A brief review of the studies based on the available literature is presented in this chapter. An attempt has been made to reveal the main trends in research of cognitive performance in relation to the independent variables used in the present study.

The relevant research has been summarized under the following headings:

1. Personality/Temperament and Cognitive Performance
2. Meal and Cognitive Performance
3. Gender and Cognitive Performance
4. Personality/Temperament, Meals, Gender and Cognitive Performance

**Personality/Temperament and Cognitive Performance:** The literature on personality/temperament and cognitive performance is considerably complex and is fraught with inconsistencies. Many studies have found significant personality/temperament and cognition relationships (Ray, 1959; Hogan, 1966: Corr and Gray, 1995; Perkins and Corr, 2005; Graham and Lachman, 2012).

A number of studies (Helode, 1985; Helode and Sawade, 1985; Jain 1990; Singh 1990; Gupta, 1991 and Arora, 1992) reported that neuroticism significantly affected cognitive performance. Schmidt and Hunter (1998) found that the relationship between the neuroticism and applied performance is less clear; neuroticism does not correlate consistently with performance in occupational settings. Barrick and Mount (1991) found no significant relationship between emotional stability (low neuroticism) and job performance, except amongst professionals. Barrick et al. (2001) reported that emotional stability was significantly related to performance in some occupations but not others.

Neuroticism is consistently linked to lower performance across various domains including executive functioning, information processing, pattern analysis, memory and creativity (McCrae and Costa, 1987; Ackerman and Heggestad 1997; Moutafi et al., 2003, 2005; Schaie, et al., 2004; Chamorro-Premuzic et al., 2006; Willis and Boron, 2008; and Williams, et al., 2010;). High neuroticism 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; Graham and Lachman, 2012). Corr and Gray (1995) and Allender and Greig (2000) reported significant interactions between cognition and negative emotion. Claridge and Davis (2001) reported that neuroticism acts mainly in interaction with other psychological variables. However, these studies show variation in the specific shape of the interaction, suggesting that other factors, possibly the situation, may play a role in determining the precise effect on performance of ability and neuroticism factors.
Socor and Bucik (1998) found that participants that were more emotionally stable were quicker on choice reaction time (but not on inspection time) tasks as compared to high emotional ones and argued that this effect was due to less efficient processing by those high in neuroticism. Bates and Rock (2004) found that neuroticism may not affect inspection time. Perkins and Corr (2005) reported that performance ratings were negatively correlated with neuroticism. The individuals with a ‘stress intolerant’ profile of low ability and high neuroticism would perform worst. Pearman (2009) reported that neuroticism was not related to processing speed. Graham and Lachman (2012) reported that neuroticism was negatively related to working memory and reasoning. Moreover, those who remained stable and low in neuroticism had better reasoning than those who were stable or high.

Bakan (1959) found that the performance of extraverts (assessed by scores on the sociability dimensions of Heron’s (1956) inventory) benefited to a significantly greater extent and this improvement was most apparent during the first 32 min. of the task, whereas the introverts benefited only during the last 16 min. of the task. Bakan et al., (1963b) used introverts, extraverts and ‘normals’ as determined by the Maudsley Personality Inventory (Eysenck, 1959). The 48 minutes task was similar to that used previously (Bakan, 1959) except that the signal consisted of 3 successive digits in the order odd-even-odd. The performance of the normals and extraverts was very similar in that the number of correct detection decreased with time on task at much the same rate introverts on the other hand showed improvement from the first to the second 16 min. period and decrement from the second to the third period. The interaction between temperament and time on task was thus significant.

Tune (1966) found that introverts and extraverts made about the same correct detection scores but the introverts made a few errors of commission. It was assumed, inflated the detection scores of extraverts and masked any possible temperament differences in performance which might otherwise have been demonstrable using this dependent measure. However, Caille (1964) and Davies et al. (1966, 1969) have found that introverts made significantly more commission errors than did extraverts, in both visual and auditory tasks.

Hogan (1966) used the Maudsely Personality Inventory in order to determine his subjects’ temperament rating, prior to 10 min run on the Continuous Performance Task (Rosvold et al., 1956). The subjects watched a display on which letters appeared singly for a brief period and to report the occurrence of the letter if it was immediately by the letter. The extraverts, apparently, made significant fewer correct responses than the introverts not because their performance became worse over time (the temperament × time interaction was insignificant) but because they began and continued at a low level of performance.
The most extensively studied personality dimensions that have been found to affect cognitive performance include extraversion (Helode and Sawade, 1985; Helode 1985; Matthews, 1985; Eysenck 1986; Kumar et al. 1986; Nicholas and Newman, 1986, Tanwar and Kumar, 1986; Singh 1989; Amelang and Ullwer, 1991; Koelega, 1992; Matthews et al. 1992; Derryberry and Reed, 1994; Corr et al, 1995b; Gupta, 1995; Mohanasundaram and Murugesan, 2000) and anxiety (Gupta and Sharma 1986; Wallace et al., 1991; Eysenck, 1992; Mueller, 1992; Sarason et al., 1995 and Tennenbaum and Bar- Eli, 1985).

Lieberman (2000) and Stahl and Rammsayer (2008) reported that extraversion was significantly related to both speed and STM. Studies examining the extraversion-speed link have found that extraverts have a quicker motor responses than introverts both in terms of performance measures and psychophysiological responsivity (Doucet and Stelmack, 2000; Lieberman, 2000). Introverts tend to have higher basal levels of arousal which in turn may lead them to modulate their responses so as to prevent over-arousal (Eysenck, 1967; Stelmack, 1997). Furthermore, extraversion is positively related to activity in the prefrontal cortex and parietal lobe (Canli, 2004; Eisenberger et al., 2005) as is processing speed (Peers et al., 2005; Rypma et al., 2007). Similarly, Gray and Braver (2002) found that behavioral approach sensitivity, an affective dimension similar to extraversion, was related to better working memory performance in an adult sample. People lower on conscientiousness tend to score higher on general ability measures (Moutafi et al., 2006). It has even been suggested that some adolescents and younger adults actually develop higher levels of Conscientiousness when they enter secondary school and college as a means of coping with a lower overall ability level (Moutafi et al., 2003).

Findings on personality predictors of STM are also mixed (Humphreys and Revelle, 1984; Liberman, 2000; Baker and Bichsel, 2006). Liberman (2000) found that extraverts had better STM than introverts but suggested that this was merely due to the faster processing speed of extraverts. Baker and Bichsel (2006) found that consciousness and openness is linked to STM across the life span; this was supported by Roberts and Mroczek (2008). Quiroga (2007) found that some people solve cognitive tasks using their basic abilities while others are more influenced by their cognitive styles (fast-accurate, slow-inaccurate, impulsive and reflexive). Males high in conscientiousness may be more deliberate and cautious (reflexive) in the speeded tasks (trading speed for accuracy), whereas females high in conscientiousness may not have to make such a trade off because of higher baseline levels of competence on speeded tasks (fast accurate).

Extraversion is also related to cognition but the directional nature of the relationship varies. It has been associated with better creativity, speed, long-term memory, and intelligence, but
worse divergent thinking, crystallized intelligence, spatial orientation, reasoning, and verbal ability (McCrae and Costa, 1987; Ackerman and Heggestad, 1997; Moutafi et al., 2005; Baker and Bichsel, 2006; Chamorro-Premuzic et al., 2006a; Chamorro-Premuzic, Furnham, et al., 2006b; Willis and Boron, 2008). Extraverted individuals may be less invested in intellectual activities than social ones or are less likely to develop effective study habits or test-taking strategies (Chamorro-Premuzic, et al., 2006). Further, extraverted individuals may be better at performing speed-based tasks but worst at tasks requiring effortful processing because they are less inclined to deliberate over problems for long periods of time but thrive in a setting where completing a task quickly is the goal (Baker and Bichsel, 2006). Openness to experience has been consistently linked to intelligence and cognitive performance, especially with executive functioning, divergent thinking, creativity, verbal ability, verbal memory, spatial orientation and inductive reasoning (McCrae and Costa, 1987; Holland et al., 1995; Ackerman et al., 1999; Schaie et al., 2004; DeYoung, et al., 2005, 2008; Baker and Bichsel, 2006; Chamorro-Premuzic, et al., 2006; Higgins et al., 2007; Willis and Boron, 2008; Sharp et al., 2010; Williams et al., 2010). Those who are flexible and open-minded are more likely to perform well on complex tasks and abstract reasoning than those who are more rigid and narrow-minded (Schaie et al., 1991). Conscientiousness shows positive association to reasoning, speed and academic performance but is negatively related to intelligence, verbal ability, reasoning and divergent thinking (McCrae and Costa, 1987; Schaie, et al., 2004; Moutafi et al., 2005; Willis and Boron, 2008). Individuals who need to work hard to do well on cognitive tasks may develop conscientious characteristics as a means of compensation, such that being more organized, motivated, and deliberate may help him or her perform well. Finally, agreeableness, which is not typically associated with cognitive ability, has been linked in a few studies with worse inductive reasoning, spatial orientation, and general cognition (Schaie et al., 2004; Willis & Boron, 2008). Wolf and Ackerman (2005) and Backer and Bichsel (2006) showed that high extraversion is associated with lower performance on tasks that require effortful processing such as reasoning. Crowe et al. (2006) examined the relationship between personality and risk of cognitive impairment in older adults. They measured extraversion and neuroticism at one time point and cognition at 25-year intervals and found that those with a combination of high neuroticism and high extraversion showed the greatest risk for cognitive impairment and cognitive decline in adulthood. A recent study of Sharp and colleagues (2010) examined the role of openness to experience in predicting cognitive change. They found that openness was associated with better cognitive performance but not with maintaining cognitive functioning over time. Graham and Lachman (2012) reported that high extraversion is related to lower cognitive performance. Extraversion would be associated to worst performance on tasks requiring effortful processing.
Sinha and Goel (2012) reported that 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.

2. Meal and Cognitive Performance

There is an utter dearth of literature available on the effects of meal on subsequent performance, with the majority of studies concentrating on the effects of lunch on laboratory based tasks.

Post-lunch impairments in efficiency have also been found both in real-life setting (Bjerner and Swensson, 1953; Prokop and Prokop 1955; Hildebrandt et.al 1974, 1975) and also in the laboratory (Blake 1971; Craig et.al 1981).

The nature of the activity being carried out has been found to be important to the occurrence and extent of the post-lunch dip in performance. King, Bickerman, Bouvet, Harrer, Oyler and Seitz (1945) conducted a study on altitude tolerance comparing the performance of pilots in lunch and non-lunch conditions. The authors found that the performance of a psychomotor task (block placement) was worse when lunch was not consumed than when it was. Simonson, Brozek and Keys (1948) used a letter recognition task and failed to demonstrate significant differences between lunch and non-lunch conditions. Hammer (1951) found that post-lunch dip is altered by the time at which lunch is eaten. Hutchinson (1952) reported that Consumption of mid day meal can impair mental functioning. Blake (1967) through controlled laboratory experiments reported a decrement in performance following lunch on a number of tasks including vigilance, digit span, card sorting, serial reaction, calculations and reaction time. Blake (1971) failed to demonstrate a difference between lunch and non-lunch conditions on a letter cancellation task. Colquhoun (1971) also showed the effect of post-lunch dip, even in the absence of meal. Subjects who are deprived of lunch for one day may still show impaired afternoon performance because of ‘conditioned lunch effects’. Colquhoun (1982) found the time of day effect on performance. Woods and Porte (1974) reported that increased blood glucose leads to a parasympathetic initiation of an insulin surge, which is responsible for the behavior effects. Christie and McBrearty (1979) used letter cancellation, hand writing speed and a tracking task and did not find clear evidence of a post-lunch performance deficit on letter cancellation. There are subjective impressions of changes in pulse rate and deep body temperature, and increases in capillary glucose (Christie and McBrearty, 1979), increase in the level of cortisol (Follenius, 1982) or serotonin (Spring et al., 1983) are responsible for these effects.
Leaving the laboratory and considering real-life field data, the evidence for a post-lunch dip becomes more compelling. Bjerner and Swensson (1953) found trough in alertness and efficiency at about 14:00 hrs (the period that follows the usual time for lunch) in studies of accuracy of reading meters. The other authors through their experiments i.e. speed of answering a switchboard (Brown, 1949), instances of falling asleep while driving (Prokop and Prokop, 1955), lapses of attention by train drivers (Hildebrandt et al., 1974), frequency of minor accidents in hospitals (Folkard et al., 1978) showed post-lunch deficit in performance in real-life tasks. Hilderbrandt et al. (1974) found that changes in observed behavior in the early afternoon may be primarily the results of circadian rhythms in mental alertness rather than the consumption of meal.

Post-lunch dip can clearly showed through a collection of actual-task circadian performance curves (Folkard and Monk, 1979) and international meta-analysis of traffic accidents (Mitler et al., 1988). Folkard (1983) and Marks & Folkard (1984) provide considerable evidence of diurnal variation in efficiency of performance. Monk and Folkard (1985) reviewed and investigated diurnal variation in real-life tasks, which ranged from speed of answering a switchboard to the frequency of minor accidents in hospitals and clearly found a post-lunch dip in performance. Folkard and Monk (1987) examined time of day effects in various laboratory measures of performance efficiency and subjective activation and found a little evidence of a clear post-lunch dip. Monk et al. (1996) showed a clear post lunch dip in performance at a monotonous vigilance task. Monk (2005) studied the post-lunch dip in performance and reported that there is a dip in performance during the mid-afternoon hours. All these studies suggested that the post lunch dip in performance reflected changes in endogenous rhythms. Later on few studies provided data which suggested that the post lunch dip had both endogenous and exogenous components.

Craig et al. (1981) compared perceptual discrimination when lunch was eaten with when it was not. Performance was assessed one hour before and one hour after the consumption of the lunch. Clear discrepancies were seen between the lunch and no-lunch conditions, with those subjects who had been given lunch showing impairment in their ability to discriminate between events. Since, no such decrement was seen in those who had not eaten lunch; it seems likely that the effect was due to direct effect of eating lunch and not to endogenous factors such as circadian rhythms alone.

In contrast to above, a few studies indicated that there was a meals-dependent decrement in cognitive performance following the ingestion of lunch by adult subjects (Craig, 1986; Smith and miles, 1986 a, b; Smith, et al., 1988). The ability to maintain attention and react quickly to a new stimulus was impaired following lunch. A maximal dip in performance occurred after one to two
hours of lunch. Smith (1985) found that subjects who ate lunch reported a decrease in alertness and anxiety after the meal and those who abstained from eating were more alert and anxious in the early afternoon. Smith and Miles (1986a) contrasted early afternoon vigilance performance in subjects who had eaten lunch with those who had not. Testing took place one hour prior to the lunch and again one hour following the lunch. The results indicated that the consumption of lunch produced a performance deficit on the detection of repeated numbers task and an estimation task. Further evidence of difference in performance between lunch and no-lunch conditions was provided by Smith and Miles (1986b) who compared late morning and early afternoon performance in 48 subjects who either had lunch or abstained from eating. Performance on a serial self-paced choice reaction time task and stroop color test were assessed one hour prior to and following lunch. The results showed that consumption of lunch impaired performance on the choice reaction time task. Movement time was significantly slower in the early afternoon than in the morning and this effect was independent of the consumption of a meal. The results also indicated that none of the stroop test conditions was influenced by the consumption of lunch. Smith and Miles (1987 a, b) found that after eating lunch subjects had detected fewer targets in a cognitive vigilance task and were slower on a memory-loaded search test. Smith and Miles (1987a) found that movement time in the serial reaction task was slower in the afternoon, both for subjects who had eaten lunch and for those who had not. The post lunch mood changes do not reflect either the composition (Smith et al., 1988) or size of meal Smith et al. (1991). The strongest test of the existence of endogenous rhythms is to minimize the influences of exogenous factors through ‘isolation studies’ (Campbell, 1992). These involve isolating the subject from any cues relating to the passage of time, generally by placing the subject in a specially constructed isolation unit (Folkard and Monk, 1985). Subjects are allowed to eat and sleep when they wish, influenced by outside factors such as day/night or time of day. Such studies indicate a drop in performance, similar to the post-lunch dip which is unassociated with meal regularity, but is also seen in measures of body temperature. It is proposed that at least part of the post-lunch dip is due, not to ingestion of a meal, but is controlled by endogenous rhythms (Wever, 1985). Such findings suggest that the post lunch dip has both exogenous and endogenous components and that these are related to some extent to the nature of the performance task (Smith and Miles, 1987; Smith, et al., 1988). Craig (1986) reported that eating lunch led to a decrement in performance on a perceptual discrimination task.

An adverse effect of lunch does occur on some task particularly on those requiring focusing and sustaining attention. This effect depends to some degree on the nature of the task, the age, sex, personality and eating habits of the person who consumes the lunch and the nature of the meal in
lunch (Spring et al., 1983; Craig, 1986; Smith and Miles, 1986a, b; Kanarek and Swinney, 1990). Furthermore, Carskadon and Dement (1992) have shown that the post-lunch dip still occurs, even when the subject has a constant routine with no knowledge of time of day and does not eat lunch. Although undoubtedly worsened by a heavy lunch, the post-lunch dip is an endogenous effect, predicting, rather than reacting to, the midday meal. Kanarek (1997) examined the effect of meal intake on performance of mental tasks and demonstrated that lunch intake was associated with impairment in mid-afternoon performance on mental tasks and more negative reports of mood. Wells et al. (1998) clearly indicated that food intake does contribute to post-lunch dip and mental abilities at mid-day are impaired to greater degree in individuals who have consumed lunch than in those who have not. Owens et al. (2000) reported a drop in performance after a mid day meal. Lowden et al. (2004) investigated the effects of lunch on simple reaction time task and found significant performance deficit. Mahoney et al. (2005) reported that the consumption of lunch is usually followed by a decrease in performance on measures of sustained attention and alertness. The post-lunch dip in performance tends to peak about an hour after meal consumption and the extent of the dip depends upon characteristics of the person eating the meal, size of meal and types of meal tested.

Not only is the nature of the task (or activity being carried out) is important but within task components are differently affected by the nature of the meal. It is generally believed that larger the meal, the most likely that post-lunch effects on performance are to be demonstrated. The effect of size of meal has been shown to interact with eating habits of the individual, with a larger than normal lunch resulting in a greater dip in post-lunch performance than a normal size lunch. Performance efficiency can drop alarmingly after a large meal size, and strongly influence the shape of the daily curve of work (Muscio 1920; Roethlisberger and Dickson, 1939; Poffenberger, 1942; Asmussen and Boje, 1945). Drop in mental performance, by eating a large meal size usually accompanied by feeling of lethargy and coupled with various metabolic and psychological changes (Hutchinson, 1952; Craig; 1986). 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). The dip in performance can affect speed, but is more reliably found in accuracy scores, and is most noticeable when the task requires sustained attention (Laird et al., 1936; Kassouny et al, 1970). In these laboratory studies, the manipulation of the meal often meansthat people are asked to eat a meal that differs from their usual one. It is likely that some of the effects obtained are due to the unusualness of the meal and to departures from normal eating habits (Kassouny et al., 1970; Colquhoun, 1971).
Meal size was only an important factor for subjects who had a different meal to normal, with subjects who normally had a small lunch being impaired by a large meal, and those who normally had a large meal showing a post-lunch improvement after a sandwich (Craig, 1986). Smith and Miles (1986c) also reported post-meal impairments with a small sandwich based lunch.

Most studies reflected post-lunch performance deficit in uncontrolled eating situations i.e. in which subjects were allowed to eat what they wanted (Craig et al., 1981; Smith and Miles, 1987; and Smith et al., 1988). Craig and Richardson (1989) demonstrated the effects of lunch size (light v/s heavy proper) on a sustained attention task. Temperature, pulse rate and speed and accuracy of performance were measured. The authors reported that speed only and body temperature was unaffected by the size of the lunch but accuracy of task, hunger and pulse rate were influenced by the size of the habitual lunch as well as by the size of the experimental lunch. Subjects received a heavier than normal meal made more errors than those received a smaller lunch (one sandwich).

Kanarek and Swinney (1990) suggested that a late afternoon energy-containing snack can have positive effects on cognitive performance on tasks that require sustained attention. Smith et al. (1991) examined the effects of size of meal on post lunch changes in attention, mood and cardiovascular function with assessments before and after lunch. The results indicated that there was no effect of meal size on pulse rate or blood pressure, although pre/post meal differences were observed. It was also reported that the subjects who had a larger lunch than normal made more errors on focused attention and search tasks than those who had normal sized lunch or one which was smaller than normal (only one sandwich and four biscuits). Smith and Kendrick (1992) reported that subjects showed impaired performance on sustained attention task after taking large meal. Smith et al. (1994) reported that the subjects given the full heavy meals responded more slowly than those who were given small meals in lunch. Bellisle et al. (1998) reported that a large lunch-time meal contributed to the post-lunch dip in performance on sustained attention task.

Lombard (2000) studied the role of food in preventing depression, improving mood and cognitive performance and reported that eating regular meals as well as afternoon snacks improved cognitive performance. The large meals provided at lunch consistently impair cognitive performance (memory, vigilance and reaction time) and mood (alertness and fatigue) over the next one to two hours, compared with the effects of those consuming no lunch or a light lunch. Post-lunch dip in performance is related to normal changes in daily circadian rhythms as well as changes to habitual intake pattern (Dye et al., 2000; Gibson and Green, 2002).
3. Gender and Cognitive Performance:

Although less contradictory, the research on gender differences in cognition has also quite been complicated. There is evidence that boys and girls are overwhelming alike in their cognitive abilities (Brannon, 2002).

Weschler (1958) and Turner et al. (1977) found no gender differences in general intelligence. Willerman (1978) and Brody (1992) found greater dispersion in the distribution of intelligence in men. Girls seem more likely to report that they used the strategy of learning landmarks on a route; boys were more likely to report that they used a spatial orientation strategy. Some boys and girls used the strategy more typical of the other gender. The development of cognitive abilities occurred as children matured and interacted with the world formed an increased complex and accurate understanding of their bodies and the world.

The gender differences found in the verbal fluency or mathematical problem solving task have moderate to small while that found elevated in the more complex tasks of spatial aptitude (Linn et al., 1985; Hyde et al., 1988, 1990). Girls and women have been found to have some advantage in verbal performance. McCarthy (1954) and Maccoby (1996) suggest that female superiority in verbal tasks has been established around the age of 10-12 and is maintained throughout the college years (Maccoby and Jacklin, 1974). These advantages include the rapidity and proficiency with which the girls acquire language compared to boys, an advantage that girls maintain throughout grade school (Moreno, 1999).

On the contrary, boys have more advantage over girls in reading skills and verbal reasoning. Studies of males’ advantage in visual spatial ability suggested that it begins around 6 to 8 years of age (Maccoby, 1966). Men outperformed women on disembedding tests, mathematical reasoning, and are more accurate in target-directed motor skills (Kimura, 1993). Regarding specific skills (Carroll, 1993), numeric aptitudes (only the tasks of resolving math problems and spatial aptitude) have been better in men (Linn et al., 1985; Feingold, 1988; Gouchie et al. 1991; Voyer, 1995; Geary, 1996; Collins et al. 1997). Further, male advantages have been found in problem-solving aptitude tests, targeting (Watson and Kimura, 1991), and a slight advantage on verbal intelligence (Halpern, 1992). The most consistent and reliable male advantage has been found on tests of mental rotation of spatial stimuli (Peters et al., 1995; Voyer et al., 1995).

Females are superior to men on the ability on computational test (Chapman, 1988), visual memory for objects (Harshman et al., 1983; Galea and Kimura, 1993), depth and perceptual speed
(Majeres, 1983; Kimura, 1999), way finding and landmarks (Williams et al., 1990), incidental memory (McGuinness et al., 1990) and spelling (Kimura, 1999). Additional female advantages have been found on speed on object location memory (Eals and Silverman, 1994; McBurney et al., 1997; Levy et al., 2005).

Several studies have demonstrated greater performance in women in certain tasks that involve verbal memory- tasks of verbal memory- for simple lists of unrelated words, digits, paragraph content (Rosser et al., 1984; Heaton et al., 1996; Kimura, 1999), word fluency, spelling, language ability and grammatical usage (Kimura, 1999) as well as associated verbal pairs or logical memory (Ivison, 1977, Bleeker et al., 1988, Mann et al., 1990, Basso et al., 2000). The verbal fluency, fine motoricity and perceptual speed have been found to be higher in women (Feingold 1988; Mann et al. 1990; Halpern, 1992; Hall and Kimura, 1995; Nicholson and Kimura, 1996). Females also tend to excel at memory tasks, including associational fluency, which includes generating synonyms, as well as color naming, or listing items beginning with a designated letter (Kimura, 1992; Halpern, 2000). Savage and Gouvier (1992) found no significant differences between the sexes on a structured verbal memory tasks (American Verbal Learning Test- a task that includes components that show a female advantage in younger participants). Corey-Bloom et al. (1996) found no gender differences in performance on their battery (global screening, verbal and visual memory tasks, category fluency, and maintaining cognitive set).

Meinz and Salthouse (1998) found that females tended to have faster processing speeds than males across life span, although the magnitude of this difference was small (r = .05). Female outperformed men in processing speed (Burns & Nettelbeck, 2005) and on verbal episodic memory tasks (Herlitz et al., 1997; De Frias et al.,2006). Kruger (2001) found that females consistently shown an advantage for verbal abilities, including earlier language, acquisition and longer attention spans than males for conversation. Exel et al. (2001) reported that women have a better cognition function than men, despite their lower level of formal education. Townsend et al. (2002) showed that neither gender nor duration of untreated psychosis is related to the degree of change in cognitive functioning in perceiving in the stroop color and word test. Gottschalk et al. (2002) found no significant effect on cognitive impairment scores by age, education, gender, race or duration of drug abuse abstinence. Halari et al. (2005) found significant sex differences favored men on spatial tasks (Mental Rotation and Judgement of Line Orientation) and on an inhibition task and favored women on a verbal task (Category Fluency).
Parsons et al. (2005) examined the gender differences in cognitive performance among adults and the results showed that the established patterns for females are altered with age and for males remain stable through time. Torres et al (2006) studied gender differences on cognitive functions and reported that women outperform men on verbal fluency, perceptual speed tasks, fine motor skills, verbal memory and verbal learning where as men outperformed women on visuospatial ability, mathematical problem solving and visual memory but no gender differences on attention and working memory are found. Graham and Lachman (2012) reported that men show higher verbal fluency and reasoning and women show higher episodic memory and reaction time.

The extensive literature on Stroop Test (Stroop, 1935), includes many inconsistencies. Golden (1974) investigated gender differences and found females performance on color-naming trials to be faster than males but measure of interference was not significantly across gender groups. Moreover, women were quicker on Stroop color-word card test than men (Sarmany, 1977). Ben et al. (1993) found no significant gender differences in latency of naming the color of words which were related to being fat.

On the color word card, no significant gender differences have been reported for latency of naming of color words (Stroop, 1935; Peretti, 1969; Bone and Eysenck, 1972; Waber, 1976; Naish, 1980; Alansari, 1990; Singh, 1991).Several other studies have also reported a significantly shorter latency for women (Peretti, 1971; Golden, 1974; Dash and Dash, 1987; Pati and Dash, 1990) whereas significantly shorter latencies for males 5 times in succession have also been reported (Sarmany, 1977). Experimental evidence is not conclusive for the interference effects of gender in the Stroop Test.Most authors reported age-related decrements in stroop test performance (Daigneault et al., 1992; Houx et al., 1993; Feinstein et al., 1994; Libon et al., 1994; Swerdlow et al., 1995; Ivnik et al., 1996; Klein et al., 1997; Spreen and Strauss, 1998; Hameleers et al., 2000; Van Boxtel et al., 2001; Moering et al., 2003).

Mekarski et al. (1996) found that men were consistently slower than women over trial blocks and women were performing in shorter latencies on stroop test than men. Strickland et al., (1997) reported significant sex differences on time taken to complete the colors naming and word reading cards. Sex differences in stoop test performance have been reported by Martin and Frenzen (1989), Hameleers et al. (2000), Van Boxtel et al. (2001) and Moering et al.(2003) where as Trenerry et al. (1989), Houx et al. (1993), Swerdlow et al.(1995) and Klein et al.(1997) found no gender differences in stroop test performance.
Alansari (1997) investigated the effect of sex and culture on performance on the stroop color and word test and reported that stroop interference has no relationship to sex variables and is best related to cultural variables in cognition. Alansari (2003) reported that Kuwait college students had longer latencies than their British counterparts with no gender differences on stroop interference. Baroun and Alansari (2006) studied the gender differences in performance on stroop test and reported that the Kuwaiti women read faster on the color card than did the males. Gender differences were observed in the color card and color-word card tests, but not significantly for the word card test. Armengol (2002) showed significant gender differences on stroop test performance. Van der Elst (2006) studied the influence of age, sex and education on the stroop color-word test. Chengappa and Mohan (2009) found that males showed higher mean reaction time as compared to the females on stroop test performance.

The gender differences are infavor of men in the retention of spatial information (Kail and Siegel, 1977; Basso et al., 2000; Lewin et al., 2001) and in the reproduction of previously presented stimuli have been found (Maccoby and Jacklin, 1974). There is controversy regarding remembering the site of objects; some authors find no differences (Kail and Siegel, 1977); while others find a greater performance in women (Postma et al. 1998; Silverman and Eals, 1992). Silverman and Eals, (1992) discovered that women have a better memory for location than men, especially under incidental learning conditions. Women outperformed men in identifying the locations of moved objects. Females typically excel at tasks requiring perceptual speed (identifying matching items), verbal and ideational fluency, precision manual tasks, mathematical calculations, and at determining whether an object has been displaced from a series of objects (Kimura, 1992, 1993; Halpern, 2000) whereas males perform better than females on various spatial tasks, including mental rotation. Halpern and LayMay (2000) reported that females have a greater tendency to use landmarks as a strategy to orient them, while males more likely rely on spatial cues. Silverman et al. (2007) found that women scored significantly higher than men on a test of object location memory in all seven ethnic groups and 35 of 40 countries. Stoet (2011) investigated sex differences in search and gathering skills and reported that men found target objects faster and made fewer mistakes than woman in a classic visual search study. The men performed better than women on gathered items but no significant sex differences were observed on incidental learning of object locations.

The research on gender differences in verbal short-term memory (STM) has found less clear results. Meinz and Salthouse (1998) found that the males have an advantage in working memory ($r= .07$). No gender differences were found in the verbal working memory task such as the WAIS Digit subtest immediate repetition of a series of numbers in the same order in which they are presented
(direct digits) or in inverse order (inverse digits) (Makarek et al., 1993, 1995; Barnfield, 1999). Jorm et al. (2004) found that males performed better on Digit Span Backwards and on reaction time, while females were better on recall and Symbol-Digit Modalities Test. Females significantly performed better than men on working memory task (Fox et al., 2005). Goldstein et al. (2005) reported no gender differences in STM and Van Der Elst et al. (2008) showed female advantage in STM. The females had lower scores than males in every test of Digit Span (Muangpaisan et al., 2010). Adewuyi and Ayenibiowo (2012) showed no gender difference in recall of digit span numbers.

4. Personality /Temperament, Meal, Gender and Cognitive Performance

The most influential factor that has been found to influence post-lunch dip in performance is the characteristics of the person eating the meal. There is some evidence to suggest that the post-lunch dip in performance is mediated by the personality factors. Craig et al. (1981) found that the post-lunch dip of perceptual sensitivity was significantly correlated with scores on the Extraversion and Neuroticism dimensions of Eysenck Personality Inventory (i.e. stable extraverts demonstrated a larger post-lunch dip in performance on this task than did neurotic introverts). This finding was sustained in a study by Smith and Miles (1986, c) who investigated the relationship between extraversion, neuroticism and anxiety with post-lunch dip in performance of a task which involved monitoring a series of digits, responding to either three consecutive odd or three consecutive even digits. Pre/Post differences on the vigilance task (on hit rate) correlated 0.44 with extraversion, -0.47 with neuroticism and 0.83 with state anxiety scores. The results showed that the subjects with low levels of trait or state anxiety showed the greatest post-lunch impairments. It has been postulated that differences in performance between stable extraverts and neurotic introverts may be due to different levels of anxiety, with stable extraverts generally being thought to have low anxiety levels.

Gender also appears to play an important role in the development and extent of post-lunch performance deficits. Christie and McBreatry (1979) found no evidence of a general dip in performance following lunch, but a sex-by-meal effect was seen for a letter cancellation task with significant differences being seen between the lunch and no-lunch conditions for males only. Spring et al. (1983) examined post-meal effects of protein and carbohydrate meals on mood and performance on auditory reaction time and a dichotic shadowing task (a measure of selective and sustained attention) in males and females subjects. Females reported sleepiness after a carbohydrate meal than after a protein meal whereas males reported calmness. Craft et al. (1994) reported that older man (range 58-57 years of age) may be more susceptible to the effects of glucose on performance (memory) than younger men and younger or older woman and women showed less
sensitivity to a glucose administration effects on memory performance than men whereas Benton and Owens (1993) found no gender differences to investigate the effects of blood glucose levels on memory in college students. Travis et al. (1988) found that gender interacted with both locus of control and type of achievement domain in predicting motivation for success.

Wankowski and Cox (1973) found that among female students, stable extraverts gained high honor degrees but for males, it was introverts who gained first class honors. Margrain (1978) reported that performance was highest for males among stable introvert females. Terrell et al. (2008) found that man and woman acted aggressively in competitive situations based on their personality types. Yahaya et al. (2009) reported no significant gender differences between the personalities based on the extraversion and neuroticism scale with the students’ academic achievement. Pearman (2009) reported that high extrovert female positively predicted processing speeds. The author also found that female high in conscientiousness was significantly faster than males high in conscientiousness and males with higher consciousness were significantly slower than the rest of the sample. High extrovert and low conscientiousness male were predictive of STM. These differences may be accountable to differences in cognitive styles in low conscientious and high conscientious men and women (Dickman and Meyer, 1988; Quiroga et al., 2007).

While there has been no published research that examines gender and personality interactions in understanding basic cognitions in adults, there are several lines of research (Margrain, 1978; Pearman, 2009) suggested that males and females with different personalities may behave differentially in certain circumstances. It has been found that males and females may have different motivational levels for different types of task which may lead directly to the performance differential (Pearman, 2009).
The Present study

The review of literature thus clearly represents clear-cut inconsistencies in the findings reported regarding the relationship between meals and performance. The studies clearly demonstrated that the performance efficiency changes after lunch. The link between meals and performance has been complex and to interpret the link between meals and performance, the number of factors that involved the nature of the meal, type of activity being carried out and individual differences in the people being studied, have been highlighted. The majority of studies concentrated on the acute effects of meals, and thus knowledge of the eating and not eating certain types of meal was limited and there was a need to conduct studies both in the laboratory and real life situations. Also, Smith and Kendrick (1992) and Kanarek (1997) suggested a number of factors namely gender, personality/temperamental dimensions, influences of snacks and short term fasting (missing one meal) which remain to be explored and further work was required to understand the separate and combined roles of these factors in regard to meal intake and cognitive performance. Moreover, not even a single study, more specifically in Indian context has come to hand in which the effects of temperamental dimensions, lunch conditions and gender have been investigated altogether on cognitive performance. The present study was, therefore, a step in this direction.

The present study was, therefore, designed to examine the effects of temperamental dimensions (emotionality, activity, sociability and impulsivity), lunch conditions (skipping of lunch, snacks in lunch and proper lunch) and gender (male and female) on cognitive performance.

The title of the present study is: “Effects of Temperamental Dimensions, Food Intake and Gender on Cognitive Performance”.

Objectives

The study was conducted with the following objectives in the mind –

1. To study the independent effect of temperamental dimensions (i.e. emotionality, activity, sociability and impulsivity) on cognitive performance.

2. To study the independent effect of lunch conditions (varied at three levels i.e. skipping of lunch, snacks only in lunch and proper vegetarian lunch) on cognitive performance.

3. To study the gender differences in cognitive performance.
4. To study the interactive effects of temperamental dimensions, lunch conditions and gender on
cognitive performance.

Hypotheses

The following hypotheses were formulated:

1. Low scorers on all temperamental dimensions will perform better on cognitive performance
tasks than the high scorers.

2. Post-lunch dip in cognitive performance will be the greatest with proper vegetarian lunch as
compared to no lunch and snacks in lunch(light lunch).

3. There will be significant gender differences on cognitive performance.
   a) Females will perform better than males on stroop test performance.
   b) Males will outperform females on visual search test and digit span test.