INTRODUCTION

In the last three decades, there has been an increasing concern with the role of the environmental context in the functioning of the human being. The early impetus to the field came from architects and engineers interested in the effects of design on its users, leading to growing interest in the human experience of natural and built environments. The psychological study of the relationship between environment and behaviour can be traced back to the nineteenth century psychologists who studied human perception of environmental stimuli such as light, sound, weight, etc. By the 1940s, research started trickling in on the psychology of cognitive maps of the environment. During the 1950s, work in the area began to pick up and the effects of the environment on the spatial behaviour of children, psychiatric ward design etc. were examined (Bell et al., 1996).

As psychology moved into the twenty first century, it adopted worldviews and research paradigms that allowed for construing human experience in its full dynamic complexity. Environmental psychology spearheaded this movement by rejoining persons and environments in their transactional nature (Stokols & Altman, 1987; Wapner, 1987). For too many years, the person was treated as an individual studied apart from the environment as a separate, often reactive entity. Today, there is an increased recognition of persons as transactional entities with their environment. The present investigation is an attempt to understand the linkages between behaviour and environment, more specifically, to study the impact of environmental stressors on perceived stress, health and subjective well-being.
The physical dimension of the environment is definable not only in terms of organized spaces and objects placed in them but also through characteristics and particular properties – such as those manifesting in the form of light, acoustic and thermal stimulations – more directly involving our sensory activities and thus, contributing towards specifying the quality of the environments we live in and perform our daily activities. These enduring characteristics of physical environments may influence and produce many stress-provoking stimuli that affect both psychological and physiological responses of the individual.

One of the ways to understand the relationship between the environment and human behaviour is to analyze environmental conditions that are capable of interfering with optimal human functioning. Physical characteristics of settings and individual appraisals of the potential harm of an environmental array largely determine how environmental conditions affect human health and well-being. Environmental stress refers to every situation in which the environmental demands on individuals exceed their ability to respond (Evans, 1982). This concept offers to environmental–psychological research a potentially unifying frame of reference for the analysis of many non-optimal conditions in which individual-physical environment interactions take place.

Environmental stressors may be defined as disturbing environmental agents, factors or properties that call upon the individual to activate his coping strategies, to cope with and neutralize the disturbance / threat component which these properties involve. Four general types of environmental stressors have been identified: cataclysmic events, stressful life events, daily hassles and ambient stressors (Campbell, 1983; Baum, Singer, & Baum, 1982; Lazarus & Cohen, 1977). Cataclysmic events are sudden catastrophes that demand major adaptive responses from all individuals directly affected.
by the event e.g., floods, earthquakes, nuclear power plant accidents etc. Stressful life events are major incidents in the lives of people that typically require personal or social adaptive responses. Daily hassles are the typical events of ordinary life that may cause frustration, tension or irritation. Ambient stressors is a term that has been developed to distinguish the more continuous, relatively stable and intractable conditions of the physical environment (Campbell, 1983) e.g., air pollution.

MODELS OF ENVIRONMENTAL STRESS

In spite of the remarkable familiarity with the term 'stress', psychologists concerned with environmental stress have not neglected the preliminary need for an accurate conceptual definition (McGrath, 1970; Appley & Trumbull, 1967; Cofer & Appley, 1964). Evans (1982) among others, pointed out that research on stress refers primarily to two main models. The first, in chronological order, is the one developed in the area of biomedical studies and focuses on the reactions of the organism and its physiological processes, which are activated through interaction with the external environment and its demands (Selye, 1956). The second accentuates the psychological processes that mediate the relationship between the individual and environment. Specific reference is made to the cognitive process through which people interpret the environment and evaluate the threat of its characteristics (Lazarus, 1966).

Physiological Model

This model focusses attention on the autonomous emergency response system and on the functions it is meant to perform for the organism in confronting or avoiding damaging stimulations and/or adverse situations considered as threats for its internal equilibrium. In this perspective, the functioning of the organism is entrusted to those
homeostatic regulation mechanisms which tend to maintain the fluctuations (or changes in the state of equilibrium) induced by the external environment, within certain limits. Thus, the responses that are produced to the disturbing agents, called stressors, primarily carry out the function of re-establishing lost equilibrium. Within this dynamic, stress figures as a consequence of the solicitations the mechanisms of homeostatic regulation are repeatedly subjected to.

It is primarily in this perspective that a type of environmental context, such as the urban one, has often been assumed by environmental-psychological research as an emblematic situation for describing the origins of stress. In particular, equilibrium must be maintained persistently and continuously because of the multiform and equally continuous solicitation by external environmental factors. As Selye (1956) has pointed out, every defensive position which does not consist in the escape from the field necessitates the use of adequate strategies and thus, of investments of psychological as well as physical energy. The amount of this adaptive energy which can be invested in one’s transactions with the stressor or stressors is finite and its depletion results in a deleterious impact on the organism. A second influential aspect of Selye’s theory is his argument that pathogenic effects occur as a result of the body’s attempt to cope with the stressor. This assertion is termed as the “adaptive-cost hypothesis”. Specifically, the hypothesis suggested that the process of adaptation itself causes deleterious effects that occur either during or after exposure to a stressor.

Many of the pathophysiological concomitants of stress are believed to result from activation of the sympathetic-adrenal medullary system (SAM) and the pituitary-adrenocortical axis (PAC). The SAM reacts to various emergency states with increased adrenalin (epinephrine) secretion. If SAM activation is excessive, is persistent over a period of time or is repeated too often, it may result in a
sequence of responses that culminate in illness. The responses include functional disturbance in various organs and organ systems (Dunbar, 1954) and ultimately permanent structural changes of pathogenic significance at least in predisposed individuals (Raab, 1971).

The hormonal responses of the PAC axis are elicited by pathogens, physical stressors (e.g. shock or noise), and psychosocial stressors and proceed in a characteristic three-stage pattern referred to as the general adaptation syndrome (GAS). During the first stage of the GAS, the alarm stage, the organism's physiological changes reflect the initial reactions necessary to meet the demands made by the stressor agent. The anterior pituitary gland secretes adrenocorticotropic hormone (ACTH), which then activates the adrenal cortex to secrete additional hormones (cortical steroids). The hormone output from the adrenal cortex increases rapidly during this stage. The second stage, resistance, involves a full adaptation to the stressor with consequent improvement or disappearance of symptoms. The output of cortical steroids remains high but stable. Finally, the third stage, exhaustion, occurs if the stressor is sufficiently severe and prolonged to deplete somatic defences. The anterior pituitary and the adrenal cortex lose their capacity to secrete hormones and the organism can no longer adapt to the stressor. Symptoms reappear, and if stress continues unabated, vulnerable organs (determined by genetic and environmental factors) will break down. This breakdown results in illness and ultimately death.

Psychological Model

The psychological model places emphasis on the organism's perception and evaluation of the potential harm posed by a stimulus. The perception of threat arises when the demands imposed upon an individual are perceived to exceed his or her felt ability to cope with
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these demands. This imbalance gives rise to the experience of stress and to a stress response that may be physiological and/or behavioural in nature. Psychological stress then is not defined solely in terms of the stimulus condition or response variables but rather in terms of the transaction between the person and the environment. It involves interpretation of the meaning of the event and the interpretation of the adequacy of coping resources. In short, the psychological stress tradition assumes that stress arises totally out of persons' perceptions of their relationship to their environment.

The concept of environmental stress has been increasingly used within the general hypothesis of a cognitive mediation intervening to specify the relationship between disturbing factors and behavioural responses. Lazarus (1980, 1977, 1966) argued that a situation will result in a stress reaction if it is evaluated as a harm / loss, threat or challenge. Thus, the possibility of defining a stimulation as disturbing is no longer entrusted to physicalist criteria. Therefore, Holahan (1982) opines that noise is a sound the listener does not want to listen to and not just an acoustic stimulus that surpasses a certain intensity, measured in decibels.

Various authors have defined the cumulated costs deriving from adaptation to environmental stress in terms of cognitive fatigue (Cohen, 1980, 1978; Glass & Singer, 1972b). The active effort always involved in the task of coping with unfavourable environmental conditions results in negative effects e.g., decrease in the degree of personal tolerance to frustration and decrease in effectiveness in performing specific cognitive tasks (problem solving) (Glass & Singer, 1972a, 1972b). The nature and degree of these effects are closely linked to opportunities for 'personal control' to be exerted at the onset of disturbing stimulations.

Accentuating the role carried out by individual cognitive
mediation in defining stress and its negative effects, Cohen (1980, 1978) proposed an alternative hypothesis. He defined the environment as the context from which individuals select the information necessary for organizing their behaviour and actions. Within this premise, the disturbing properties of the environment are considered as an 'information overload' people have to cope with and therefore, the reason for a surplus of cognitive work compared to that otherwise necessary or expected: the more unpredictable the ways these properties are manifest, the more attention and elaboration ability is required for the information coming from them. Cognitive fatigue, is conceptualised in this case, as a consequence of an information overload the environment relays repeatedly over time. Caplan (1982), Stokols (1979) and Michelson (1970) have also conceptualized environmental stress in terms of the incongruence between aims relevant for the individual and opportunities offered by the environment.

The psychological model of environmental stress, therefore, attributes centrality to cognitive mediations in specifying the relations that link properties of the physical environment and peoples' responses. It emphasizes a more interactive frame of reference, in which individuals are not merely reactive entities but are in an active position towards the environment more in the nature of transactional entities.

EFFECTS OF STRESSORS

Effects of environmental stress are costs that individuals find themselves sustaining in facing unfavourable properties or conditions in the surrounding environment. These effects primarily involve the physical health and psychological well-being of individuals. Five specific areas of stressor impacts have been identified. They are as follows:
Physiological Effects

A wide variety of aversive stimuli cause increased catecholamine and corticosteroid output that is detectable either in blood or in urine (Baum, Brunberg, & Singer, 1982; Frankenhaeuser, 1971; Mason, 1968). These circulating hormones, epinephrine in particular, produce secondary changes in various target organs related to activation of sympathetic arousal. Catecholamine discharge is believed to induce many of the pathogenic states associated with psychological stress including (a) haemodynamic effects such as increased blood pressure and heart rate (McCubbin et al., 1980); (b) induction of myocardial lesions (Raab, 1971); (c) increased cardiac demand for oxygen and (d) provocation of ventricular arrhythmias believed to lead to sudden death. Numerous other investigations of a wide array of noxious stimuli have also recorded psychophysiological indices of stress including increased blood pressure, skin conductance, respiration rates, muscle tension and cardiac output.

Task Performance

The influence of stressors on human task performance is difficult to characterize because at least for short periods of time, most people can effectively overcome the aversive effects of a stressor by coping devices such as increased effort or concentration. Nevertheless, certain patterns of task deficits have been found to occur under stress: Stressors interfere with tasks involving rapid detection which typically
require an individual to respond to information appearing at a very rapid rate e.g., a serial reaction time task that requires subjects to respond as rapidly as possible to a signal. As soon as a response is made, another signal appears and the sequence repeats. Tasks requiring sustained attention to uncertain, low-frequency signals are also interfered with by stressors e.g., vigilance tasks. Attention, as indicated by visual search tasks where the participant has to identify one or more target stimuli among an array (e.g., location of all of the letter Es in a passage), appears to be sensitive to chronic noise exposure (Muller, Pfeiffer, Jilg, Paulsen, & Ranft, 1998). Auditory search tasks also reveal similar trends (Haines, Stansfeld, Job, Berglund, & Head, 2001a; Kyzar, 1977). However, Hygge, Evans, and Bullinger (2002); Haines, Stansfeld, Brentnall, et al. (2001); and Evans, Hygge, and Bullinger (1995) failed to replicate these findings in both an initial cross-sectional comparison and in a prospective, longitudinal study. Stress may also interfere with multiple cue tasks where more than one target cue must be attended to (e.g., monitoring two signals). It is interesting to note that stressors interfere with only the secondary signal and do not affect the primary signals.

Two principal memory deficits have also been noted under stressors: Firstly, adverse effects on both incidental and intentional memory. Memory for incidental or secondary information in a task is poorer under stressor conditions (Lercher et al., 2003; Meis et al., 1998; Heft, 1979). In the intentional memory paradigm, subjects are aware at the time of encoding that they will be subsequently tested. Studies indicate that intentional memory can be adversely affected by chronic noise exposure (Hygge et al., 2002; Haines, Stansfeld, Job, et al., 2001b; Meis, Hygge, Evans, & Bullinger, 1998; Evans et al., 1995), although Haines, Stansfeld, Brentnall, et al. (2001) did not replicate this effect. Secondly, stressors also cause faster processing of information in working memory but apparently at the expense of total
capacity. Memory span in working memory may be shorter under stress. There is also evidence of poorer comprehension of complex information such as context or thematic structure that is believed to occur because of reduced working memory capacity (Cohen et al., 1986; Broadbent, 1971). Noise exposure appears to alter information processing strategies to create a bias in attention allocation toward more important or essential information (Meis et al., 1998; Smith & Jones, 1992; Broadbent, 1971).

**Affect and Interpersonal Behaviour**

Both self-reports of affect and interpersonal behaviours like aggression are influenced by stressors. Many studies have demonstrated greater anxiety, tension and nervousness plus greater ratings of stress under aversive conditions (McGrath 1970a; Lazarus, 1966). Some research has found more negative social interpersonal behaviour under stress including less altruism and cooperation and greater competitiveness, hostility and aggression (Evans, 1982; Cohen, 1980). Another aspect of interpersonal behaviour influenced by stress causes premature closure wherein decisions are made before all pertinent data have been considered (Janis, 1982; Janis & Mann, 1977). There is fixation on one or two dominant aspects of a task with little regard for other components. Reversion to traditional, stereotyped thinking patterns is common under stress. Novel information or tasks requiring different approaches are more apt to be redefined in terms of pre-existing schemata (Staw, Sandelands, & Dutton, 1981; Holsti, 1978).

**Observation**

Both verbal and nonverbal categories of stress measurement have been developed. Verbal indicators include speech faults (e.g., repetition, tongue slips), filled pauses (e.g., ah, um), accelerated rate
under certain conditions, and increased pitch. Words or phrases revealing tension or anxiety about the problem at hand (e.g., hopeless, worried) may also occur (Siegman, 1982; Spence, 1982). Nonverbal indicators of stress include more defensive body posturing (e.g., leaning away, crossing arm/leg), reduced eye contact or facial regard, greater automanipulative behaviours (e.g., itching, touching hair, fidgeting with clothes), and stereotyped object play (e.g., tapping pencil, manipulating small objects such as beads).

**Adaptation**

People are able to adapt to stressors through various coping mechanisms. These mechanisms may reduce the immediate stress response in the form of habituation but the process itself may take its toll. Negative aftereffects of coping may include less ability to cope with subsequent stressors, lower motivation, socioemotional adjustment problems and greater susceptibility to infectious diseases (Cohen, 1980).

With repeated exposure to a stressor, habituation or decrements in response sensitivity are seen (Glass & Singer, 1972a, 1972b; Wilkinson, 1969). Cohen (1980) has identified several types of aftereffects following exposure to acute stressors, including decrements in tasks requiring moderate or high motivation, decreased altruism and sensitivity to others’ needs, increased aggression and increased susceptibility to learned helplessness. Overgeneralized coping responses have also been found e.g., learning to cope with loud noise by tuning/filtering out auditory stimulation. This becomes a routine part of the cognitive repertoire of persons chronically exposed to noise even when they are in quiet conditions (Cohen et al., 1980).
RESIDENTIAL DENSITY

Density is defined as the number of people in a given space; as such it refers to the physical conditions associated with numbers of people in given amounts of space (Stokols, 1972). Density is a necessary but not sufficient condition for the experience of crowding. Crowding refers to an experience that is the outcome of appraisal of physical conditions, situational variables, personal characteristics and coping assets. According to Paulus (1980), crowding refers to a subjective judgement that one is surrounded by too many people. In terms of environmental stress, density refers to the objective feature of the spatio-physical restrictions whereas crowding indicates the outcome of individual perceptions of these restrictions. Therefore, under some conditions and for some people, a given level of density in a setting will lead to crowding while in other conditions or for other people it may not. In much the same way as people evaluate and interpret stressors (Lazarus, 1966), crowding is an outcome of evaluation of settings. Density is only one of the several aspects of settings that appear to determine the outcomes of these appraisals.

Despite the unitary nature of density (the ratio of people to space), several types of density have been identified. The most basic of these typologies refers to the different ways of increasing density. One can either increase the number of people without changing the amount of space they occupy or shrink the space that a constant-sized group uses or both. Varying group size with the amount of space held constant is called social density whereas changing space while holding group size constant is referred to as spatial density (Zlutnick & Altman, 1972; Loo, 1972; McGrew, 1970).

Distinction has also been made between density in primary and density in secondary environments (Stokols, 1976; Zlutnick & Altman, 1972). Zlutnick and Altman (1972) define inside density as the density
in one's primary area of functioning e.g., home or classroom. Primary environments are those in which persons spend more of their time and in which they relate to others on a personal basis. Outside density is defined as the density in secondary areas such as the community, school or shopping center. Secondary environments are those in which encounters with others are transitory, anonymous and inconsequential (Stokols, 1976).

Cohen, Glass, and Philips (1979) distinguish between internal and external density. Internal density refers to dwelling space per person (e.g., rooms per person or square feet per person). External density refers to the number of persons occupying a residential area (e.g., people per acre, square kilometer or square mile). Internal density is a measure of density in a primary environment, the home whereas external density is a measure of a secondary environment, the neighbourhood. These two measures of density may be independent of one another; for example, a luxury high rise housing project in a metropolitan city would have a high external density but a low internal density whereas a low income housing project made up of four storey tenements in India would have a relatively high external density with a high internal density. Residential density is calculated by dividing the number of people living in the home by the number of rooms in the house (Evans et al., 1989).

The degree of density, in both a spatio-physical and social (population) sense, is one of the features that has great importance in the evaluations people make about the quality of their environment. High concentrations of people and things tend to be among the primary disturbing factors characterizing the urban socio-physical environment. The ever increasing population in most Third World countries, particularly India, has given rise to a host of social problems as well as problems associated with the physical aspects of space. Rapid urbanization has forced human settlements in high density
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conditions (Jain & Palsane, 2004). India's population totalled 846.3 million with 2.14 per cent annual growth rate and 274 persons per sq.km. as the average population density with variation from 10 to 6,352 persons per sq.km. (Census of India, 1991). Being one of the most populated countries in the world, the population having crossed the one billion mark, and because of the tradition of extended family, India faces a unique problem of crowding which occurs not only outside but also inside the house. Further, the wide disparity in economic classes has resulted in large variability in density levels and types of housing in India as compared to many other countries. High density is found to be related to a number of adverse effects.

Several studies have suggested that density is related to a number of pathologies for instance, heightened vulnerability to infectious diseases; increase in blood pressure, heart rate and skin conductance; and self-reports of worry and unhappiness. Further, it has been reported that the negative effects of residential density (Lepore et al., 1991; Evans et al., 1989) appear to generalize outside the residence. Elevated cortisol levels have been noted among crowded shoppers (Heshka & Pylypuk, 1975) and elevated catecholamine levels in crowded commuter trains in Sweden (Singer, Lundberg, & Frankenhaeuser, 1978; Lundberg, 1975). When placed in a non-crowded situation with strangers, people from crowded households appear to be less sensitive to offers of social support. They are also less likely than persons from low-density homes to provide support to another individual in need of support. People chronically exposed to high-density environments may learn to withdraw from others indiscriminately regardless of whether the social interaction is potentially beneficial (Evans & Lepore, 1993).
NOISE

Noise is defined as unwanted sound. In scientific and engineering terms, a noise is any form of random, unpredictable signal (The Hutchinson Encyclopaedia, 1997). It does not constitute only intense sound rather it is a complex sound with little or no periodicity and without any agreeable musical quality (Madhuri & Shivakumar, 2003). Psychologically speaking, noise is any sound that is physiologically arousing and harmful, subjectively annoying or disruptive of performance (Glass & Singer, 1972; Anastasi, 1964); it is just any sound undesired by the recipient (Madhuri & Shivakumar, 2003). More people are affected by noise exposure than any other environmental stressor. There is also some evidence that it can adversely affect general health and well-being in the same manner as chronic stress (Suter, 1991). However, because its associated health effects are not as life-threatening as those for air, water and hazardous waste, noise has been on the bottom of most environmental priority lists (Cowan, 1994). Noise induced hearing loss, for instance, is often overlooked because it usually occurs insidiously without any dramatic consequences such as bleeding, deformity or death (Berger, 2000).

Typically, noise has both auditory and psychological components. In respect of auditory components, noise is characterized by intensity (db), frequency (pitch), periodicity (continuous or intermittent), duration (acute or chronic), predictability of noise bursts (random or fixed interval) and degree of personal control over noise. Intermittent sounds appear to be somewhat less damaging to hearing than continuous sounds because of the ear’s ability to regenerate during the intervening quiet period. However, intermittent and impulsive sounds tend to be more annoying and disturbing because of their unpredictability. It has been reported that in general, intermittent, higher frequency, short-duration and intense sounds have greater effects on well-being and health than do continuous, low-frequency,
long-duration, low-intensity sounds (Baker & Holding, 1993). Intermittent noise can also affect performance more adversely than continuous noise of equivalent energy. Aperiodic intermittencies are more likely to produce adverse effects than regular ones. Psychological characteristics of noise include the predictability of noise, attitudes to the noise source, the meaning of the noise and the degree of personal control over the noise.

The intensity of noise is measured in a scale called the decibel or db scale. It is a logarithm scale which means a sound of the level of say 50 db would be ten times more than the sound of 40 db. Permanent incurable loss of hearing can be caused by prolonged exposure to high noise levels (above 85 db). Over 55 db on a daily outdoor basis is regarded as an unacceptable level. If the noise is in a narrow frequency band, temporary hearing loss can occur even though the level is less than 85 db or exposure is only for short periods. Lower levels of noise are an irritant but seem not to increase fatigue or affect efficiency to any great extent. The Union Ministry of Environment and Forests has laid down standards for noise pollution for four categories of areas viz., Industrial, Commercial, Residential and Silence zones for both day and night. Silence zones are the areas upto 100 metres around certain premises like hospitals, educational institutions and courts. A limit of 50 db has been kept for day time for these silence zones; in addition, it is desirable that honking of vehicle horns, use of loudspeakers, bursting of crackers and hawker noise should be banned. In a review of noise and sleep research, Griefahn (1990) recommends that the nighttime average sound level be kept below 45 db in the sleeper’s quarters.

Noise is considered a nonspecific biological stressor, eliciting a response that prepares the body for action, sometimes referred to as the “fight or flight” response. The physiological mechanism thought to be responsible for this reaction is the stimulation by noise (via the
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auditory system) of the brain’s reticular activating system (Cohen, 1977). Neural impulses spread from the reticular system to the higher cortex and throughout the central nervous system. Noise can, therefore, influence perceptual, motor and cognitive behaviour, and also trigger glandular, cardiovascular, and gastrointestinal changes by means of the autonomic nervous system.

Noise as an auditory stressor, can produce both direct and indirect health effects. The direct health effect known to be attributable to noise is hearing loss (resulting from damage to the inner hair cells of the organ of corti) with noise exposure higher than 90 decibels. The noise from locomotive engines, horns and whistles, and switching and shunting operations in rail yards can impact neighbouring communities and railroad workers. For example, rail car retarders can produce a high-frequency, high-level screech that can reach peak levels of 120 db at a distance of 100 feet (EPA, 1974c), which translates to levels as high as 138 or 140 db at the railroad worker’s ear. Evidence from field studies indicates that men incur more hearing loss than women from comparable noise exposures (Royster et al., 1980; Berger et al, 1978; Burns & Robinson, 1970), and that Caucasians appear to be more susceptible than Blacks to noise-induced hearing loss (Royster et al., 1980). Other factors, such as age, preexposure hearing threshold level, general health and use of alcohol, have not yet proved to be reliable predictors of susceptibility (Ward, 1983), although there is some indication that the use of tobacco may increase susceptibility to noise-induced hearing loss (Stark et al., 1988; Barone et al., 1987).

The deleterious effects of noise on children, both in school and at home, have been well documented. Noise can disrupt communication in the classroom to the extent that the instructional method used in schools close to airports is sometimes nicknamed “jet pause” teaching. It has been found that elementary school children on the side of a school facing train tracks, performed more poorly on a
reading achievement test than children in classrooms on the quiet side of the school (Bronzaft & McCarthy, 1975). Cohen and Weinstein (1981) have reviewed several studies, which, after controlling for socioeconomic factors, indicate that the academic performance of children in quiet schools is better than that of children in noisy schools. Research also shows that skills, such as auditory discrimination and reading achievement can be adversely affected when children live in noisy circumstances, even though their schools may be no noisier than average. Chronic exposure to high levels of aircraft, rail and road traffic noise can lead to attention deficits, concentration difficulties and poorer speech discrimination, memory and reading ability in children (Stansfield et al., 2000b).

Suter (1991) explained the psychosocial handicap that results from noise-induced hearing loss. Individuals with early noise-induced hearing loss often think that other people no longer speak clearly. They soon begin to notice that they have difficulty in understanding speech when there is noise in the background, and in groups of people, and that it is hard to identify which person is talking. As the hearing loss progresses, these individuals avoid social occasions and situations where they must listen at a distance, like theater. The eventual result can be loneliness and isolation. Further, it has been reported that environmental noise can have a profound effect on the quality of life: it spoils the home life of one in three people to some extent, and totally spoils the home life of one in a hundred people (Grimwood, 1993). Although there is no consistent evidence that noise causes mental ill-health, people who have existing mental problems such as depression or anxiety are more prone to be annoyed by environmental exposure than the general population. Unwanted noise can elicit different emotions including anger, fear and depression. The impact of noise is likely to be greatest if it makes the individual fearful (Fields, 1994).
The most common outward symptom of stress building up in humans, when faced with noise is annoyance (Health and Welfare Canada, 1989). Beyond annoyance, there is good evidence for a causal relationship between environmental noise and hypertension and heart disease. Non-auditory physiological effects of noise exposure include a possible increase in cardiovascular disease from elevated blood pressure and physiological reactions involving the cardiovascular endocrine system (Talbott & Thompson, 1995). In addition, community noise has been shown to adversely affect sleep, communication, performance and behaviour, reading and memory acquisition and mental health (Talbott & Thompson, 1995). Similarly, Basrur (2000) has pointed out that exposure to excessive noise can also induce or aggravate stress-related health outcomes, including those on the cardiovascular system, immune system, sleep, task performance, behaviour and mental health. There is also evidence of impacts on immune functions, birth weight, psychiatric disorders and well-being (Stansfield et al., 2000a).

The above effects of noise can be summed up in the following broad areas identified by a 1992 WHO Task Force as: (i.) annoyance, (ii.) cardiovascular, (iii.) communication, (iv.) hearing loss, (v.) performance, (vi.) productivity, (vii.) psychosocial, (viii.) sleep, and (ix.) social behaviour. Miller (2003) has further summarized the noise-related health effects into two categories viz. (i.) behavioural effects (activity interference) including speech interference, sleep interference, annoyance and children’s learning wherein deleterious effects include potential delays in language acquisition, memory deficits, learned helplessness and adverse impact on reading test scores and (ii.) medical effects including hearing loss (auditory) and physiological effects (non-auditory).

Thus, noise is a stress that injures man and other animals. Man, in particular, needs peace and quiet to function efficiently, physically as
well as psychologically but constant exposure to the noise of everyday living deprives him of this quiet environment. Noise levels in the world's urban centers have been rising steadily in our highly mechanized society to a point where noise intensity and chronicity are a hazard to public health. According to one survey of various cities, noise levels are rising at the rate of a decibel per year (The Encyclopedia Americana, 1995). Research indicates that noise level in communities is directly related to the population density. Because the noise in urban areas generally exceeds that of suburban and rural areas, it is not unreasonable to assume that noise is increasing at least in proportion to the increase in urbanization and more rapidly than the growth of the general population.

The direct effects of noise on behaviour, though seemingly obvious, are difficult to demonstrate. For, in time, people learn to ignore noise. However, the proposition that man is adaptable has an important corollary namely that man pays a price for adaptation that is observable in behaviour (Wohlwill, 1970; Dubos, 1965; Selye, 1956). In other words, aversive stimulation of various kinds entails certain residual aftereffects, what Glass and Singer (1972) have called the "psychic cost" of adaptation to environmental stress. Although people often believe they get used to nighttime noise, physiological tests point to the contrary. Impulsive or other sudden loud sounds can produce a startle response that does not completely habituate with repeated, predictable exposures. Studies have shown that while the subjective response improves with time, cardiovascular responses remain unchanged (Muzet, 1983). In Canada, the Working Group on Environmental Noise of the Federal/Provincial Advisory Committee on Environmental and Occupational Health acknowledged that noise can produce serious physical and psychological stress. No one is immune to this stress. People appear to adjust to noise by ignoring it but the ear, in fact, never closes. The body at times still responds with
extreme tension, such as to a strange sound in the night (Health and Welfare Canada, 1989). Vallet et al. (1990) conclude that habituation is not complete, even after 5 years of exposure to noise.

**NOISE SENSITIVITY**

Theoretical research models in environmental psychology have emphasized that the person-environment relationship is bi-directional and involved in a dynamic process (Wapner, 1998; Wachs, 1989). Transactional models have considered the person’s adjustment to a specific context as dependent on the individual characteristics, the environmental attributes and their interaction (Werner & Altman, 1998; Moore, 1988). Within this perspective research of the factors of the physical environment that can affect the behaviour of individuals should be associated with the examination of the personal-social characteristics that increase or decrease the sensitivity of the individuals to these potent environmental factors (Legendre, 1999; Garmezy, 1989). Psychologists concerned about environmental problems observe how people react to stressful and threatening aspects of their physical surroundings including such conditions as noise, crowding, air pollution and crime. In earlier research, investigators tended to assume that noise produced direct health effects, such as hearing loss with noise exposures above 90 decibels, and paid little attention to individual differences in response to noise and noise as a stressor (Thompson, 1996).

Striking individual differences exist in how people perceive and adapt to environmental stressors. Unwanted sound to some may be considered wanted sound by others, as in the case of loud music (Talbott & Thompson, 1995). Not only do people differ in their initial responses to a problem, but they also appear to differ greatly in their ability to adjust to aversive surroundings over a longer period of time. Surveys around airports, for example, find many people in the areas of
highest noise exposure who seem practically oblivious to noise, while even in the most distant zones polled, there are individuals who find the aircraft sounds extremely annoying (McKennell, 1970). Similarly Joneh et al. (1981) reported that even at very low levels of noise, there will be some individuals who are intensely annoyed by noise and although this proportion increases with the level of noise, yet at the highest level of exposure, a few individuals will remain unperturbed. Bhatia and Muhar (1988) on the basis of quantitative output and physiological energy expenditure, reported that the same noise differentially affects different people. As such, there are individual differences in sensitivity to noise consistent across situations. Nivison (1992) proposed that sensitivity to noise is a static rather than phasic condition of the individual. It is more likely related to a disposition to react to noise in general than to the physical properties of noise.

Noise sensitivity can be viewed as an independent variable, which may be directly related to outcomes such as health status, or it can be conceptualized as a factor that modifies or mediates the effects of noise exposure on the outcome measure (Smith, 2003). In general, it is assumed that those who are sensitive to noise tend to be disturbed by or annoyed with noise from the environment in greater degree than those who are less sensitive to it. Thus, noise sensitivity has been postulated as an intervening factor that determines the annoyance level in the noise-exposed individual. In fact, the “noise vulnerability hypothesis” states that noise has its greatest effect on certain predisposed individuals: the highly sensitive subjects. Noise sensitivity is highly correlated with the general trait negative affectivity, a measure of the extent to which individuals perceive or report negative features of their environment or self. Noise sensitivity can also be considered in terms of physiological reactivity to noise sources. Such effects are often only weakly associated with self-reports of noise sensitivity (Smith, 2003).
Weinstein (1978) reported that noise sensitive individuals have significantly fewer social skills and a stronger desire for privacy than those who are not so sensitive. He also found a consistent tendency for those who are bothered by noise to be less intellectually able (the Intellectual Efficiency Scale of the California Psychological Inventory) and less able to work persistently (the Achievement via Independence scale of the California Psychological Inventory and the Endurance of the PRF). Noise sensitive people attend more to noises, discriminate between noises, find more noises threatening and out of their control and react to and adapt to noises more slowly than less noise sensitive people (Stansfeld, 1992).

It has been postulated that differences in noise sensitivity are determined by the functioning of the autonomic nervous system. So, it will be reasonable to assume that noise sensitivity is positively associated with sensitivity to a variety of noxious environmental stimuli and accordingly with the desire for excluding or reducing them. This assumption is supported by Weinstein's (1978) finding that there is a moderate and positive association between noise sensitivity and reported annoyance of a wide range of nuisances. Noise sensitive individuals are more likely to be critical of their surroundings and to express annoyance about situations generally recognized as being irritating (Weinstein, 1978). Later, Weinstein (1980) added further evidence to this assumption through the discovery of intra-individual consistency in the evaluation of noise, air pollution, privacy, amenity and overall neighbourhood satisfaction. Iwata (1981c) reported findings that supported this assumption. Those who are noise sensitive are more likely to be aware of other noxious stimuli from the environment than those who are less noise sensitive. This is because when they are disturbed or annoyed by noise from the environment, noise becomes a cue which draws their attention to other noxious environmental stimuli (Iwata, 1986). Moreover, there is a positive
relationship between noise sensitivity and pro-environmental orientation, purchasing-behaviour and coping-behaviour which directly contribute to environmental conservation and pollution control (Iwata, 1986).

Research has shown that there is a link between noise sensitivity and mental health. Nystrom and Lindegard (1975) found that noise sensitivity predicted the later occurrence of depression. Tarnopolsky et al. (1980) also report an association between noise sensitivity and psychiatric disorder. Stansfeld et al. (1985) reported that psychiatric symptoms increased with noise sensitivity but this effect was only significant for subjects living in areas of high noise exposure. A strong correlation has been reported between noise sensitivity and total health complaints viz., trait anxiety, nervous, muscular, intestinal, allergic and cardiac health complaints, poor sleep quality and nocturnal awakenings. In fact, subjective reactions to noise, annoyance and noise sensitivity showed stronger correlations with health and sleep complaints than did objective noise levels (Nivison, 1992).

Noise sensitivity has been found to influence mental functioning as well. Smith and Stansfeld (1986) reported that highly sensitive subjects reported significantly greater frequencies of occurrence of everyday errors including errors of perception, memory and motor action than subjects low on noise sensitivity. Laul et al. (1988) also showed that there is a relationship between noise sensitivity and mental efficiency. Bhatia, Shipra, and Muhar (1991) reported that due to adaptation, efficiency (indexed by performance on a multiplication subtraction task) was not much affected even under high intensity noise in the case of low noise sensitivity subjects but adaptation was not effective and efficiency was adversely affected in the case of high noise sensitivity subjects under both high as well as low intensity of noise.