Chapter I

THE CONCEPT OF AROUSAL
The concept of "arousal" has been developed and employed by many co-investigators over a period of many years. The historical roots of the concept of arousal lie in Cannon's concept of "energy mobilization" during "emotion" (1929). Elizabeth Duffy is the pioneering investigator who tried to explain "arousal" or "activation" relating it with Cannon's concept "energy mobilization". Duffy (1951) explained the concepts the "emotion", "drive", "instinct", "tension", "libido" etc. has 2 constructs – (1) energy mobilization and (2) direction as only these 2 are basic dimensions to all psychological phenomena. Duffy (1934) suggested that it was unnecessary to make any distribution between the concepts like emotion, motivation, etc. Since with the exclusion of directional aspect of drive, both could be placed under a common heading of "physiological arousal" or "activation" which describes the intensive dimension of behaviour. Later, Berlyne (1960) similarly found drive to be common in all aforesaid concepts and mentioned that of all the factors of drive, energizing one is related to the concept of arousal. Thus, it is found that release of energy or energizing factor is common to the concept of both energy – mobilization and arousal, as these, two belong to the intensive dimension of behaviours and later Duffy (1957) used the two terms as synonymous to each other.

As arousal, the intensity aspect of behaviour, is the only dimension where some quantification of behaviour is possible through physiological measures, it may give some scientific explanation of behaviour. The group of behavioural
energetics further suggested that the level of arousal follows a hypothetical continuum which ranges from sleep, through normal waking to terror and anger. Duffy (1957) opined that the continuum of each of the physiological measures appear at least roughly, to correspond to the continuum of arousal. She also described an inverted "U" shaped relationship between arousal and performance (Duffy 1957) i.e. level of performance rises with increased level of arousal, but beyond the optimal point there is a fall in the level of performance (Broadhurst 1959).

Principles of arousal growing out of work on behavioural intensity got further recognition when the attempt was made to explain it from neuro-physiological orientation. Jasper (1941) discovered that there was distinctive wave patterns in EEG characterizing the levels of psychological functioning in the progression from deep sleep to highly alerted state of activity. Later on, Moruzzi & Magoun (1949) observed that electrical stimulation of lower brain-stem, i.e., reticular formation causes generalized desynchronization of cortical electrical activity and induction of fast components in EEG picture. The changes in EEG they found were similar to those which accompany arousal from sleep. Lindsley (1951) in his activation theory termed the desynchronization as activation pattern, which he found consistently to be associated with increased alertness. He proposed the continuum to be extended from deep sleep at low activation and to excited state at high activation, which is the function of cortical
bombardment by ARAS (ascending reticular activating system). Lindsley (1960) described 5 stages in EEG pattern in different states of consciousness. Thus, the continuum of arousal proposed by behavioural energetics got confirmation from the explanation of neurophysiological viewpoint too. They also confirmed the inverted "U" curve concept as regards the relationship between arousal and performance (Broadhurst 1959). Malmo (1959) further opined that "moderate activation level" has meaning only in relative terms and the optimum arousal varies with different tasks being higher for easier task and lower for difficult one (Lader and Marks 1971).

Thus, it is found that the two terms "arousal" and "activation" have been used to describe more or less the same phenomenon, though "activation" is used mainly referring to the functioning of ARAS (Eysenck 1967) while arousal is its psychological counterpart. But, from another viewpoint, Pribram & McGuinness (1977) described arousal and activation as two separate control mechanisms where different brain structures were involved. Arousal phase is controlled by amygdala which regulates all afferent and efferent information while hypothalamus through proper integrated activity arrests the ongoing behaviour and helps to register a new stimuli, reticular formation then, generates sufficient neural activity and raises the level of awareness of the organism, whereas activation phase is readiness to respond to the newly registered stimuli and is centered on basal ganglia which regulates motor control. Thus, they
suggested arousal and activation as two different stages of the same process. But Freeman (1948) and Hebb (1955) used the term arousal to refer to the intensive dimension and Malmo (1957) proposed a broad definition of the intensity dimension, in which level of physiological activity, arousal and intensive level are employed as roughly synonymous terms. Activation theory of Lindsley is now also replaced by the term arousal theory and use of the terms, cortical, autonomic and somato-motor or behavioural arousal are in vogue today (Lacey 1967). Arousal and activation has become virtually interchangeable terms (Horvath 1980). Malmo (1959) from the view point of learning theorists, proposed that drive without the steering component is identical with activation or arousal.

Another term “orienting response (OR)” is often referred as arousal response (Pavlov, 1927). Sokolov (1960) stated that “orienting response” is characterized by two general properties (1) it is an unspecific reflex and is initiated by an increase, decrease or qualitative change of a stimulating agent and (2) it is subject to habituation following repeated presentation of the stimuli. Lynn (1966) described the components of OR as (a) increase in the sensitivity of the sense organs (b) changes in EEG towards faster and lower amplitude activity and (c) changes in autonomic activity. Sokolov (1960) introduced 2 other terms “adaptive reflexes (AR)” and “defensive reflexes (DR)” and differentiated them from OR. He described that OR is response to a new stimuli,
but by repetition they are extinguished and is replaced by AR in case of moderate intensity stimuli and by DR in case of intense stimuli. Vasodilation in the extracranial vessels are associated with OR which habituates and vasoconstriction is associated with DR which does not habituate. Lader (1966) explained these 2 as to represent two different points along the intensity continuum of arousal.

Anxiety is another related term to arousal or activation, but the nature of relationship between the two is a question. According to Malmo (1957) heightened level of arousal is associated with anxiety. Spence & Spence (1966) described anxiety as a determinant of arousal. Horvath (1980) said that arousal is the physiological counterpart of anxiety, but anxiety may not always be the psychological counterpart of arousal. Similarly, Lader & Wing (1966) reported that anxiety is associated with arousal but arousal may underlie other emotional states. So, when drive or anger is concerned, anxiety is a narrower term than arousal. But in the case of psychiatric disorders, anxiety is found to be in the core of all disorders, which is revealed through the intensive dimension of behaviour i.e. the continuum of arousal. Whatever difference be present in symptomatology of different psychiatric illnesses, the patients definitely belong to some point on the arousal continuum.

Lader & Wing (1964) similarly mentioned that anxiety is a term which may refer to a commonly experienced emotion, to a personality variable or to a
symptom accompanying physical or mental illnesses. It further denotes that high arousal level found in different psychiatric disorders is the expression of anxiety related to that disorder. Lader & Wing (1969) confirmed it from their own findings. They (1969) differentiated the depressives into agitated and retarded subgroups and noted that whereas agitated patients showed overarousal, the retarded showed the reverse picture. This finding reveals that the presence of agitation or anxiety caused the heightened arousal in agitated group and lack of anxiety was reflected in decrement in arousal state in retarded patients. This finding was later supported by Roy & Chattopadhyay (1980) in our laboratory.

According to Berlyne (1960) arousal is a function of cortical bombardment and the greater the bombardment the higher is anxiety or arousal. Spence and Taylor (1953) equated anxiety and drive level and used arousal and anxiety as synonymous. Other researchers (Chattopadhyay, Bond & Lader 1975, Chattopadhyay et al. 1979, 1980, Chattopadhyay & Das 1982, Chattopadhyay & Mazumder 1982, Chattopadhyay, Mazumder & Basu 1982, Chattopadhyay et al. 1983, Bandopadhyay et al. 1987) also considered "arousal" and "anxiety" as synonymous to each other in their experiments. Thus following the notion of Spence and Taylor (1953), in the present study also the two terms "arousal" and "anxiety" will be used interchangeably.
Arousal may be classified into 2 conditions –

(1) tonic arousal (Horvath 1980) and (2) phasic arousal (Lader & Wing 1966).

Tonic arousal is base line arousal whereas phasic arousal is response to a novel stimulus. The phasic response further can be classified as orienting, adaptive and defensive.

There are various means to measure “arousal” or “activation”. Be tonic or phasic arousal it would be measured either through cortical or peripheral system. Among the measures which may be employed are skin conductance, muscle tension, the electro-encephalogram (EEG), pulse rate, respiration and others. These measures show consistent inter-correlations but the degree of correlations is not always high (Cannon 1929, Duffy 1957). Since there is patterning in the excitation of the individual, the nature of which appears to depend upon the specific stimuli situation and upon organic factors within the individual.

Duffy (1957) gave some explanations which might cause the low inter correlation (a) some processes probably reach their physiological limit before the other processes reach that particular limit (b) particular processes may in order to maintain homoeostasis, begin at a certain point to function in compensatory fashion (c) response specificity (d) difference between measures in the degree of generality of arousal which they reflect. Lacey (1958) emphasized on
response specificity for such low inter-correlations while Davis (1957) emphasized on stimulus than individual variation. Engel (1960) considered both stimulus and response specificities to be important. Malmo (1959) explained it in terms of physiological specificity while Lacey (1967) suggested that electrocortical, autonomic and behavioural arousal are organized separately and thus high inter-correlation cannot be expected.

Thus, the above review reveals that arousal is not a unitary concept. In some situations, one autonomic variable may show sympathetic dominance while another variable may indicate parasympathetic response (directional fractionation).

In the present experiment, skin resistance level will be taken as "tonic arousal" measure and some characteristics of GSR will be analysed as the "phasic arousal" response to the signals.

The reason behind taking skin resistance is to find out whether individual's tonic arousal level show any particular pattern, whereas GSR characteristics are expected to reveal basal arousal and patterns of habituation it will also be examined whether tonic arousal and the phasic arousal response characteristics of a given individual are inter correlated (Bernstein, 1967).