From every day experiences it is obvious that eating meal has effects on mood and mental performance. People eat to profit from the satisfying and rewarding effects of meal in a variety of social and personal contexts. Eating plays an important role in social interaction and communication among humans. International Obfuscated C Code Contest (IOCCC) believes that eating and food are the most important sources of pleasure in life for humans and eating per se has effects on mood and cognitive performance. As a matter of fact, the association between meals and performance has complex one. Many factors that seem to play an important role to interpret the link between meals and performance include the nature of the activity being carried out (type of performance task), the nature of the meal and the characteristics of the person eating the meal (Smith and Kendrick, 1992). It may, therefore, be assumed that interactions between meal and performance have likely to be influenced by personality/temperamental dimensions, types of meal intake and gender. The field of cognitive performance (ability of an individual to think, reason, remember and attend to information effectively) has no exception. In the present study, the main and interactive effects of three independent variables namely, each of four temperamental dimensions, three lunch conditions and gender have been investigated on cognitive performance. Although research has provided insights into the role of meal intake on cognitive behavior and mood, an effort has been made in the following pages to interpret and discuss the findings specifically related to main and interactive effects in a more generalized way. Looking at a wide array of significant main effects and interactions reported in various tables and displayed in histograms, it would be very difficult to discuss each of them separately. Moreover, this would have led to a great deal of repetition. However, the discussion and interpretation of the specific main and interactive effects has been taken up for emphasizing certain points. It may also be pointed out that the findings related to the higher order interactions are purely exploratory as very few studies could be traced in the literature where such interactions have been investigated.

Main Effects

Temperament and Cognitive Performance

The results in regard to the emotionality dimension of temperament reported in Tables 2, 4, 7 and 9 clearly indicated that emotionality produced a significant effect on cognitive performance; low emotional (emotionally stable) subjects performed better than high emotional (neurotic) subjects in all cognitive tasks.

The results are, therefore, consistent with the findings of McCrae and Costa (1987), Stelmack (1993), Ackerman and Heggestad (1997) Moutafi et al. (2003), Schaie et al. (2004), Moutafi et al.
Chamorro-Premuzic et al. (2006a) Willis and Boron (2008); Williams et al., (2010). Perkins and Corr (2005) and Graham and Lachman (2012) reported that high neuroticism is negatively correlated with performance. The results are consistent with those of Socor and Bucik (1998) who found that emotionally stable people were quicker on choice reaction time than high emotional ones. The authors argued that this effect might due to the less efficient processing by those high in emotionality (neuroticism). The results are in line with findings of Barrick, Mount and Judge (2001) who found that emotional stability was significantly related to performance in some occupations but not others. The findings are not consistent with Barrick and Mount (1991) who reported no significant relationships between emotional stability (low neuroticism) and job performance, except amongst professionals.

According to Broadbent (1958), stability-neuroticism (low-high emotionality) is an important source of variation in performance and was associated with greater decrements in performance following stress, thereby resulting in impaired performance.

According to Eysenck’s (1967) theory, individual differences in neuroticism (high emotionality) seem to be associated with the limbic system. The people who score high on neuroticism (high emotional) have a more reactive sympathetic nervous system, and are more sensitive to environmental stimulation. Eysenck (1990) also explains neuroticism (high emotionality) in terms of activation thresholds in the sympathetic nervous system or visceral brain. The visceral brain is also referred to as the limbic system, which consists of the hippocampus, amygdala, septum, and hypothalamus, and regulates such emotional states as sex, fear, and aggression. It is responsible for the fight-or-flight response in the face of danger. Heart rate, blood pressure, skin conductance, sweating, breathing rate, and muscular tension in the forehead can measure activation levels of the visceral brain (Eysenck, 1990; Eysenck and Eysenck, 1985). Neurotic (high emotional) individuals have greater activation levels and lower thresholds within the visceral brain and thus they are easily upset in the face of very minor stresses where as emotionally stable (low emotional) people are calm under such stresses because they have lesser activation levels and higher thresholds (Eysenck, 1990).

Mathews and Deary (1998) reported that neuroticism is an enduring tendency to experience negative emotional states. Individuals who score high on neuroticism (emotionality) are more likely than the average to experience such feelings as anxiety, anger, envy, guilt, and depressed mood. They respond more poorly to environmental stress, and are more likely to interpret ordinary situations as threatening, and minor frustrations as hopelessly difficult. At the opposite end of the spectrum, individuals who score low in neuroticism (low in emotionality) are more emotionally
stable and less reactive to stress. They tend to be calm, even-tempered, and less likely to feel tense or rattled and thus likely to perform better.

Schwartz et al. (1975) also suggested that emotional responding may be mediated by the right hemisphere, whereas worry or rumination may be mediated by the left hemisphere. The interhemispheric interference results from simultaneous arousal of the right and left cerebral hemispheres (Papsdorf et al., 1995) which in turn, contributes to the difficulty of high-anxious subjects in maintaining attention and hence impairs performance on cognitive tests.

Neuroticism or emotionality is characterized by high levels of negative affect such as depression, anxiety, fearfulness, worry and they get excited quickly. The persons high in trait anxiety are more distractible than those low in trait anxiety, have more trouble concentrating and focusing of task and are more susceptible to distraction by external and internal worries and preoccupations (Wine, 1971; Eysenck, 1992, 1997). Deffenbacher (1977) found that worry was broadly related to performance and the effects of emotionality varied with worry level. High worriers did less well than low worriers. At high levels of worry, high emotionality impaired performance. Furthermore, there is some evidence that anxiety and arousal produce a narrowed attention and also seems to reduce attentional control and this further increased distractibility. The high-anxiety subjects have been reported spending far less time than low-anxiety subjects attending to task relevant information (Deffenbacher, 1978; Eysenck and Eysenck, 1985). Anxiety reduces the efficiency of the central executive component of working memory, thus it would be expected that short term memory should be adversely affected by anxiety (Eysenck and Eysenck, 1985).

Neuroticism (high emotionality) is often thought to be reflected in self-oriented thoughts, worry and anxiety each of which acts as a distracter for learning and recall (Belojevic et al., 2003). The findings lend support to the earlier findings suggesting that high neuroticism or emotionality may interfere with performance, which could be explained by the heightened anxiety and intrusive thoughts associated with neuroticism (Stelmack, et al., 1993; Moutafi et al., 2005). Jackson et al. (2009) found that higher neuroticism (emotionality) is associated with higher decreased brain size thereby resulting in impaired performance with age. Moreover, individuals high in neuroticism (emotionality) are characteristic more anxious and prone to intrusive thinking and distraction, which likely impedes their ability to focus on a task and further leads to worst performance (Graham and Lachman, 2012).

Emotional stability (low emotional) is significantly related to performance and one possible explanation for this variability is that high neurotic (high emotional) individuals are prone to perform
poorly in stressful environments (McFarlane, 1989); however, in stress-free environments their performance may be unimpaired, or even improved. There is some evidence to support this contention. Cattell et al. (1970) found that people employed in five hazardous occupations (policeman, fireman, electrical engineer, airline pilot and hostess) tended to be less apprehensive, less tense, less imaginative and more emotionally stable people employed in five non-hazardous occupations (janitor, nun, priest, foreman and artist).

Thus, it can be interpreted that the high emotional subjects had more difficulty in focusing their attention on cognitive tasks due to their intrusive thoughts and worries and it seems that more accuracy, lesser omission on the task and the reaction time noted down acted as a minor stressors which easily made high emotional subjects upset, thereby resulting in impaired performance on stroop task and visual search test. The high emotional subjects seem to interpret this ordinary situation as threatening and their anxiety may reduce the efficiency of central executive component of short term working memory and hence impairs performance on digit span test. The results of the present study verify the hypothesis that low emotional subjects performed better than high emotional subjects on cognitive tasks.

Similarly, the results reported in Tables 12, 14, 17 and 19 regarding the activity dimension of temperament clearly revealed that low active subjects performed better on cognitive performance than those of high active subjects on all cognitive measures. The results reported in Tables 22, 24 and 27 in regard to the sociability dimension of temperament clearly indicated that low sociable subjects performed better than high sociable subjects in Stroop Test and Visual Search Test. Contrarily, individuals having sociability dimension of temperament did not significantly produce an effect on digit span test performance (Table 29). The results reported in Tables 32, 34, 37 and 39 regarding the impulsivity dimension of temperament clearly revealed that impulsivity produced a significant effect on cognitive performance; low impulsive subjects performed better than high impulsive subjects on all cognitive tasks.

As activity is one component of adult extraversion (Martin et al., 1994) and sociability and impulsivity are considered to be the two major sub-factors of extraversion and these two sub-factors are by no means independent but show a reasonably close +ve relationship ($r = 0.468; n = 300; p<0.01$; Eysenck and Eysenck 1969, p. 148), so the results will be discussed in the light of extraversion.

The results are, therefore consistent with the findings of Bakan et al. (1963) and Keister and McLaughlin (1972) who reported that extraverts’ performance deteriorates more rapidly in terms of
detecting frequent signals. The results are, thus, in line with the findings of Thackray et al. (1974) who found that introverts performed better than extraverts in terms of variability and speed of continuous reaction time and in the ability to stay awake on long distance drives (Fagerstrom and Lisper, 1977). Lamb et al. (1982) also reported a direct relationship between sociability and motor performance. Ray (1959) reported that introverts perform better than extraverts on learning. The results are also in line with the findings of Baker and Bichsel (2006) and Graham and Lachman (2012) who found that high extraversion is associated with lower performance on tasks that required effortful processing such as reasoning. The results are also consistent with the findings of Sinha and Goel (2012) who reported that the low impulsives performed better than the high impulsives in card sorting with regard to different attentional tasks. Response interference task was found to be most difficult and high impulsive subjects took longest time for this task as compared to filtering and information integration.

According to Eysenck (1955) extraverted people generate reactive inhibition more quickly and dissipate it more slowly than do the introverts and thus they may be expected to show worse vigilance performance. The introverts are characterized by higher levels of activity than extraverts and so are chronically more cortically aroused than extraverts (Eysenck and Eysenck, 1985). Callaway (1959), Griew and Lynn (1960) and Hogan (1966) provided support to Eysenckian postulates.

Broadbent (1963) also assumed that the introverts are chronically over aroused and are thus better equipped for work in monotonous situations such as vigilance tasks than are extravertswho are considered to be underaroused. According to Broadbent (1971), the individual differences in introversion-extraversion depend upon two interrelated arousal mechanisms, namely the lower and the upper mechanisms. The lower mechanism is concerned with the execution of well established decision processes. The upper mechanism monitors and alters the parameters of the lower mechanism in order to maintain a given standard of performance. Broadbent assumes that the consequences of inefficiency of the lower mechanism will not become manifest in performance provided the upper mechanism remains in an efficient state. The upper mechanism is affected more by the introversion–extraversion dimension than the lower mechanism (Broadbent, 1971).

Broadbent (1971) further argues that the high or low arousal in the lower mechanism will only impair performance provided the controlling upper mechanism does not function efficiently. The cognitive control exerted by the upper mechanism is much greater in introverts than in extraverts. Thus, the strongly functioning upper mechanism in introverts tends to prevent changing
level of arousal from manifesting themselves in performance, where as the weakly functioning upper mechanism in extroverts means that their performance is directly effected by the prevailing level of arousal in the lower mechanism. Thus, in general terms, introverts (low active, high sociable, high impulsive) perform faster than the extroverts (high active, high sociable and high impulsive) under moderately arousing conditions. Individuals thus develop strategies that make their inherent level of arousal compatible with the optimal level (Gale, 1981).

According to Swets (1977), vigilance decrement is primarily due to increased cautiousness of responding. There are two parameters of vigilance measurement d' and β. D is a measure of the subject’s sensitivity to signals and β is a measure of the cautiousness of responding. Tune (1966) found that extraverts had a lower β than introverts. Harkins and Geen (1975) also reported that extraverts had a lower criterion for reporting signals than introverts and introverts had much greater sensitivity (d') than extraverts. The vigilance decrement is occasionally caused by a decline in sensitivity, especially if there is a rapid rate of stimulus presentation; the vigilance decrement is largely attributable to a progressive increase in the strictness or cautiousness of the response criterion (Broadbent, 1971). Moreover, Eysenck (1981, 1982) also argues that the setting of the response criterion is influenced by the subjective gains associated with correct responding and by the subjects costs associated with incorrect responding. According to Gray (1973) introverts are more susceptible to punishment than extraverts but are less susceptible to reward. It seems that introverts attach more importance than extraverts to the costs of false alarms and the extraverts are more affected than introverts by the potential gains of correct responding. As a result, introverts have a higher response threshold than extraverts.

Nugent and Revelle (1991) also found that variations in affect (situationally induced by positive and negative feedback) or stable personality traits (impulsivity and neuroticism) affect the memory for neutral stimuli.

It can be, therefore, interpreted that in stroop test (feedback in the form of correct and incorrect) and in visual search test (feedback in the form of absent and present) positive and negative feedback of responses and subjects’ sensitivity seems to affect their performance. It seems that low active/ low sociable/ low impulsive subjects attach more importance to the –ve feedbacks (incorrect in stroop test and absent in visual search test) than high active/ high sociable/ high impulsive subjects. Moreover, in stroop test – name and font different and in visual search task – searching a target from a number of distractors made tasks complex and the optimal level of performance is adversely related to task difficulty.
Lunch Conditions and Cognitive Performance

The results reported in Table 2, 4, 7, 9, 12, 14, 17, 19, 22, 24, 27, 29, 32, 34, 37 and 39 clearly revealed that lunch conditions produced a significant effect on performance on all dependent measures namely stroop test (name and font same), stroop test (name and font different), visual search test and digit span test. The results, are, therefore, consistent with the findings of Blake (1967), Colquhoun (1971), Craig et al. (1981), Monk and Folkard (1985), Smith (1985a), Craig (1986), Smith and Miles (1986a, 1986b), Carskadon and Dement (1992), Lowden et al. (2004) and Monk (2005) who also reported that the consumption of meal produces acute effects on cognitive performance in adults. The extent of dip depends upon characteristics of the person eating the meal, size of the meal and the types of task tested (Mahoney et al., 2005).

The results of the present study clearly indicate that the subjects who had proper lunch (proper vegetarian lunch) performed lesser than subjects who had snacks in lunch (small lunch i.e. one sandwich and 2 biscuits in the present study) and those who skipped their lunch (no lunch) on all cognitive tasks namely namely stroop test (name and font same), stroop test (name and font different), visual search test and digit span test. Thus, the results indicate a significant post-lunch dip with proper lunch than no lunch and snacks in lunch on all dependent variables.

The results are, therefore, consistent with the findings of Craig et al. (1981), Craig and Richardson (1989), Smith and Miles (1986c, 1987a), Smith et al., (1988), Smith, Ralph and Mc Neil (1991) who also reported that large lunch has a different impact from that of a small lunch i.e. large lunch deteriorates performance to large extent as compared to small lunch.

According to Hutchinson (1952) and Craig (1986), eating large lunch causes a drop in cognitive performance along with feeling of lethargy, drowsiness and coupled with various metabolic and physiological changes and the effects usually peak within an hour of eating but may take several hours to go away and their size increases with the size of the meal (Hovland, 1936; Laird et al., 1936; Hutchinson, 1954; Kassouny et al., 1970). Smith and Miles (1986, c) showed post lunch dip with a small meal.

Craig and Richardson (1989) reported that the subjects who ate a large lunch were more impaired than those who ate a light lunch and that this effect of dip was greatest for those given the large lunch that normally had a small lunch. Smith et al. (1991) also found that the changes in meal size produce more momentary inefficiency or lapses of attention.
Such effects are influenced by a combination of the normal eating habits of the participants and novelty of the test meals. People will under react or over react to an unusual meal, depending upon whether it is bigger or smaller than their usual meal: they will respond more appropriately to their usual lunch size (Mahoney et al., 2005). The large lunch impairs cognitive performance (memory, vigilance and reaction time) and mood (alertness and fatigue) over the next one to two hours, compared with those consuming light lunch and no lunch. Normal changes in daily circadian rhythms and habitual intake pattern is related to post-lunch dip in performance (Dye et al., 2000; Gibson and Green, 2002).

Eating and meal are two of the major important sources of pleasure (Westenhoefer and Pudel, 1993). There is a substantial body of evidence about the effects of meals or energy intake on mental performance (Bellisle et al. 1998). One possible explanation for the effect of food on cognitive performance is that the macronutrients consumed within a meal differentially affect cognitive performance (Lieberman et al., 1986; Spring 1986; Spring et al., 1986; Smith et al., 1988, 1994; Kelly et al., 1994; Lloyd et al., 1994; Kaplan et al, 2001: Fischer et al .2002).

Several different physiological and endocrinological explanations of the effects of lunch have been given. It has been reported that glucose is the only metabolic fuel available to the brain. The decline in glucose, occurring in both mild and severe hypoglycemia impairs performance. A change in blood glucose level after lunch produces a hypoglycaemic state and decrease in arousal, thereby resulting in impaired performance (Karlan and Cohn, 1946). Woods and Porte (1974) suggested that the change in blood glucose leads to a parasympathetic initiation of an insulin surge, which is responsible for most effects. Consumption of lunch produces large physiological effects such as a change in blood capillary glucose and change in heart rate (Christie and McBrearty, 1979). Manning et al.(1990) found that poor performance is associated with lack of available energy and consequently lower or slower removal of blood glucose. Subjective effects of neuroglycopenia (low blood glucose at the neuronal level) include negative mood (e.g. increased tension and anger) and attenuated arousal (drowsiness). Memory is particularly affected by changes in glucose availability (Strachan et al., 1997) and the reaction time task appears to be sensitive to changes in blood glucose. Peripheral measures of blood glucose decreased under the high cognitive load (Blundell et al., 2003).

It has also been found that Glucose tolerance (i.e the ability to take up glucose from the blood stream to tissues) is posited as important in mediating nutritional effects on cognitive functions. There are substantial individual differences in glucose tolerance (Lev-Ran, 1981) as reflected in the susceptibility to impairment of cognitive performance.
Moreover, Guyton (1981) also reported that after consuming the meal, a major part of cardiac output is involved in digestion of food through autonomic nervous system thereby resulting in relative decrease in the blood supply to brain which in turn leads to similar changes in behavior and post-meal dip in performance.

Follenius et al. (1982) have reported that changes in the levels of plasma cortisol or serotonin from brain neurons (Spring et al., 1983) are responsible for the post-lunch effects. Serotonin is an important neurotransmitter involved in the regulation of mood (Young, 1993; Heninger et al., 1996) and food intake (Leibowitz and Shor-Posner, 1986). Tryptophan is an essential amino acid which is the precursor of serotonin. Intake of food decreases plasma levels of large neutral amino acids (LNAA). The LNAA and tryptophan compete for common transport sites to central nervous system and thus a decrease in LNAA will elevate brain level of tryptophan. The neurotransmitter serotonin (a derivative of tryptophan) will be affected by rising levels of tryptophan; will increase the release of serotonin which further will increase subjective feelings of fatigue and decreased feeling of vigor activity. In general sleep and feelings of fatigue are affected by tryptophan intake. In both adults and children, tryptophan reduces sleep latency, i.e. time to fall asleep and promotes feelings of drowsiness and fatigue(Steinberg et al., 1992). The post-lunch dip in performance has been found to be due to change in blood glucose and serotonin levels after consuming lunch which leads to relaxation, sleepiness, boredom, drowsiness, calmness and low alertness (Smith, 1985; Kanarek and Swinney, 1990; Smith et al., 1991; Christensen and Redding, 1993; Lloyd et al., 1994).

Smith and Miles (1986a), Lloyd et al. (1994) and Wells et al., (1995) reported that increased drowsiness or reduced arousals after meals are associated with deterioration in performance on vigilance and reaction time tasks. Conners and Blouin (1983) found impaired performance with decrease in arousal after meal. Optimal attention or memory may require some but not too much arousal, alertness and anxiety (McGaugh, 1989; Smith, 1992; Reid and Hammersley, 1999). The subtle changes in mood are less easily detected than effects on performance. Moreover, effects on mood may be more idiosyncratic than those on performance; two subjects may be equally aroused, yet one could interpret the situation negatively, the other positively (Reid and Hammersley, 1999). So, in the present study after lunch reduced arousal impacts performance on all dependent measures. Mahoney et al. (2005) studied that changes in mood and cognitive performance are due to altered levels of neurotransmitters produced by food consumption.

The results of correlated t- test reported in Table 3, 5, 8, 13, 15, 18, 23, 25, 28, 33, 35 and 38 clearly indicated that post-lunch performance was significantly lesser than the pre-lunch performance.
on stroop test (name and font same), stroop test (name and font different) and visual search test as well as digit span test.

The results are consistent with the findings of Craig (1986), Smith and Miles (1986 a, b), Smith and Miles (1987 a, b), Kanarek (1997) who also reported that post-lunch scores are more than pre-lunch scores on different cognitive tasks. The results are also consistent with the findings of Folkard and Monk (1979, 1987), Carskadon and Dement (1992), Monk et al.(1996) who reported that post lunch dip had circadian rhythms as the basis.

The results of correlated t-test also clearly reported a significant dip in performance on all dependent measures in those subjects who skipped their lunch.

These changes in behavior observed in the early afternoon were not an effect of lunch. Hildebrandt et.al (1974) has argued that these post-lunch impairments are due to endogenous rhythms rather than to consumption of the meal. In North America and Northern European cultures, this afternoon propensity for sleep is recognized, but viewed as a nuisance and labeled the post lunch dip or the “afternoon blahs” (Dinges and Broughton, 1989). There is considerable evidence of diurnal variation in the efficiency of performance (Colquhoun, 1981; Folkard, 1983; Mark and Folkard, 1984). Aspects of performance were not impaired by lunch but were worse in the afternoon irrespective of whether or not lunch had been eaten. Folkard and Monk (1985) argued that the strongest evidence for endogenous rhythms in the post-lunch dip comes from isolated studies where the subject is internally desynchronized. The post-lunch dip propensity may be linked to the size of the 12-hour harmonic component of the physiological circadian rhythm of body temperature (Monk, 1996). Monk (2005) studied that afternoon propensity for sleep is the reason of the post-lunch dip and it can be posited that the size (or timing) of the 12-hour temperature rhythm component might be predictive of the size (or presence) of a post-lunch dip in performance. Carskadon and Dement (1992) observed that the post-lunch dip still occurs, even when the subject has a constant routine with no knowledge of time of the day and does not eat lunch. The performance got adversely affected by a heavy lunch, so the post lunch dip has an endogenous effect, predicting rather than reacting to the midday meal.

Thus, the results of present study clearly verify our hypothesis that post-lunch dip is the greatest with proper vegetarian lunch as compared to snacks in lunch and skipping of lunch.
Gender and Cognitive Performance

The results reported in Tables 2, 4, 7, 9, 12, 14, 17, 19, 22, 24, 27, 29, 32, 34, 37 and 39 clearly revealed that gender produced a significant effect on performance on all cognitive tasks. The results reported in Tables 2, 4, 12, 14, 22, 24, 32, and 34 clearly indicated that females performed better than males on stroop test (name and font same) and stroop test (name and font different). These results are therefore, consistent with the findings of Golden (1974), Sarmany (1977), Dash and Dash (1987) and Mekarski et al. (1996) who reported that females were quicker than males on stroop test. The results are in line with the findings reported by Alansari (1997), and Baroun and Alansari (2006) who reported that females performed better than males on stroop test performance.

The performance on stroop test is related to the lateralization of certain cognitive functions to different hemispheres of the brain. The males have more difficulties with distinguishing colors and males are more color blind than females. Watson and Kimura (1991) reported that the females’ quicker performance on Stroop tasks could be ascribed to their verbal and fine motor abilities. The authors have suggested that neural substrate accounts for these effects labeling in line communication from color receptors to the tectum, superior colliculus, and pulvinus which might account for faster color processing, while a retinal geniculostraital routine might serve for fine grained word pattern analysis (Noback et al., 1996). However, slower and less accurate processing of words than colors might demand grouping, and possibly morphological transformation of letters, which ultimately impart meaning at cortical level (Thompson, 1952).

Some of the studies (Kimura, 1997; Goy and McEwen, 1980; Burke and Yeo, 1994) have clearly reported that the differences between males and females in stroop perception are due to brain physiology, such as a larger callosal area and planum temporal in women than in men (Kimura, 1997; Goy and McEwen, 1980; Burke and Yeo, 1994).

Kimura (1992) reported the differences between the intellectual capacities of the sexes appear to be in patterns of ability, rather than in overall intellectual functioning. Attention and perception appear to differ between the sexes and provide some clues in regard to differences that occur later on in cognitive processing. Infant girls have been found to gaze longer at visual stimuli than boys, and males are much more likely to be diagnosed with attention related problems. There are variations in all of the sensory systems. Males tend to be more adept at dynamic visual acuity, which involves the ability to detect slight movements in the field of vision. Males are also more adept than females in temporal cognition, the ability to recognize the passage of time. Females tend to be more sensitive to touch, odors, taste, and sounds --much of which is detectable shortly after birth.
Moreover, according to the Drubach (2000) the male brain is approximately 10% larger than the brain of females however, after adjustment for body size, the body-weight ratio for the female brain is actually greater. Magnetic resonance imaging has revealed that the male brain contains more white matter and cerebrospinal fluid (CSF) than the female brain, and the female brain contains a relatively greater proportion of grey matter (Gur et al., 1999). Gray matter is where computation takes, while white matter is responsible for communication between groups of cells in different areas of the brain. Women have a high percentage of tissue devoted to computation than men. Men have a greater proportion of tissue assigned to the transfer of information between distant regions. While higher volume of tissue correlated with better performance on both verbal and spatial intelligence tasks, the highest levels of spatial task performance required greater amounts of white matter that exists in most male brains. The corpus callosum, a large body of nerve fibers that connects the right and left hemispheres of the brain, however, is composed of white matter, placed a priority on this structure in women.

The results of the present study reported in Tables 7, 17, 27 and 37 clearly revealed that the females outperformed males on visual search test. The results are, thus consistent with the findings of Silverman and Eals (1994), Mcburney et al. (1997) and Levy, (2005) who reported that females outperformed males on object location memory and visuospatial abilities. The results do not provide support to the findings of Silverman (2007) who found that men scored significantly higher than women on a test of 3 dimensional mental rotations in all seven ethnic groups and 40 countries used where results are in line with the second part of the study which reported that women scored significantly higher than men on a test of object location memory in all seven ethnic groups and 35 of the 40 countries.

Silverman and Eals (1992), contended that if spatial abilities associated with hunting were selected for in males, it is feasible that spatial abilities relate to gathering were correspondingly selected for in females. In support of this it has been shown that females have larger visual fields than do men; that are they can see farther out on the periphery while fixating on a central point (Burg, 1968). They are also better than males at scanning, excelling on various tests of perceptual speed. The males prefer to use an orientation strategy in navigational skills while females prefer a landmark strategy. The hunter-gatherer theory of spatial sex differences, however, suggests that the use of a landmark navigational strategy in females may be an aspect of the same evolved cognitive mechanism, emanating from their role as gatherers, that enables their greater object location recall. Whereas orienting strategy enables the hunter to navigate across long distances where landmarks are un available or distributed far out of sight of each other, a landmark strategy is more efficacious for
the gatherer, navigating in a smaller space where the pattern of landmarks can be more readily observed and recalled (Alcock, 1984; Silverman and Choi, 2005).

A few studies on adults have found positive correlations between home range size and various male biased spatial abilities for males only (Gaulin and Hoffman, 1988; Ecuyer-Dab and Robert, 2004). Such cognitive differences have been found to be related to sex hormonal mechanisms. The endogenous sex hormones, estrogen or androgen, affect cognitive function through both pre and perinatal permanent organizational effects on brain structure as well as through the reversible post natal activation effects that are thought to occur during puberty or in adulthood (Hampson, 1995). Girls (women) who were known to have been exposed to high levels of testosterone in utero, due to congenital adrenal hyperplasia (CAH), appear to demonstrate better spatial skills than other girls and they are more likely to behave aggressively similar to boys (men) Collaer & Hines (1995).

The results reported in Tables 9, 19, 29, and 39 clearly revealed that the males outperformed females on digit span test except in the experiment on activity. The results are, therefore, consistent with the findings of Meinz and Salthouse (1998), Jorm et al. (2004) and Muangpaisan et al. (2010) who reported that females performed poor than males on digit span test.

The results of the present study clearly revealed that females perform poorer than males on digit span test (verbal STM task). Possibility for understanding the sex differences on STM relates to the nature of the task used in this study. Many STM tasks (including digit span and backwards subtraction) involve numbers, which may put males at an advantage (Meinz and Salthouse, 1998; MuMuangpaisan et al. 2010). The biological viewpoint suggests that males are superior to females on numerical tasks due to evolution and brain structure, but it has been also suggested that female difficulties with mathematical concepts are due to the different socialization and education patterns of males and females (Pearman, 2009). Indeed, several studies have shown that the use of numbers in tasks may set up stereotype threat situations in which the women respond with anxiety due to an implicit fear of math tests (Steele, 1997).

Goldstein et al. (2005) found gender differences on the brain regions used during digit span test. That is, they found that the right superior parietal lobe was activated during males STM performance and the left dorsolateral prefrontal cortex and the right orbitofrontal cortex were activated during females STM performance. If it is the case that young females use their frontal and prefrontal cortex for STM tasks, whereas young males rely more on their parietal lobe, then it stands.
to reason that known age-related degradation of the prefrontal cortex (Hillary et al., 2006) may lead females to have more difficulty on STM with each passing year.

Li et al. (2012) reported that the correlations between the digit backwards scores and the gray matter volumes in the right anterior superior temporal gyrus (STG). The digit backward performance is related to the structural and functional organizations of the brain areas that are involved in the auditory phonological loop and the salience network. The right anterior superior temporal gyrus (STG), the right posterior STG, the left inferior frontal gyrus and the left Rolandic operculum, are four critical areas in the auditory phonological loop of the verbal working memory. The digit backwards scores were positively correlated with the rsFCs (resting-state functional connectivity) within the salience network (SN), that is, between the right anterior STG, the dorsal anterior cingulate cortex and the right fronto-insular cortex. They found that the digit backwards scores were negatively correlated with the rsFC within an anti-correlation network of the SN, between the right posterior STG and the left posterior insula.

The findings of a female advantage on stroop test and visual search test performance therefore, provide present study an interesting contrast with the male advantage on digit span test.

**Interactive effects**

The results of the present study have clearly revealed that the temperamental dimensions namely emotionality, activity, sociability and impulsivity interact significantly with other variables namely lunch conditions and gender in their effects on all dependent measures. Although, the objectives in regard to these interactive effects were purely exploratory in nature, an attempt has been made to explain such effects on performance.

**Temperament and Lunch Conditions**

It is clear from the results reported in Tables 2, 4, 7 that the dimension of emotionality significantly interact with lunch conditions in its effect on all cognitive tasks. The results clearly revealed that the high emotional subjects who had proper lunch significantly had larger reaction time than those who had no lunch and those who had snacks in lunch. Low emotional subjects who skipped their lunch performed the best of all the other groups.

The results are, therefore, are not consistent with the findings reported by Craig et al.(1981) and Smith and Miles (1986b) who found that low anxious subjects show the greatest impairment after eating lunch.
The results reported in Tables 12, 14 and 17 clearly revealed that temperamental dimension of activity also interact significantly with lunch conditions in its effect on performance on cognitive tasks namely stroop test (name and font same), stroop test (name and font different) and visual search test. The results clearly revealed that the high active subjects who had proper lunch significantly had larger reaction time (worst performance) than those who had no lunch and those who had snacks in lunch. Low active subjects who skipped their lunch performed the best of all the other groups.

The results reported in Tables 22, 24 and 27 clearly indicated that temperamental dimension of sociability also interact significantly with lunch conditions in its effects on cognitive tasks like stroop test (name and font same), stroop test (name and font different) and visual search test. The results also indicated that the high sociable subjects who had proper lunch significantly had larger reaction time than those who had no lunch and those who had snacks in lunch. Low sociable subjects who skipped their lunch performed best of all other groups.

The results reported in Tables 32, 34 and 37 clearly revealed that temperamental dimension of impulsivity also interact significantly with lunch conditions in its effect on cognitive tasks like stroop test (name and font same), stroop test (name and font different) and visual search test. The results also revealed that the high impulsive subjects who had proper lunch significantly had larger reaction time (worst performance) than those who had no lunch and those who had snacks in lunch. Low impulsive subjects who skipped their lunch performed the best of all other groups.

The results of the present study thus clearly indicated that pre-lunch performance of low scorers on activity/ sociability /impulsivity on all cognitive measures were greater than the performance after lunch. The results can be explained on the basis of Eysenck’s (1967) arousal theory according to which introverts have chronically high levels of cortical arousal than extraverts. According to Blake (1967) human circadian rhythms also play an important role in individual differences there by indicating that introverts are more aroused than extraverts only at certain times of day. Thus, people who prefer to work in the morning may be called morning types and those who prefer in evening called evening types. Revelle, Anderson and Humphreys (1987) suggests that introverts may be more aroused than extraverts in the morning where as extraverts may be aroused than introverts in the evening. Relating personality differences and time of day effects on a vigilance task Colquhoun (1960) reports that interovert perform better than extroverts in the morning where as extravert perform better than introverts in the evening.
It can be inferred, therefore, that due to their high arousal in the morning, the low scorers on activity/sociability/impulsivity (introverts) performed better before taking lunch. As the consumption of lunch leads to relaxation, sleepiness, boredom, drowsiness, calmness and low alertness as reported by Smith (1985), Kanarek and Swinney (1990), Smith et al. (1991), Christensen and Redding (1993) and Lloyd et al. (1994), the arousal level of introverts is further lowered down in the afternoon i.e. after taking lunch which may hinder their ability to concentrate on the cognitive tasks thereby causing deterioration in the performance. Blake (1967) and Gupta (1991) also postulated that mental vigor and receptivity declines as the day progresses thereby resulting in poor performance.

Post-lunch dip has been found to depend upon size of lunch too Craig et al. (1981) Smith and Miles (1987), Smith et al. (1991), Smith et al. (1994) and Bellisle et al. (1998) reported that large lunch-time meal contributed to greater post-lunch dip in performance. The extent of dip depends upon the size of lunch. The more is the lunch size, greater is the impairment. The proper lunch decreases the arousal level to greater extent as compared to light lunch and no lunch. As the result of the present study clearly reveal a post-lunch dip in performance after taking proper lunch than the snacks in lunch and no lunch, it is evident that size of the lunch tends to decrease the arousal level to the greatest extent as compared to light lunch.

Lunch Conditions and Gender

The results reported in Tables 2, 4, 7, 12, 14, 17, 24, 27, 32, 34, and 37 clearly revealed that all lunch conditions significantly interact with gender in their effects on cognitive performance on cognitive tasks namely stroop test (name and font same), stroop test (name and font different) and visual search test. The results clearly indicate that the males who had proper lunch significantly had higher scores (worst performance) than those who had snacks in lunch and those who had proper lunch. Similar differences were found in females. The females who had no lunch performed the best of all other groups.

The results in this section are also consistent with those of Christie and McBrearty (1979) who reported a significant sex-by-meal effect on letter cancellation task with significant differences being seen between the lunch and no lunch conditions for males only. The findings of the present study are also consistent with the findings of Spring et al. (1983) who investigated the effects of meals on mood and performance in male and females and found that effects of meal were dependent upon the age as well as the gender of the subjects. The results of the present study did not provide support to the findings reported by Benton and Owens (1993) who found no gender differences in the effects of meals on memory in college students.
Such interactive effects of lunch and gender on performance seems to be influenced by gender differences in eating habits. Simetin et al. (2009) also report that females tend to consume food in lesser quantity than males due to their more emphasis on physical attractiveness (slim physique) which directly affects their performance.

**Temperament and Gender**

The results reported in Table 4 clearly revealed that temperamental dimension of emotionality interacted with gender in its effects only on stroop test (name and font different). The results also revealed that high emotional males significantly showed worst performance than their female counterparts on stroop test (name and font different) and on visual search test (in case of impulsivity only). The low emotional females performed better than their male counterparts.

The results reported in Tables 24 and 34 clearly revealed that sociability/ impulsivity interacted with gender in its effect only on stroop test (name and font different). The results reported in Table 37 also indicated that impulsivity interacted with gender in its effects on visual search test performance. The results also revealed that the males having high scores on sociability/ impulsivity significantly showed worst performance than their female counterparts on stroop test (name and font different) and on visual search test (in case of impulsivity only). The females having low scores on sociability/ impulsivity performed better than their male counterparts.

The results are, therefore, consistent with the findings reported by Travis et al. (1988), Basso (2000) and Halpern (2000) and Terrell et al. (2008) who reported that personality dimensions interact with gender in their effects on performance. The results, did not agree with the findings of Yahaya et al. (2009) who reported no significant differences between dimensions of self concept and personality of students according to gender and moreover, no significant relationship was reported between the personality and students academic achievement in males and females. The results are in favour of findings reported by Pearman (2009) who found a significant combined effect of gender and personality on cognitive performance using processing speed and short term memory tasks. The high conscientious extravert females were found to have higher significant faster processing speed than the males. Pearman, therefore, hypothesized that such difference in cognitive styles in men and women bearing on their personality dimension of extraversion (especially conscientiousness). Quiroga et al. (2007) found that some people solve cognition task using their basic abilities while others are influenced by their cognitive styles (fast-accurate, slow-inaccurate, impulsives as well as reflexive). Another potential way to understand this interaction may be that males and females have
different motivational levels for different types of tasks which may lead directly to performance differentia (Travis et al. 1988).

**Temperament, Lunch Conditions and Gender**

The results reported in Tables 2, 4, 12, 14, 22, and 24 clearly reveal that temperamental dimensions of emotionality, activity and sociability interact with other variables of lunch conditions and gender on stroop test scores in name and font same and name and font different conditions where as the results reported in Tables 34 and 37 clearly indicate that temperamental dimension of impulsivity has been found to interact with lunch conditions and gender on stroop test (name and font different only) and visual search test.

The results also revealed that males having high scores on activity/sociabily/impulsivity who had proper lunch significantly showed greatest post-lunch dip in the stroop test performance than all other groups whereas females having low scores on activity/ sociability/ impulsivity who skipped their lunch performed the best.

Although no direct theoretical and imperical explanations are available in literature to account for these interactive effects still the findings can be explained on the basis of general psychological theory of eating habits (Attie et al., 1990) that clearly suggests that eating habits in male and females linked to their personality characteristics which inturn influence their achievement.

A few studies have reported that gender differences in eating habits are influenced by personality characteristics of famininity (Jackson, Sullivan and Rostker, 1988), autonomy (Rolls et al., 1991) and anxiety/depression (Silverstein and Perlick, 1995 and Walters & Kandler, 1995).

Silverstein & Perlick (1995) have reported that high anxious females who had high need for achievement differ in their eating habits as compared to low anxious females. Waller and Matoba (1999) also report that eating is used as a way to cope with the negative effect especially in women which produces a direct impact on their achievement and performance.

It can be concluded, therefore, the temperamental dimensions (emotionality, activity, sociability and impulsivity), lunch conditions (skipping of lunch, snacks in lunch and proper vegetarian lunch) and gender (male and female) differentially produce their independent as well as interactive effects on all cognitive tasks namely stroop test (name and font same), stroop test (name and font different), visual search test and digit span test.