional state of an individual [1,2].

It is quite often noted that people listen music to improve their concentrating ability as noted among students, drivers or at work place. There are studies which consider music as distracter and deteriorate cognitive performance. But there are other studies which show improvement in response time to various stimuli. The effects are debatable.

Reaction speed is the ability to give a quick motor response to a definitive stimulus and the time taken for a motor reaction for a sensory stimulus is called reaction time. This response time includes the time required for conduction of sensory impulse, processing of stimulus and to execute motor response [3]. Thus the measure of reaction time in-turn indicates the integrity of central nervous system. If the pathways of motor and sensory system are intact reaction time will depend on the ability of central processing of stimulus.

Depending upon the number of stimuli used, reaction time is of two types- Simple reaction time and choice reaction time. Simple reaction time is shorter than choice reaction time [4]. Simple reaction time does not always depend on conscious recognition of stimulus [5]. But the choice reaction time requires conscious recognition of stimulus.

Apart from integrity of CNS, type of reaction time experiment, type of stimulus [6] and stimulus intensity [7,8,9], there are several other factors that influence the reaction time. These are arousal, age, gender, left vs. right hand, central vs. peripheral vision, practice and errors, fatigue, fasting, distraction, alcohol intake, order of presentation, finger tremors, personality type, exercise, punishment, stimulant drugs, brain injury, illness and others factors [10,11,12].

A study on the effect of music on motor reaction time and inter-hemispheric relations showed that music shortened reaction time, and its stimulating effect was stronger in the case of longer initial reaction times with-out music. The influence of various other types of music was more effective than of classical music [13]. Listening to stimulating music can influence certain factors, (e.g. arousal) affecting reaction time. Reaction time is faster at an intermediate level of arousal and slower if the subject is either too relaxed or too tense [12].

Various studies examined the effects of background music on different aspects of cognitive processing: test performance, memory, reading, space relations, numerical ability, and verbal reasoning [14,15,16]. Although music was found to improve performance in cognitive tasks except for serial recall, it might have a detrimental effect on the speed in which these tasks are performed. Besides, this effect might be highly dependent on the type of background music.

The present study examined the effects of type of background music on speed of cognitive-motor performance using visual reaction time (VRT) for different colors and auditory reaction time (ART) for different pitch sounds. Two types of music considered were instrumental and verbal heavy metal. We predicted that verbal heavy metal would be more distracting than instrumental music. Hence, we expected slower reaction times for the visual and auditory stimuli performed with verbal heavy metal than those performed with instrumental music. So, we hypothesized that background music would slower the speed ofprocessing and thus lengthen reaction time to visual and auditory stimuli.

Aims and objectives

To record reaction time to visual and auditory stimuli with and without background music and note the effect of type background music on these reaction times.

METHODOLOGY

Study design: It is a pre and post intervention study design on the same study group.
Sample size: 30

Sample selection and method

Institutional ethical committee approval was taken before beginning the study. Subjects for this study were randomly selected irrespective of their gender. All were employees of SSIMSRC, Davangere, Karnataka. Before selecting them as participants they underwent general physical examination, systemic examination even to rule out ENT and ophthalmological diseases. The examination was done in concerned departments OPD of SSIMS&R Hospital. The participants had no hearing disability and no visual defects including colour blindness. Before they were selected, procedure of the study was explained in detail and they had given informed written consent for participation.

The participants thus selected were tested for simple reaction time for different visual and auditory stimuli. The instrument used was Reaction Time Apparatus, INCO make, displaying reaction time in milliseconds. Visual stimuli included inbuilt 3 different colours- red, yellow and green. Visual reaction time (VRT) was noted for each given colour which was presented randomly to the participant. VRT for each colour was recorded 10 times and the average of 10 recordings for each colour was considered for statistical analysis. Similarly auditory stimuli included inbuilt 3 different pitch sounds- high, medium and low. Auditory reaction time (ART) was noted for each given sound pitch which was presented randomly to the participant. VRT for each sound pitch was recorded 10 times and the average of 10 recordings for each sound pitch was considered for statistical analysis.

The study was conducted in a quiet room of Research Laboratory in Physiology Dept., SSIMSRC, Davangere. VRT and ART were recorded of each participant initially without disturbance and later with 2 background music separately on the same day. The background music played in a laptop was presented with fixed volume to all participants. 2 background music were used separately- 1) verbal heavy metal of Bollywood movie and 2) instrumental- violin.

Before noting VRT and ART each participant practiced until less number of mistakes and better performance was achieved as judged by the observer. Single observer recorded VRT and ART on all participants of this study.

The recordings were entered into a master chart and appropriate statistical methods were applied to note the effect of background music on cognitive-motor performance.

e-ISSN: 2319-9865
p-ISSN: 2322-0104

RESULTS AND ANALYSIS

Descriptive Statistics

The study included 30 randomly selected subjects aged between 20-40yr. Mean age of study group was 31yr. 11 females and 19 males participated in the study (Table 1 and 2).

Table1

Minimum Age	Maximum Age	Mean Age	Std. Deviation
24yr	39yr	31yr	3.667

N=30

Table 2

Gender	Frequency	Percent
Female	11	36.7
Male	19	63.3
Total	30	100.0

Table 3 shows that with background music either verbal heavy metal or instrumental the mean VRT for different colours is lesser than mean VRT without background music. Similarly, the mean ART for different pitch sounds is lesser than mean ART without background music.

Table 3: Reaction time to visual and auditory stimuli

Scenario	Visual stimuli (colour)	Mean VRT	Std. Deviation	Auditory stimuli (pitch of sound)	Mean ART	Std. Deviation
Without background music	Yellow1	897.93	278.27	1Low	1502.17	534.43
	Red1	793.60	130.42	1High	872.19	350.57
	Green1	895.76	284.33	1Medium	1292.01	565.01
With background music- verbal heavy metal	Yellow2	784.77	215.55	2Low	1445.61	478.73
	Red2	746.78	174.58	2High	796.13	190.31
	Green2	776.86	159.74	2Medium	1158.15	435.79
With background music- instrumental	Yellow3	755.23	182.70	3Low	1323.56	372.38
	Red3	765.49	146.50	3High	792.48	157.60
	Green3	778.28	137.22	3Medium	1046.68	372.65

N=30

Table 4 shows the mean difference in VRT to different colours between the VRTs without background music and with background music. The difference was statistically significant for yellow and green colours ($p<0.05$) with background music either verbal heavy metal or instrumental.

Table 4: Difference in reaction time to visual stimuli recorded without and with background music

Pairs considered to note difference in Mean VRT	Mean Difference in VRT	Std. Deviation	Std. Error Mean	t	Sig. (2-tailed)
Yellow1 - Yellow2	113.15	150.91	27.55	4.107	<0.001*
Yellow1 - Yellow3	142.69	201.84	36.85	3.872	0.001*
Yellow2 - Yellow3	29.54	127.62	23.30	1.268	0.215
Red1 - Red2	46.82	119.30	21.79	2.150	0.040*
Red1 - Red3	28.11	114.74	20.95	1.342	0.190
Red2 - Red3	-18.71	78.30	14.30	-1.309	0.201
Green1 - Green2	118.89	163.85	29.91	3.974	<0.001*
Green1 - Green3	117.47	212.68	38.83	3.025	0.005*
Green2 - Green3	-1.42	120.14	21.93	-.065	0.949

N=30, Paired T test *p<0.05

Table 5 shows the mean difference in ART to different pitch sounds between the ARTs without background music and with background music. The difference was statistically significant for low and medium pitch ($p<0.05$) with background music

being instrumental. The mean difference in ART is statistically significant between the ARTs of low and medium pitches when recorded with verbal heavy metal and instrumental background music.

Table 5: Difference in reaction time to auditory stimuli recorded without and with background music

Pairs considered to note difference in Mean ART	Difference in Mean ART	Std. Deviation	Std. Error Mean	t	Sig. (2-tailed)
1Low - 2Low	56.56	296.39	54.11	1.045	0.305
1Low - 3Low	178.60	328.99	60.07	2.973	0.006*
2Low - 3Low	122.04	206.76	37.75	3.233	0.003*
1High - 2High	76.06	237.53	43.37	1.754	0.090
1High - 3High	79.71	260.81	47.62	1.674	0.105
2High - 3High	3.65	85.63	15.63	.233	0.817
1Medium - 2Medium	133.86	292.74	53.45	2.505	0.018*
1Medium - 3Medium	245.33	298.53	54.50	4.501	<0.001*
2Medium - 3Medium	111.47	202.59	36.99	3.014	0.005*

DISCUSSION

Here is a comparative study of VRT and ART of study subjects recorded without background music and with background musiceither verbal heavy metal or instrumental. The results indicate improvement in VRT and ART of subjects when recorded with background music either verbal heavy metal or instrumental. But the improvement in VRT noted is statistically significant ($p<0.05$) for yellow and green colours with background music either verbal heavy metal or instrumental. Similar improvement in ART noted is statistically significant for low and medium pitch sounds when recorded with instrumental background music. This improvement indicates that there is facilitation in processing of stimuli in the somatosensory cortex and hence leading to acute motor response. Musiccan influencethereactiontimeofaspecifictask as here the cognitive-motor response to different colours (VRT) and to different pitch sounds (ART). Thus the speed of processing is increased leading to improved response time. The improvement seems to be better for instrumental background music.

Cockerton, Moore, and Norman found that background music facilitated cognitive task performance. Two intelligence tests were given to undergraduate students, one in silence and the other with background music. Their analysis showed that more questions were answered correctly under the music condition compared to the control condition of no music [14].

Salame and Baddeley examined the effects of background music on memory performance. They presented their subjects various kinds of music during a serial recall task. They found that vocal music was significantly more disruptive than instrumental music [15].

Inanother study, Miller and Schyb examined the effects of background music on a variety of standard cognitive tasks: spatial, numerical, and verbal reasoning, and reading. Differential Aptitude Test Battery was used. Subjects completed these tasks either with no background music or with various types of music: classical, vocal, or pop. Performance on nonverbal tasks was facilitated by background music, especially for females. The type of music did not differentially affect the improvement in performance. They suggested that the improvement in tasks might be due to the low levels at which music was played. Perhaps louder music would distract the subjects and interfere with their processing [16].

The results of this study are similar to that of Cockerton et al, Salame et al and Miller et al.

This study concludes that there is improvement of ART and VRT with background music due to facilitation of processing of stimuli in somatosensory cortex. The improvement is better with instrumental background music. The hypothesis is proved to be null. These results have to be confirmed over larger population. With volume of background music being in comfortable zone would improve reaction time, but with increased volume distracting effect may be noted.

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