Cognitive Performance

Cognition refers to mental activity, describes the acquisition, storage, transformation and use of knowledge which includes attention (tonic and phasic alertness, and selective and sustained attention), working memory (phonological, used for speech, reading and writing; and visuospatial, used for spatial processing, drawing, and mathematics), and executive function including initiative, decision making, and problem solving (Valdez et al., 2008).

In cognitive psychology, the term ‘performance’ refers to the measurement of several processes that can be represented both in cognitive and somatic functions of the brain. “The term performance denotes abilities and skills from the psychological functional ranges of perception, attention (concentration), learning and retention, thinking and intelligence, and psychomotor activity, all of which can be assessed by test”. So, cognitive performance is not defined by a single value like the intelligence quotient but rather as a combination of performance of several cognitive functions and processes (Budde and Barkowsky, 2008).

Cognitive performance can be assessed by using many tasks, such as subjective measures, reaction time, memory tasks, reading comprehension, arithmetical operations, time estimations, or logical reasoning. All these tasks are the output of basic cognitive processes that are the building blocks of higher cerebral functions and human behavior. According to Cajochen et al. (2004) there are three basic cognitive processes that may be the bases of cognitive performance namely attention, working memory, and executive functions. Attention is the capacity to interact efficiently with the environment and includes components of tonic alertness, phasic alertness, selective attention, and sustained attention (vigilance) (Posner and Rafał, 1987; Cohen, 1993).

- **Tonic alertness** is the capacity to respond to events in the environment; it reflects the arousal level, general alertness, or activation of the organism at any time, and it is also the most primitive component of attention. The level of tonic alertness determines the capacity for, and speed in processing information.

- **Phasic alertness** is the capacity to respond to an event after a warning signal— it is crucial to be ready and respond to a change in the environment.

- **Selective attention** is the capacity to produce a specific response to a specific stimulus and a different response to another stimulus; it involves filtering out irrelevant information from the environment.
• **Sustained attention**(vigilance) refers to the capacity to continue responding efficiently for sometime (minutes to hours).

  Tonic alertness depends on the reticular activating system, whereas the other components require the participation of the cerebral cortex (mainly the parietal and frontal lobes). There are circadian variations in tonic alertness, phasic alertness, and selective attention. The lowest levels of these components of attention processes occur from 04:00 to 07:00 hr (Valdez et al., 2005). Sleep deprivation impairs tonic alertness and selective attention (Thomas et al., 2000) and fatigue produces a reduction in sustained attention (Gillberg and Akerstedt, 1998).

  Working memory is the capacity to store, retrieve, and use information for a very limited period (seconds). There are two storage components of working memory: Phonological and Visuospatial.

  • **Phonological storage** is crucial for verbal comprehension, speech production, reading and writing. The phonological storage component depends on the activity of the temporal lobe of the left hemisphere (Baddeley and Logie, 1999).

  • **Visuospatial storage** is relevant for image and spatial processing as well as for drawing and mathematical ability. The visuospatial storage component depends on that of the occipital lobe of the right hemisphere (Burton et al., 2005).

  Circadian rhythms have been documented in both storage components of working memory, with the lowest levels occurring from 04:00 to 07:00 hr (Ramirez et al., 2006). Sleep deprivation also produces a reduction in the capacities of these components of working memory (Weaver, 2001).

  Executive functions include initiative, planning, action, monitoring ongoing activity, and adjustment of behavior according to current conditions. Executive functions are crucial for decision making, self-control, and problem solving. Components of executive functions are initiation or “go” responses, inhibition, planning, flexibility, and self-monitoring (Stuss and Levine, 2002; Godefroy, 2003).

  As all cognitive processes are modulated by some components of executive functions; a central executive component is included in analysis of attention (Berger and Posner, 2000) and of working memory (Baddeley, 1996). Executive functions exert an influence also on complex cognitive processes, such as language, learning and problem solving. Executive functions depend on the activity of the frontal cortex, specifically, the prefrontal areas (Miller and Cohen, 2001). Circadian
variations and sleep deprivation effects have been documented in some components of executive functions (Nilsson et al., 2005; Killgore et al., 2006; Harrison et al., 2007), but there are problems while assessing these functions in laboratory conditions. Tests designed to measure executive functions require procedures that incorporate decision making, planning, and solving new problems (Jones and Harrison, 2001; Alexander and Stuss, 2006); they must also be “ecologically valid”, that is, directly related to the capacity to solve problems in the real world (Harrison and Horne, 2000).

There is a large body of research that considers biological factors that are associated with accidents or errors in the workplace, the aim being to develop strategies that minimize such occurrences. This approach has been complimented by laboratory based studies that investigate the factors that affect cognitive performance, the basic argument being that the poor performance is more likely to result in errors, which, if in-corrected, lead to accidents (reviewed in Folkard, 1990; Horne & Reyner, 1995; Dinges, 1995; Akerstedt, 1995, 2007; Waterhouse et al., 2001). In the present context therefore, “Cognitive Performance” can be defined operationally as the outcome of a task, effort or activity that engages the central nervous system (CNS).

The cognitive performance of a person is an important indicator for the specific capabilities and needs one has in a certain situation. The level of cognitive performance is an individual characteristic for a human, which varies significantly in the course of a day caused by changes of the environment, personality/temperament of individual, the human affective state, fatigue and nutrition (Newell et al., 2003). Due to the continuous variability, it is important to measure cognitive performance constantly or any time the influencing factors change. As cognitive performance is a highly individual characteristic of a human, the measurement has to be tailored to the individual characteristics (Salthouse et al., 2006).

As cognitive performance is a complex of cognitive abilities which are influenced by both the intellectual abilities and non-intellectual factors like fatigue or interest and the individual’s cognitive performance is not stable over the day but rather varies significantly. So, each person has an intraindividual level of cognitive performance the level of which is affected by performance factors. These performance factors can be divided into three types namely a) Situation-specific variables like noise or heat. b) Task-specific variables like complexity or time-limit of a task. C) Individual specific variables like temperament, health status, fatigue, affective state, mood, motivation, interest and nutrition (meal).
Some of these factors are likely to vary within short periods and completely different in their impact on performance and termed as reversible or flexible performance factors (Budde and Barkowsky, 2008).

**Independent Variables:**

In the present study, effects of three independent variables namely temperament, food and gender have been studied on the dependant variable of cognitive performance. The conceptual connotations of the independent variables are as follows:

1. **Temperament**

   The word Temperament which is derived from the Roman “temperamentum,” originally referred to a proportionate mixture of bodily humors, and it took the form of the fourfold typology among Greco-Roman physicians close to 2000 years ago (Diamond, 1974).

   Temperament may have origins in ancient Egypt or Mesopotamia. Empedocles in the fifth century B.C. proposed that all of nature is composed of four elements: Air (primarily wet and secondarily hot), Fire (primarily hot and secondarily dry), Earth (primarily dry and secondarily cold) and Water (primarily cold and secondarily wet). Greek physician Hippocrates (400 B.C.) systemized and developed medical theory and reported that these elements are represented in the human body in the form of four “humors”. If one humor predominated in the body, we would expect to find a corresponding predominance of someone temperament (Allport, 1961).

   According to Galen (150 A.D.), four elements were used by Hippocrates in describing the human body with an association with the four humours: yellow bile (fire), black bile (earth), blood (air), and phlegm (water) and reported that the humors as the root cause not only of temperament but of diseases. Too much of yellow bile might cause fever; too much black bile, depression and decline. Galen assigned a definite cause for each of four outstanding types of individuals. Sanguine person always full of enthusiasm was said to own his temperament to the strength of the blood; the sadness of the melancholic was supposed to be due to the over functioning of black bile; the irritability of the Choleric was attributed to the pre-dominance of the yellow bile in the body; the phlegmatic person’s apparent, and lowness of apathy was traced to the influence of the phlegm.

   According to the Greeks, the **Sanguine** type has a particularly abundant supply of blood (hence the name sanguine, from sanguis, Latin for blood) and so also is characterized by a healthful look, including rosy cheeks. The Sanguine temperament personality is fairly extroverted. People of a
sanguine temperament tend to enjoy social gatherings, making new friends and tend to be quite loud. They are usually quite creative and often daydream. Sanguine are very sensitive, compassionate and thoughtful. Sanguine personalities generally struggle with tasks all the way through, are chronically late, and tend to be forgetful and sometimes a little sarcastic. Often, when pursuing a new hobby, interest is lost quickly in them when it ceases to be engaging or fun. They are talkative and not shy. For some people, these are the ones whom they want to be friends with and usually they become lifelong friends. They are cheerful and optimistic, pleasant to be with, comfortable with his or her work. The sanguine person is free and full of hope; attributes great importance to whatever he may be dealing with at the moment, but may have forgotten all about it the next. They keep their promises but fail to do so because they never considered deeply enough beforehand whether they would be able to keep them.

**Choleric** name refers to bile (a chemical that is excreted by the gall bladder to aid in digestion). A person who is choleric is a do-er. They have a lot of ambition, energy, and passion, and try to instill it in others. They can dominate people of other temperaments, especially phlegmatic types. Many great charismatic military and political figures were choleric. They are characterized by a quick, hot temper, often an aggressive nature. They like to be leaders and in charge of everything. Physical features of the choleric person include a yellowish complexion and tense muscles. These hot-headed are quickly aroused, but easily calmed down if their opponent gives in; they are quick in activity, but not persistent. Precisely because they are not persistent; they prefer to give orders, but do not want to be bothered with carrying them out. They love appearances, pomp, formality and open recognition and want to be publicly praised. In one word, the choleric temperament is the least happy, because it is the most likely to call forth opposition to itself.

**Melancholic** has been adopted as a synonym for sadness, but comes from the Greek word for black bile. A person who is a thoughtful ponderer has a melancholic disposition. They are often very considerate and get rather worried when they could not be on time for events. They can be highly creative in activities such as poetry and art and can become occupied with the tragedy and cruelty in the world. These people tend to be sad, even depressed, and take a pessimistic view of the world. A melancholic is also often a perfectionist. They are often self-reliant and independent. One negative part of being melancholic is that sometimes they can get so involved in what they are doing and they forget to think of others. People tending towards melancholia attribute great importance to everything that concerns them. They discover everywhere cause for anxiety, and notice first of all the difficulties in a situation, in contradiction to the sanguine person. They do not make promises easily, because they insist on keeping their word, and have to consider whether they will be able to do so.
All this is not so because of moral considerations, but because interaction with others makes them worried, suspicious and thoughtful; it is for this reason that happiness escapes them.

Phlegmatic comes from the word phlegm, which is the mucus we bring up from our lungs when we have a cold or lung infection. Phlegmatic tend to be self-content and kind. They can be very acquiescent and affectionate. They may be very receptive and shy and often prefer stability to uncertainty and change. They are very consistent, relaxed, rational, curious, and observant, making them good administrators and astronauts. These people are characterized by their slowness, laziness, and dullness. Physically, these people are thought to be kind of cold, and shaking hands with one is like shaking hands with a fish. Phlegma means lack of emotion, not laziness; it implies the tendency to be moved, neither quickly nor easily, but persistently. These people warm up slowly, but they retain the warmth longer. They act on principle, not by instinct and their happy temperament may supply the lack of sagacity and wisdom. They are reasonable in their dealing with other people, usually get their way by persisting in objectives while appearing to give way to others.

These four types are actually the corners of two dissecting lines: temperature and humidity. Sanguine people are warm and wet. Choleric people are warm and dry. Phlegmatic people are cool and wet. Melancholy people are cool and dry. There were even theories suggesting that different climates were related to different types, so that Italians (warm and moist) were sanguine, Arabs (warm and dry) were choleric, Russians (cool and dry) were melancholy, and Englishmen (cool and wet) were phlegmatic.

Kant (1798) described four temperaments as follow: (a) The Sanguine Temperament (Blood) – enthusiasm. (b) The Melancholic Temperament (Black Bile) – sadness, depression. (c) The Choleric Temperament (Yellow Bile) – activity is quick but not persistent. (d) The Phlegmatic Temperament (Phlegm) – slowness, dullness, lack of emotions.

According to Wundt (1903), men may differ in the characteristic intensity of the response or characteristic speed of emotional arousal. Melancholics and choleric are inclined to strong affects, while sanguinies and phlegmatics are characterised by week ones. Kant and Wundt jointly describe these four temperaments on two major dimensions i.e. emotionality and changeability.

Jung (1921) shows relation between the four temperaments on two major dimensions the modern introvert-extravert dimensional system. Jung (1923), based on patients’ studies, observed that humans were engaged in both inward and outward directed pattern of behavior. Persons whose behaviors were inward-influenced were considered to be introverts (inner world of thought and
feelings) and those whose behaviors were more outwardly-influenced, were considered to be extraverts (outer world of things and people).

Kretschmer (1921) proposed a theory that linked physique to mental illness and identified three major types of body build: (a) The linear physique called Asthenic (b) The muscular called Athletic and (3) The roly-poly called Pyknic(A youth type, the Dysplastic, was comprised of those rare individuals with inconsistent body builds that struck the observer as ugly) (Peterson, 1988) and found that individuals suffering from Schizophrenia were apt to be asthenic, while manic-depressive tend to be pyknic and with age we all tend toward a pyknic physique so have increased risk for bipolar depression (Hall & Lindzey, 1978).

On the earlier ideas of Kretschmer, Sheldon (1940, 1942) extended constitutional psychology to normal individual and reported that each component of physique is associated with a particular personality style. Sheldon and his colleagues (1949) defined temperament as “the patters of the mixture of three primary components Visceratonia (This was paired with Endomorphy, characterized by enjoyment of food, people and affection), Somatotonia (this was paired with Mesomorphy - love of physical adventure and risk taking) and Cerebrotonia (This was paired with Ectomorphy – desire for isolation solitude, and concealment) (Fehr, 1983).

The scientific explanation of temperament was given by Pavlov theory about the types of higher nervous activity. Pavlov (1951) described three properties (force, steadiness and mobility) of the processes of excitation and braking and further depending upon the combination of these, four basic types of higher nervous activity were differentiated. The author correlated the types of nervous systems with the psychological types of temperaments and explained temperament as a manifestation of the type of nervous system into the activity. As a result the relationship of the types of nervous system and temperaments appears as:

- Strong, balanced, mobile type - sanguine temperament;
- Strong, balanced inert type - phlegmatic temperament;
- Strong, unbalanced, with the predominance of excitation - choleric temperament;
- Weak type – melancholic temperament.

LaHaye (1966, 1984) reported twelve mixtures of the four temperaments, representing people who have the traits of two temperaments, called Mel-Chlor, Chlor-San, San-Phleg, Phleg-Mel, Mel-San, Chlor-Phleg; and the reverse of these: Chlor-Mel, San-Chlor, Phleg-San, Mel-Phleg, San-Mel, and Phleg-Chlor. The order of temperaments in these pairs was based on which temperament was the "dominant" one (this is usually expressed by percentages).
According to Eysenck (1970), personality has been sub-divided into two parts. One is non-cognitive aspect which is referred to as Temperament (which may be said to designate a “raw material” from which personality is fashioned) and other cognitive aspect is Intelligence. Personality can be studied from either temperamental or cognitive aspects, or both (Eysenck and Eysenck, 1985). Eysenck (1991) focused on the temperament aspect of personality in his PEN model. There are only three major dimensions or superfactors in the description of personality: Extraversion-Introversion; Emotional Stability-Instability or Neuroticism and Psychoticism-Impulse control (Superego).

Extraverts are characterized by sociability, impulsiveness, jocularity, liveliness, optimism, and quick-wittedness, whereas Introverts are quiet, passive, unsociable, careful, reserved, thoughtful, pessimistic, peaceful, sober, and controlled. The author believed that the principle difference between extraverts and introverts is one of cortical arousal level.

Neuroticism/Emotional stability is largely influenced by genetic factors. People high in neuroticism have such traits as anxiety, hysteria, and obsessive compulsive disorders. They frequently have a tendency to overreact emotionally and to have difficulty in returning to a normal state after emotional arousal. They often complain of physical symptoms such as headache and backache, but they also may be free from psychological symptoms.

The latest and weakest of Eysenck personality factor is Psychoticism/Superego. High Psychotic scores may indicate anxiety, hysteria, geocentricism, non-conformance, aggression, impulsiveness, hostility, and obsessive compulsive disorders. Both normal and abnormal individual may score high on neuroticism scale.

In reviewing the literature on temperament, a primary challenge lies in adopting a widely acceptable definition of the broad construct of temperament or of any of its component dimensions (ElseQuest et al., 2006). Many modern scientific approaches to temperament are rooted in Allport’s personality theory.

Temperament covers the qualities abstracted from his or her behavior such as dullness or alertness, torpor or vigor, gentleness or brusqueness, passivity or assertiveness, apathy or readiness to flare into anger and into other emotions, emotional stability or restlessness, and so on. Temperament is also used to denote the strength, vividness and other qualities attached to the senses and basic drives like hunger and sex. It refers to a person’s characteristic mode of responding behaviorally and emotionally to the environment (Allport, 1924; Mead 1956).
Allport (1937) and Cattell (1950) viewed temperament largely as hereditary characteristics that were somewhat resistant to environmental influence when compared to those aspects of personality more determined through experiential factors. Allport emphasized emotional and mood qualities, while Cattell discussed temperament in terms of impulsiveness versus reflectivity, or threshold for excitability.

According to Allport (1961), “Temperament refers to characteristic phenomena of an individual’s nature, including his susceptibility to emotional stimulation, his customary strength and speed of response, the quality of his prevailing mood and all peculiarities of fluctuation and intensity of mood; these being phenomena regarded as dependent upon constitutional make up, and therefore largely hereditary in origin”.

Temperament includes two dimensions - Reactivity and Mobility (Strelau 1974, 1983, 1985a 1985b) and it has also been found to be related to personality (Strelau, 1982; Cloninger, 1987 and Strelau and Zawadzki, 1995). Strelau (1987, p.182) discusses five respects in which there is at least a popular difference between personality and temperament.

- Temperament is biologically determined where personality is a product of the social environment.
- Temperamental features may be identified from early childhood, whereas personality is shaped in later periods of development.
- Individual differences in temperamental traits like anxiety, extraversion-introversion, and stimulus-seeking are also observed in animals, whereas personality is the prerogative of humans.
- Temperament stands for stylistic aspects. Personality stands for content aspect of behaviour.
- Unlike temperament, personality refers to the integrative function of human behavior.

Angleitner and Strelau (1991) suggest one of the most essential differences between personality and temperament inventories i.e., "...whereas personality items refer mainly to the frequency dependent (how often a given behavior occurs), temperament items mostly have to do with the intensity measure [how strong (intense) a given reaction (behavior) is expressed]" (p.198). Hofstee (1991) argues that temperament is a subclass of personality.

Temperament is a set of genetically inherited broad dispositions that appear early in life and underlie a variety of personality traits (Buss and Plomin, 1975). These authors proposed that temperament is the precursor to adult personality and presented five criteria to be met when deciding which personality dispositions should be called temperaments. These criteria include:
• Evidence of a genetic component;
• Stability during development
• Presence in adulthood
• Adaptive qualities
• Presence in other animals.

They stated that temperament is expected to differentiate during development with the course of these inborn dispositions being determined by interaction with the environment. For example, emotionality in early infancy is displayed by crying and fussing behaviours undifferentially. However, with maturation emotionality differentiates into fearfulness, frustration, and negative responses to specific environmental situations. The authors identified four temperamental dimensions-EASI, Activity, emotionality, Sociability and Impulsivity. Activity refers to total energy output. Emotionality refers to affiliativeness, a strong desire to be with others. Impulsivity refers to tendency to respond quickly rather than inhibiting the response.

**Emotionality** is equivalent to intensity of reaction. The emotional person is easily aroused, and he tends to have an excess of affect. It may appear as a strong temper, a tendency toward fearfulness, violent mood swings, or all these together. The autonomic nervous system is usually involved in such arousal, but we also include the expressive aspects of emotional arousal. The temperament emotionality is designed to measure level of affect or emotional reactivity. This is divided into three components, called general emotionality, fear and anger. General emotionality represents undifferentiated emotion—a tendency to be easily aroused. Fear is defined as an escape reaction to noxious stimuli, whereas anger epitomizes attack or repulsion in comparable circumstances.

**Activity** refers to total energy output. The active person is typically busy and in a hurry. They like to keep moving and may seem tireless. Their speech and actions are vigorous. The second temperament, activity consists of two components—tempo and vigor. Tempo describes the pace with which a person engages in activity, whereas vigor describes the forcefulness with which the actions are executed.

**Sociability** consists mainly of affiliativeness: a strong desire to be with others. For the sociable person, interaction with others is far more rewarding than most non-social reinforces. We also assume these persons are more responsive to others. The third temperament, sociability consists of two components—sociability (the need for the company of others) and warmth (the ability to attract others).
**Impulsivity** involves the tendency to respond quickly rather than inhibiting the response. We assume two main components: (a) resisting versus giving in to urges, impulses, or motivational states; and (b) responding immediately and impetuously to a stimulus versus lying back and planning before making a move. The final temperament, impulsivity is the one which provokes most reservations. The core component of impulsivity represents lack of inhibitory control, that is, an inability to delay responses to stimuli. In addition, they postulate three more specific facets – decision time (quickness to respond), lack of persistence (low tolerance to aversion), and sensation seeking (low resistance to temptation).

The extremes of four dimension of temperament are:

- **Emotional-impassive**: Intensity. How much emotional and excitable the person was? Some were given to emotional outbursts of distress, fear, and anger -- others were not.
- **Gregarious-detached**: How close to others (proximity seeking). How much person enjoys or avoids contact and interaction with people. Some people are “people’s people,” others are “loners.”
- **Active-lethargic**: How much? How vigorous, how active, how energetic the person is. Some are always on the move, fidgety, busy -- and some are not.
- **Impulsive-deliberate**: Quickness vs. inhibition of response. How quickly did the person “change gears,” move from one interest to another? Some people quickly act upon their urges; others are more careful and deliberate.

Buss and Plomin (1984) remove impulsivity temperament and distinguish three basic temperaments referred to as EAS- Emotionality, Activity and Sociability. Buss(1991) describes temperament as "*a subclass of personality traits defined by: appearance during the first year of life, persistence later in life, and the contribution of heredity*" (p.43). The three personality traits that meet these criteria as defined by Buss are emotionality, activity, and sociability, from which are derived the acronym EAS. "Emotionality is defined as distress that is accompanied by intense automatic arousal". The major components here are fear and anger. "Activity is defined as the expenditure of physical energy and consists solely of movements of the head, arms, legs and body". Major components include tempo, vigor, endurance, and motivational components. "Sociability is defined as preference for being with others rather than remaining alone (p.49-50). Major components include incremental seeking out others and remaining with them.

According to Thomas and Chess (1977) Temperament can be equated to the term behavior style and it refers to the “how” rather than “what” or the “why” of behavior and is influenced by
environmental factors in its expression and even in its nature as development proceeds. Thomas et al., (1963, 1977, 1980) specified a nine-dimension model of temperament that conceptualized the how-rather than the what (i.e., ability and content) or why (i.e., motivation)-of behavior, known also as behavioral style. Nine temperament dimensions are:

- Activity level (i.e., motor activity);
- Regularity or rhythm city (i.e., predictability or regularity of behavior);
- Initial Reaction: Approach or withdrawal (i.e., response to novelty);
- Adaptability (i.e., response to alterations in environment);
- Intensity of reaction (i.e., the energy level of a response);
- Quality of mood (i.e., amount of pleasant or positive mood);
- Distractibility (i.e., effectiveness of environmental stimulation in altering the child’s direction of behavior);
- Attention span and persistence (i.e., length of time and maintenance of activity pursued by the child) and
- Sensitivity: Threshold of responsiveness (i.e., intensity of stimulation necessary to evoke a reaction);

According to Thomas and Chess(1986), “Temperament is a phenomenological term in which the categorization of any individual is derived from the constellation of behaviors at any one age period. These behaviors are the result of all the influences, past and present, which shape and modify these behaviors in a constantly evolving interactive process”.

Mehrabian (1980,1991) has a three-dimensional temperament model based on his three-dimensional model of emotions namely: Pleasure-Displeasure (P), Arousal-Nonarousal (A) and Dominance-Submissiveness (D).

- “P” means of experience more pleasure than displeasure. It relates positively to extraversion, affiliation, nurturance, empathy, and achievement, and negatively to neuroticism, hostility, and depression.
- “A” means strong response to unusual, complex or changing situations. It relates to emotionality, neuroticism, sensitivity, introversion, schizophrenia, heart disease, eating disorders, and lots more.
- “D” means control over your life. It relates positively to extraversion, assertiveness, competitiveness, affiliation, social skills, and nurturance, and negatively to neuroticism, tension, anxiety, introversion, conformity, and depression.
Rothbart and Derryberry (1981) defined temperament as constitutionally based individual differences in reactivity and self-regulation (influenced over time by heredity, maturation, and experience). Reactivity refers to the activation of motor, affective, autonomic, and endocrine systems. Self-regulation refers to the processes that modulate reactivity such as attention, approach-withdrawal, inhibition, and self-soothing. Rothbart (1986) has defined temperament as “constitutionally based individual differences in reactivity and self-regulation, with “constitutional” referring to the relatively enduring biological makeup of the individual, influenced over time by heredity, maturation, and experience.”[p365]

McCall (1986) proposes that temperament is relatively stable, continuous, pervasive, and inherited and describes that "Temperament involves those dimensions of personality that are largely genetic or constitutional in origin, exist in most ages and most societies, show some consistency across situations, and are relatively stable, at least with major development areas" (p.17).

Hinde (1986) argues that "...Temperamental characteristics cannot be viewed as aspects of the behavior style of an individual. They may vary, at least to some extent, with the context of behavior and are affected by the social and physical situation, cognitive development, and by other aspects of the individual"(p.118).

According to Slabach (1991),"Temperament refers to stable cross-situational patterns in observed behaviour" (p.215).

According to Angleitner & Reimann (1991), “Temperament refers to individual differences in temper, that is, characteristics which are largely stylistic ways of behaving in social situations” (p.192).

Van Heck (1991) referred to temperament as "those traits or mechanisms which (1) form the biological basis of personality, (2) reflect style rather than content of behavior, and (3) have a high heritability” (p.165).

Talwar, Nitz & Lerner (1991) viewed temperament as a "key instance of behavioral individuality"(p.29). Gray (1991) identified “Temperament as reflecting parameter values that determine, for a particular individual, the operating characteristics of three emotional systems (the behavioral inhibition system, the fight/flight system, and the behavioral approach system), alone and in interaction with one another"(p.123)
Cattell (1989) used factor analysis to identify a large number of traits, including personality traits. Included in personality traits were temperament traits, which are concerned with how a person behaves in general. Temperament traits include both normal and abnormal traits. Of the 23 normal traits, 16 are measured by Cattell’s famous 16 PF scale.

Temperament is a biologically driven antecedent of personality (Goldsmith et al., 1987). Goldsmith and Rothbart (1991) proposed three assessment principles of temperamental dispositions:

- The first principle is that behavior manifestations of temperamental dispositions change during development."
- A second principle of "developmentally sensitive assessment of temperaments is that the elicitors of temperament-related behaviours’ change during development."
- A third development assessment principle is that "observed individual differences in temperament can be due to either rate of development of temperament-related behaviour or characteristic (or strength) of disposition or to a combination of the two" (p. 250).

Ahadi et al. (1993) and Rothbart et al. (2000) support a three-factor model of temperament that includes effortful control, negative affectivity, and surgency. Rothbart et al’s (2000) factor analytic work on temperament and personality indicates moderate correlations between three temperament factors and **three of the Big Five personality factors are:**

- Negative affectivity (including fear, discomfort, and frustration) is linked to Neuroticism
- Effortful control (including attention focusing and shifting) is linked to Conscientiousness
- Surgency (including high-intensity pleasure, activity, and sociability) is linked to Extraversion.

Temperament arises from our genetic endowment. It influences and is influenced by the experience of each individual, and one of its outcomes is the adult personality (Rothbart et al. 2000). It includes dispositional attention processes (e.g., effortful attention, Rothbart & Bates, 2006), but it does not include specific cognitions (Evans and Rothbart, 2007, p869). Moreover, it affects creativity and intelligence (Rossman and Horn, 1972), intrinsic motivation (McKeen and McSwain, 1990) and information processing (Mauer and Borkenau, 2007; Vonderlin et. al, 2008).

Temperament is an inborn innate characteristic of a person, which remains constant over a life time (Keirsey and Bates, 1984). Keirsey and Bates (1984) describe four temperament groups which describe human behavior. They are Artisans, Guardians, Rationals and Idealists. Keirsey temperament types are based on four dichotomous pairs of preferences, which reveal a person’s temperament and character type. According to Keirsey-Bates categories:
Guardians (SJ – valuing careful, thorough, accurate work) are Sensing – likely to trust information that is in the present, tangible and concrete and Judging – are structured and rely upon a regimented schedule. Guardians, who make a judgment, strictly following a regimented schedule, are more likely to focus on a specific path (leading to decision outcome) while solving a problem than their sensing counterpart.

Artisans (SP – valuing a clever way of making things happen or getting things done) are Sensing – likely to trust information that is in the present, tangible and concrete and Perceiving – unconventional creativity, identify opportunities that others can’t see. Artisans, who due to their unconventional creativity and inclination to identifying new opportunities, are more likely to digress from the main path (leading to decision outcome) while solving a problem.

Idealists (NT – valuing quality of ideas and intellectual competency) are Intuiting – tend to trust information that is more abstract or theoretical, that can be associated with other information and Thinking – make decisions based on what seems reasonable, logical, causal, and consistent and matching a given set of rules. Idealists, who tend to follow a given set of rules, are more likely to focus on a specific path (leading to decision outcome) while making a decision, than their intuiting counterparts.

Rationals (NF – valuing oneself as a person who makes important contributions) are Intuiting – tend to trust information that is more abstract or theoretical, that can be associated with other information and Feeling – tend to come to decisions not only by looking at the rules, but by empathizing with the situation. Rationals, who due to their tendency to empathize with the situation and feel about the consequences, are more likely to digress from the main path (leading to decision outcome) while making a decision.

Due to their predisposition for sensing, Guardians and Artisans tend to focus more readily on tangible facts and figures than do individuals who focus on intuition (Idealists and Rationals). Because of their predisposition for intuition, Idealists and Rationals tend to look for trends in the data than do individuals who focus on facts and figures (Guardians and Artisans) (Agrawal and Clay, 2010).

Temperament has been found to interact with environment variables so as to shape the personal environmental relationships (Eliasz, 1985)

Bates (1987) provides a definition of temperament which captures its distinctive characteristic; biologically rooted individual differences in behavioural tendencies that are present
early in life and are relatively stable across various kinds of situation and over the course of
time. According to Bates (1989) although there are still disagreements on the number of temperament
dimensions, yet there is also a working consensus that includes the following dimensions like +ve
Emotionality (smiling, laughing), − ve Emotionality (fear, anger), Inhibition (adaptability to new
situation or people), Activity Level, Self-regulation (soothability, distractibility), Reactivity (how
intense a stimulus is needed to provoke a response) and Sociability (pleasure in social interactions)

The Big Five Factor Theory was first introduced in 1963 by Norman. Further, McCrae and
Costa (1990) proposed The Big Five Factor Theory for temperamental dimensions and the five
factors, and some defining adjectives are:

- Extraversion: adventurous, assertive, frank, sociable, talkative vs. Introversion: quiet,
reserved, shy, and unsociable.
- Agreeableness: altruistic, gentle, kind, sympathetic, warm.
- Conscientiousness: competent, dutiful, orderly, responsible thorough.
angry, anxious, and depressed
- Culture (Norman) or Openness to Experience (Costa and McCrae): cultured, aesthetic,
imaginative, intellectual, and open.

Moreover, temperament is regarded as a constitutional predisposition tied to basic
psychological processes (McCrae et al., 2000).

Temperament, thus, refers to basic dimensions of personality that are grounded in biology
and explains individual differences in the developmental process rather than universal dynamics.
While these dimensions show continuity over time, they are subject to change with maturation and
experience. The view of behavior as a function of the organism and of the environment is basic to
psychology. Accordingly, temperament serves as a mechanism to explain how individuals contribute
to their own development in a given environmental context. Harmony between persons and their
surroundings is produced through bi-directional interplay between inborn, temperamental attributes
and external demands, supports, and circumstances (Teglasi, 1995).

Shiner and Caspi (2003) proposed four higher order personality constructs in children-
extraversion, neuroticism, conscientiousness, and agreeableness-and that three of these (all but
agreeableness) map onto major temperament factors.
2. Food

Food (la. cibus) is any substance or materials eaten or drunk to provide nutritional support for the body and/or for pleasure. It usually consists of plant or animal origin that contains essential nutrients, and is ingested and assimilated by an organism to produce energy, stimulate growth, and maintain life. Food is material substance taken from outside which servers to nourish the body, build up tissues and supply energy. A selection of different complementary foods eaten together comprises a meal. A meal is an instance of eating, specifically one that takes place at a specific time and includes specific, prepared food. Food is that which is prepared and eaten, usually at a specific time (e.g. breakfast i.e. morning meal, lunch i.e. afternoon meal and dinner). People often choose to eat meals together with other family members or friends.

In the present study, the effects of only lunch has been studied on cognitive performance by varying it at three conditions namely proper vegetarian lunch (consisting of thali of 2-3 chapaties, 1 bowl of dal, 1 bowl of seasonal vegetables, 1 bowl of rice and 1 bowl of curd), snacks in lunch (consisting of 1 bread sandwich and 4 biscuits) and skipping of lunch (no lunch).