REVIEW OF LITERATURE

According to Robert J. Kosinski, reaction time has been a favorite subject of experimental psychologists since the middle of the nineteenth century. However, most studies ask questions about the organization of the brain. Various factors affecting reaction time are arousal, age, gender, direct vs. peripheral vision, fatigue, distraction, warning, order of presentation, breathing cycle, finger tremors, personality type, exercise, punishment, stimulant drugs and intelligence. (Review)

Galton (1899), Fieandt et al state that for about 100 years, the accepted figures for mean simple reaction time for college age individuals have been about 190 ms (0.19 sec.) for light (visual) stimuli and about 160 ms. For sound (auditory) stimuli (26).

Pirson W.R. (1958) et al have shown that studies of movement time and reaction time, found increasingly delay in both with age. The reactions were fastest (0.20 sec.) in early twenties, getting progressively slower with age. Beyond the age of 60 they were considerably delayed (0.25 sec). They too noticed greater variations in performance of the aged as compared with young. The variations are three times wider in elderly than young groups (64).

Era P. et al (1995) studied psychomotor speed in sample of 75-years old men and women. Both simple and multichoice reaction and movement time tests were applied using visual and auditory stimuli. The results indicated a higher psychomotor speed in the physically more active and in most cases, fitter subjects on both the sample and more complex tasks, a higher speed of performance in men compare to women. The overall finding suggests that habitual physical activity may enhance psychomotor speed in elderly subjects. Basic differences in activity did not, however, explain the difference in psychomotor speed observed between the sexes (19).
Gerald J. Tortora and Nicholas P. Anagnostakos (1990) stated that one of the effects of aging on the nervous system is that neurons are lost. Associated with decline, there is decrease capacity for sending nerve impulse to and from the brain. Conduction velocity decreases, voluntary motor movements slow down, and reflex time for the skeletal muscles increases. Deep reflexes may diminish and superficial reflexes may be lost. Degenerative changes and disease states involving the sense organs can alter vision, hearing, taste, smell and touch (27).

Among the various factors affecting the reaction time, age shortens the reaction time from childhood into the late 20s then increase slowly until the 50s and 60s and then lengthens faster as the person gets into his 70s and beyond (89).

Galton (1899) reported in his early studies that for teenagers (15-19) mean reaction times were 187 msec for light stimuli and 158 msec for sound stimuli (26).

Pathak, et al (1964) had reported that reaction time was shorten among the intellectual (14.8 +/- 1.11) as compared with backward groups (20.5 +/- 3.67) even in young people. The aged in this series have shown both wider individual variations as well as 50% more delay in their reaction time compared with Indian subjects in their twenties.

Further analysis of data reveal that there is gross difference between the performance of two groups, young and old. The old took 50% more time to react to very very simple stimulus for very very simple action, namely just pressing the key on which their finger was resting (34).

Neena misra et al (1985) have shown in their comparative study of visual and auditory reaction time of hands and feet in males and females that there are significant differences between reaction time of hands and feet, right side and left side, males and females and between auditory and
visual reaction times (ART & VRT). Both ART and VRT were significantly faster in hands. Delayed response of left side (LH, LF) was more marked in feet with ART, on crossing hands both VRT and ART took more time in RH. Males responded faster than females, difference being significant mainly in ART and that too on left side. ART was significantly faster than VRT. Faster response of right side was probably due to the fact that all subjects were right-handed persons (55).

Jing-Long Wu et al. have studied human interactive characteristics between visual and auditory systems by psychological experiments and they measured it by functional magnetic resonance imaging (fMRI). They have suggested that the visual reaction time is remarkably affected by the auditory reaction time, however, the auditory reaction time cannot be affected by the visual stimulus when the visual and auditory stimuli are concurrently presented (36).

Many researchers have confirmed that reaction to sound is faster than to light, with mean auditory reaction times being 140-160 msec. and visual reaction times being 180-200 msec. (26, 93, 21, 90, 11).

The pioneer reaction time study by Donders (1868) had shown that a simple reaction time is shorter than a choice reaction time, that the recognition reaction time is longest of all (17).

Laming (1968) concluded that simple reaction time averaged 220 msec. but recognition reaction times averaged 384 msec. (43).

Froeberg (1907) found that the visual stimuli that are longer in duration elicit faster reaction times and similar results were found by Wells for auditory stimuli (24).
Nobel et al (1964) reported that in almost every group, males have faster reaction times than females, female disadvantage is not reduced by practice (58).

Beilis (1933) reported that mean time to press a key in response to a light was 220 msec for males and 260 msec for females, for sound the difference was 190 msec (males) to 200 msec (females). While Engel(1972) has reported a reaction time to sound of 227 msec (males) to 242 msec (females) (18).

The educational psychologist Arthur Jersild (1927) pioneered the study of executive control of task set. He found that when two tasks involved a common stimulus set, subjects responded much more slowly on the alternating lists. The extra time required often referred to as the switch cost, was very large by the standards of research on simple task (some time exceeding 500 msec/item). In contrast when the two tasks had distinct stimulus sets, Jersild found no switch cost (even a small switch benefit) (35). But in contrast to this, Rogers & Monsell (1995) found that switching between cognitive tasks (even very simple one) can result in a substantial time cost (300 msec or more) (71).

Van selst et al (1999) recently studied the effect of 36 practice sessions in PRP design combining an auditory-vocal tasks (saying a loud whether a tone is high or low in pitch) with visual-manual task (pressing a button to indicate the identity of a letter on the computer screen). He observed a rather dramatic reduction in the magnitude of dual task interference with practice. The initial PRP effect (increases in second task RT as the interval between the tone and the letter was reduced) was 353 msec typical of PRP studies with unpracticed tasks, but after extensive practice the effect had shrunk to a more 50 msec. They were able to show that a control bottleneck was still present after extensive practice. Thus although practice reduced stage duration, it did not operated in series to begin operating in parallel. If the central bottleneck model holds both before and after
practice, then the reduction in the PRP effect with practice reflects the speed up in the perceptual and central stages of task 1. ( 86 ).

Hirst et al ( 1980) found striking improvements in people's ability to read while taking dictation. These results are sometimes taken to mean that even difficult mental operations become able to operate simultaneously and without interference. ( 33 ).

One of the best theory of Logan (1988) who theorized that reduction in RT (reaction time) with practice do not come about from improvement in the speed of executing a basic algorithm used by subjects at low practice level. Rather the reduction in RT with practice occur because subjects employ alternative strategy of retrieving memory traces left by previous performances ("instances") and directly choosing the retrieval solution without need for calculation ( 47 ).

Several investigations have suggested that the brain's visual system contains two separate neural pathways, each originating in primary visual centers at the back of the head and taking its own rout to the frontal lobe. Researchers say that a 'what' pathway discerns the identity of objects, while a 'where' pathway locates object in space. Two distinct neural pathways run from auditory brain tissue near that ear to the frontal lobe locates /locales favored by the two visual pathways (46).

Tassi P and Pins D. (1997) have reported strongly increased visual detection threshold in the morning (8:00 hr) in 4 of 7 subjects, followed by an important improvement at 10:00 hr, after which time it remains almost constant whatever the method used. (82)

Tassi P and et al (2000) further designed experiments to assess daily resolution power of the visual sensitivity by measure of a differential threshold. The result showed that the visual discrimination threshold was low in the morning and increase progressively over the day reaching the
first at 22:00. During the night, the same pattern occurs, with low threshold levels at the beginning of the night and high level at the end. This profile is found to be different from that of detection threshold variation (83).

On the other hand, Almirall H. Gutierrez E. (1987) found no significant difference in the mean Reaction Times by sex or time of the day; however, differences were found for the trend slope between type of stimulus and sex (5).

S. Das et al. state that both ART & VRT were significantly increased (P<0.001) during premenstrual phase. But there is no statistical difference was found in hearing in the premenstrual phase as compared to postmenstrual phase, although the values were slightly higher during premenstrual phase (74).

McBride T and Lickliter R. (1995) have examined the role of the relationship between pre and postnatal stimulus cues in directing perceptual preferences of bobwhite quail chicks. They were exposed to either prenatal auditory or prenatal visual stimulation. Both resulted in accelerated responsiveness to combined postnatal auditory-visual cues. They demonstrated by these experiments that the silence of auditory cues in directing early postnatal perceptual behavior in precocial birds, and it found augmented prenatal sensory stimulation can result in either accelerated or decelerated patterns of perceptual functioning (51).

Yagi Y. et al. have reported that visual and auditory reaction times (RTs) to decrease during moderate aerobic exercise and this has been interpreted as reflecting an exercise induced activation (EIA) of cognitive information processing. They have also reported that both visual and auditory RTs during exercise were significantly shortened compared to control and recovery periods. Paralleling the RT changes, auditory and visual P300 latencies decreased during exercise, including the occurrence of faster cognitive information processing in both sensory modalities (94).
Polich J, and Lardon M T (1997) have investigated electrophysiologic effects of physical exercise by comparing groups of individuals who engage in relatively low amounts of physical exercise (less than 5h/week) to subjects who engage in relatively high amount of aerobic exercise (more than 5h/week). Event related brain potential (ERPs) were recorded using auditory and visual stimuli in separate oddball task conditions. P300 amplitude was affected by exercise frequency, such that increased amount of exercise were associated with increase amplitude and somewhat more so for visual stimuli. No reliable exercise effects for P300 latency were observed, with little effect found for the other components. The findings suggest that a history of intensive physical exercise affect P300 amplitude (61).

Welford (1968) found that reaction time gets slower when the subject is fatigued. (91). Singleton (1953) observed that this deterioration due fatigue is more marked when reaction time task is more complicated than when it is simple mental fatigue, especially sleepiness, has the greatest effect. (76). Kroll on the other hand found no effect of purely muscular fatigue on reaction time (41).

Nakamura et al (1999) reported the effect of jogging on P300 event related potentials and found that amplitude of P300 significantly increase after jogging compared to values recorded before jogging -and finding suggests that jogging has effect of facilitating cognitive process involved in generation of P300 (54).

A. Malathi and Vidya Parulkar (1989) have reported that both VRT and ART showed a significant reduction following 1 hr yogasan (P 0.05), could be attributed to greater arousal in subjects following yogasanas (2).

One of the most investigated factors affecting reaction time is 'arousal'or state of attention, including muscular tension. Reaction time is
fastest with an intermediate level of arousal, and deteriorates when subject is either too relaxed or too tensed. (90, 12, 23).

Pathak et al (1987) studied a group of 36 medical students, who underwent one month yoga training after basal measurement of physiological parameters like pulse, blood pressure, body temperature, respiratory rate and reaction time. The post training data of these parameters showed significant decrease in pulse rate, blood pressure, respiratory rate, reaction time (43.75 msec). (60).

Robert L. Shaw et al (1971) have reported that the average reaction time of faster after meditation than before. For non-meditators reaction time is slower after a period of rest with eyes closed than before. It is also apparent from comparison of reaction times experimental manipulation that meditators were faster than non-meditators. (70) E. Schwartz (1999) reported in his study that after six weeks of practice of the Transcendental Meditation programme the new TM group improved significantly in reaction time at all level of stimulation. As expected, during the same period the long- term practitioners of TM programme did not change significantly. There was also a significant difference in reaction time between groups having faster reaction than the new TM group at all levels of stimulation during all sessions. (20).

According to Yantis and Jonides (1990), Muller and Rabbit (1989), one of the key properties attributed to the exogenous or reflexive mode of attention control is that it is involuntary. That is attention capture depends only on the occurrence of proper stimulus, not on the goals of the observer. Visual search time decreases with abrupt on set distracters even when across trials, the location of abrupt on set stimuli uncorrelated with the location of the target. Thus abrupt onset stimuli can capture attention independently of the will of the subject (38, 53).
Yantis and Jonides (1990) further noted one special case in which voluntary process could prevent capture. If subjects know with certainty the location of the target and are given sufficient time to focus attention on that target, then distracter stimuli are at least momentarily unable to capture attention. The finding suggests that if an observer’s attention is already located on to one location, the power of other stimuli to draw attention is nullified (95).

A. Malathi et al (1990) have also shown that reaction time in schizophrenics has significant prolongation of ART of BE, LE, RE, (both the ears, left ear, right ear) of the patient group when compared with the same readings of the adult control group. The mean distractibility in the patient group was 323.3 msec. as compared to that of control group of 10 msec. Which was highly significant. There was no significant difference between mean ART (454.2 +,- 410.7 msec.) of RE and LE (393+,- 420.1 msec.) within the patient group. The difference in the mean ART of BE of males (388.3 +,- 403.7 msec.) and females (402+,- 397.8 msec.) in the patient group was not significant. (4).

Rajkapoor et al (1993) have concluded that heroin addiction causes decrease in sympathetic activity, inhibition of baro-receptor reflexes, and prolongation in the auditory and visual reaction times. (69)

The reaction for various functions requiring integration by the brain is greatly reduced by administration of thyroid hormone, but on the other hand, the rate of conduction in nerve remains normal in the presence of excess thyroid hormone. Thus, thyroid hormone seems to increase synaptic activity but does not influence peripheral activity (7).

Sur and his colleagues, said the auditory cortex of his rewired ferrets interpreted input from the eyes, but it did not do the job as well as visual cortex would have. He further explains that connections between cells are
the key to brain function. By altering the input to the tissue, the connection changed as a result the very molecules changed as well.

Research has shown that in people who are blind from the birth the visual cortex can be used for the other functions, such as increased sense of touch for Braille reading or a heightened sense of hearing.

There is not an intrinsic genetic specification of the cortex to do one and only one thing, Inputs can change the function of the cortex as said by Sur (2000). (52).

The prolongation of reaction time and lack of association between mean reaction time and lead exposure measures did not appear to result from specific protocol. Although the mean reaction time for trails with briefs ISIs that followed trails with long ISIs was prolonged for all subjects, compared with the mean reaction time for trails with short ISIs following trials with ISIs of less than 8 s (329 [± or -] 79 s versus 308 [± or -] 65 s) latter mean reaction time nonetheless represents a significant prolongation above the mean reaction time for trails with ISIs of 4-10 s. Furthermore, modeling the trails with short ISIs that followed trails with ISIs of less than 8 s separately did not reveal any associations with either of the lead exposure measures (37).

Studies by Sperling G. (1960) indicates that the perception of visual stimulus is from 120 to 250 msec. in duration. At fairly high level of light adaptation, a black outlined figure on a white background has perceptual duration of 250 mesc. (78).

A.H. Shah et.al. (1996-97) observed that as age advanced, visual auditory and touch reaction times increases but decreases with education, while sex did not make any difference. Time taken to complete maze and mental status questionnaires increases with age specially in 60+ subjects with decrease arithmetic ability. Sex does not affect the performance of the
arithmetic ability and mental status questionnaires but higher the educational status better the performance (3).

In experiment it is not possible for us to collect an infinite number of reading of parameters so we have to try to collect a reasonably small number of reading which are representative of large population and in this way we are sampling of universe of possible reading. A sample should never be selected but collected randomly. Selected sample is not a representative of the universe and will exhibit higher error of sampling(14). Several categories of reaction time, such as simple reaction time, have been established and studied in experimental psychology.

In a simple reaction time experiment, the subject is presented with one simple stimulus. Such as a light, and instructed to perform one simple response, such as pressing a button.

In a discrimination reaction time experiment, the subject is presented with one of two or more different stimuli, such as red light and a green light, and instructed to perform a response to only one of the stimuli, such as pressing a button when red light is presented but not when the green light is presented.

In a choice reaction time experiment, the subject is presented with one of two or more different stimuli such as red light and green light, and instructed to perform different responses depending upon which presented, such as pressing a red button when red light is presented and pressing a green button when the green light is presented (25).

R. Cocchi and C. Carli (1973) prepared a computer program ST-CON (Stress - Control ) to check up reaction times. Yellow to red color rectangles in variation of 200/150mm dimension was used to elicit hand answer for visual stimuli, and simple auditory stimuli as beep sound lasting 55msec. stop can be obtained by pressing space bar.
The program gives RTs, the maximum, the minimum, the mini-max differential anticipation and timeouts figures. The program counts average, maximum, minimum and differential times only for 15-30 trials considered as valid. In this program immediate comparison is available with RTs ranges figures from a control group of normal person. The program also allows the comparison between visual and auditory RTs and between Left and Right hemisphere RTs. (66).

Research work in basic medical sciences closely concerned with human health, in developing country like India must have simple, effective and accurate recording device.

In recent years, investigation of sensory processes have become increasingly concerned with the detail nature of temporal patterns can be studied only with greatest difficulty from kymograph records, they can be subjected to elaborate analyses with the aid of digital computers. It seems likely that ultimately computers will play a highly significant role in understanding of sensory process in particular and the functioning of the entire central nervous system (9).

It may seem reasonable to study overall sensory experience in human subjects and to examine vary portion of sensory system electrophysiologically in animals. There are serious objections however, to extrapolating from electrophysiological studies of animals directly to the intact human.

Other serious problem result with the fact that the sensory processes of animals are not identical to those of the human. In recent years highly significant differences in the way in which visual information is processed in the sensory system of fish, frog, birds, rabbits, cats and monkeys have been revealed (9).
Various methods have been tried so far to measure reaction time. The apparatus used for the recording of the VRT by Andrew Jedrczak (1982) consists of four lights arranged in a square, which lit at a time in a random sequence. At a random interval from the beginning all four lights lit to gather, and the subject had to press the button as quickly as possible. The average response time (milliseconds) from ten experimental trials was used. (6)

M. Kesav Reddy et al (1974) performed the reaction timed coordination test with the help of making as many marks as possible with a piece of chalk on a blackboard during the five second interval before the stop signal was given. The test was repeated three times at ten minute intervals, and the lowest score was recorded. (48).

While Botwinick and Storandt (1973) measured the simpler motor speed which involved putting a horizontal line through as many vertical lines as possible in thirty seconds (10).

Reaction time to a light stimulus placed in front of the subject was measured to the nearest thousandth of a second with an electronic timer. Each subject was seated comfortably in front of the reaction time device with the forefinger of his dominant hand resting on a spot eight inches from a telegraph key "OF" pressure to depress. (16).

Rogers & Monsell found that switch cost can be reduced by allowing the subject extra time to prepare for the upcoming task switch. Preparation time reduced the switch cost only when this variable was manipulated between the blocks rather than within the blocks; it appears that subject fails to reconfigure their task set when not guaranteed sufficient time to complete the process. This finding suggests that switch cost reduction reflects an active process, rather than a passive decay of interfering representations from the previous task, from the previous task.
The results showed that the switch cost indeed much smaller when subject have more time to prepare for the upcoming task. This result confirms that the switch cost is reduced by an active topdown preparatory process during the inter trial interval, rather than by a passive decay of interfering representations from the previous trial. If the top down task reconfiguration were the only source of the switch cost, then providing very long inter trial interval should allow subject to finish the reconfiguration in advance, completely eliminating the switch cost. (71).

In a simple visual condition, a decision had to be made merely on whether a stimulus had occurred or not which is an easy detection task. In a choice reaction condition, the subject had to discriminate as to which light was on. (50)

The switch costs clearly are much greater when the tasks being studied involve overlapping stimulus sets, so that the stimulus itself does not unambiguously indicate which task needs to be performed upon it. Deliberate (topdown) mechanisms can be successfully employed to ready critical mental machinery to carry out a particular task in the near future, substantially reducing reaction times to that task. It appears that these topdown mechanisms alone cannot always achieve the full state to task readiness that can be achieved by actually having performed the task on the previous trial. Thus, there is a lingering bottom-up component to the switch cost, the exact cause of which is not yet known. (31)

Ruthurff et al (2000c) have also attempted to explain the residual switch cost in terms of a processing slow down. These authors used a variant of Roger & Monsell (1995) alternating -runs paradigm, with long inter-trial interval in which the presented task was not always the expected task. Thus the subject usually task sequence such as AABBAA, but occasionally received sequence such as AABBAB. This allowed Ruthruff et al to examine the interaction between the effect of the task expectancy and the
effect of the task recency. Furthermore, two experimental factors thought to influence the duration of response selection (namely stimulus repetition and the complexity if the stimulus repetition mapping) had effect that were generally additive with task expectancy but over additive with task recency. (72)

Underwood states that intensity of the stimulus and knowledge of the results by the subject may account for the differences in reaction time. Other problems are progressive error or practice effects foreperiod factors. In the latter the subject may "jump-the-gun" in anticipation of the stimulus and respond "before the stimulus is given. In contrast to this, the subject may control himself so as to not make a false reaction, and lose his "edge" as he waits for the stimulus. Studies have shown that foreperiod has much influence on reaction time. (85)

John M. Balbus (1998) has shown that repeated trials are separated by an interstimulus interval (ISI), which may either be fixed or may vary in duration from 1 to 12 s when a fixed ISI is used, the reaction time has a U shape relation -ship with ISI above and below approximately 2 s, reaction time increases. If one varies the ISI reaction times tends to decrease, although a high degree of variation may again lead to an increase in reaction time. (37)

The result of Van Selst et al (1999) & Ruthuff et al (2000a) suggested that practice merely shortened the time required for central processing stages, there were persistent hints that practice may also have produced some small degree of true automatization on some trials, at least for some subjects. (86)