PSYCHO-PHYSIOLOGICAL BENEFITS OF MOUNTAIN LANDSCAPE ENVIRONMENT AS STIMULUS FOR DIRECTED ATTENTION RESTORATION AND STRESS MITIGATION

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A thesis submitted in fulfilment of the requirements for the award of the degree of Doctor of Philosophy (Architecture)

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To my darling wife, Agnes Ojobo, and wonderful children, St.Luke and Paul Ojobo
ACKNOWLEDGEMENT

I return all the glory to God Almighty. Without His grace and mercy, it would have been impossible.

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Last but not the least, my gratitude goes to all the respondents that participated in the experimental aspect of the study. I would like to specifically mention Dr. Innocent Abah for excellently coordinating the medical team and Dr. Joseph Okwori for his outstanding organisational skills.
ABSTRACT

The evolutionary perspective of human-nature synergy maintains that humans evolved in natural environments over a long period. Hence, humans are largely adapted to nature. Several studies evaluating encounters with nature have been supportive of its restorative and therapeutic effects. However, most of the studies carried out in real-site, natural environments have been largely done in forests and wilderness, while mountain environments have merely been mentioned as part of picture slides or video simulations. Additionally, very little research in the assessment of nature and human wellbeing relationships has adopted a synergetic approach of the mix of real-site and psycho-physiological mode of measurement. This study explores the mechanism and intricacies of the link between restorative environments, human response and psycho-physiological wellbeing in Obudu mountain landscape environment in Nigeria. Psychological and physiological experiences were explored using quantitative research method to elicit subjective and objective responses from individuals. A total of 200 adults were engaged in the psychological measures of preference and perception of the environment, while 38 adults participated in the physiological experimental measures. A tripartite data collection strategy was utilised: (1) psychological data were elicited through self-report measures using questionnaires, (2) physiological data were gathered through pre-test and post-test measures of blood pressure, pulse rate and respiratory rate, and (2) physical measurements of the ambient environment conditions were carried out to acquire temperature and humidity data. The data were analysed using inferential and descriptive statistics and content analysis. The results revealed that preference and perceptual patterns were incongruent with evolutionary assertions suggesting that the tendency of human stress mitigation in nature is not shaped by innate or evolutionary factors. Experiential contact with the mountain landscape environment influenced individual’s ability to attain a relaxed state through the reduction of their diastolic blood pressure and pulse rate. It was found that tangible psychological and physiological effects can be obtained through short term contact with a multi-stimulus mountain landscape environment. The study concludes that contact with mountain landscape environment promotes spontaneous recovery from stress and restoration of directed attention. Policy makers, designers and developers within the context of creating buildings and cities would eventually refer to this evidence as it pertains to the potential of mountain landscape environments in mental wellbeing promotion.
ABSTRAK

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<td>ANOVA</td>
<td>Analysis of variance</td>
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<td>ART</td>
<td>Attention Restoration Theory</td>
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<tr>
<td>bpm</td>
<td>Beats per minute</td>
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<tr>
<td>b/m</td>
<td>Breaths per minute</td>
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<tr>
<td>BP</td>
<td>Blood pressure</td>
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<tr>
<td>BVP</td>
<td>Blood volume pulse</td>
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<tr>
<td>DBP</td>
<td>Diastolic blood pressure</td>
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<tr>
<td>DA</td>
<td>Directed Attention</td>
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<tr>
<td>DAF</td>
<td>Directed attention fatigue</td>
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<td>EMG</td>
<td>Electromyography</td>
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<td>ECG</td>
<td>Electroencephalography</td>
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<td>GAS</td>
<td>General adaptation syndrome</td>
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<td>HPA</td>
<td>Hypothalamic-pituitary-adrenal axis</td>
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<td>HUM</td>
<td>Humidity</td>
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<tr>
<td>mmHg</td>
<td>Millimetre mercury</td>
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<tr>
<td>PSS</td>
<td>Perceived Stress Scale</td>
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<td>PR</td>
<td>Pulse rate</td>
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<tr>
<td>RR</td>
<td>Respiratory rate</td>
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<td>SPSS</td>
<td>Statistical package for the social sciences</td>
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<td>SAM</td>
<td>Sympathetic adrenomedullary</td>
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<td>SNS</td>
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<td>β</td>
<td>Beta</td>
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<td>%</td>
<td>Percent</td>
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<td>°C</td>
<td>Degree centigrade</td>
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CHAPTER 1

INTRODUCTION

1.1 Introduction

The quest for attainment of physical and mental wellbeing through alternative medicine is a universal human goal. Quite a number of research studies have been carried out in the area of effects of nature experience on mental wellbeing (Bratman et al., 2012; Kaplan, 1992; Russell et al., 2013; Ulrich, 1979). However, a key element of the health benefits of nature may be its stress reducing effect. Meanwhile, stress can be accessed from an inexhaustible perspective. From the perspective of Selye (1976), widely regarded as the pioneer researcher on biological effects of exposure to stressful stimuli, stress is the general response of the body to any demand while a stressor is the stress producing agent (Neylan, 1998).

In his research, Neylan (1998) described the chronological development of the response to stressors when their activity is prolonged as the general adaptation syndrome (GAS). According to Selye (1976), GAS consists of the alarm reaction, resistance and exhaustion stage. Also, Burchfield (1979) in establishing the theory of stress response (TSR) stated that all organisms are genetically predisposed to adapt to stress and the physiological pattern of adaptation is similar across species. He viewed stress as anything which enables the transactions of psychological homeostatic processes. He further opined that homeostasis (Goldstein and Kopin, 2007), a complex dynamic state of equilibrium (Chrousos, 2009) is the maintenance of the normal mood state of an individual at rest.
Hobfoll (1989) in his critique described Selyes’ perspective of stress as a way of employing illogical deductive reasoning to depict stress as an outcome of one of the phases of the general adaptation sequence. He proposed a testable and comprehensive resource oriented model of stress named model of conservation of resources. The model stipulates that what actually forms a threatening situation in people is the fear of the potential or actual loss of hitherto retained, protected and built resources. Thus, psychological stress is the reaction to the environment which involves either the threat of a total loss of resources, the actual total loss of resources or the absence of resources hitherto gained. This definition tends to situate the subject of stress in terms of the individuals capacity for achieving and maintaining wellbeing. However, there seems to be a general consensus among researchers that mental stress results from interactions between persons and environments that are perceived as straining or exceeding adaptive capacities, hence, threatening wellbeing (Annerstedt et al., 2010).

In healthcare management, stress is vital in considering the etiology of diverse common health challenges which include cardiovascular diseases, anxiety disorders, obesity and depression (Lee and Oh, 2010; Probst, 2013). In landscape studies, stress is viewed in terms of the contribution of urbanization, lifestyle changes and the ameliorating potentials of nature related environments (Hartig et al., 2014). On the whole, researchers have variously tried to conceptualize the negative attributes of stress (e.g. forgetfulness, distractions, mistakes and illness) and also critically assess the positive aspects of restoration linked to nature (e.g. feeling relaxed, effectiveness, productivity and wellbeing) (Bergdahl and Bergdahl, 2002; Kaplan, 2001a; Kaplan and Kaplan, 2011; Tsunetsugu et al., 2013). The apparent detachment of most individuals from nature has however contributed to their diseased state. Hence, the proponents of nature oriented psychotherapy have advanced explanations concerning health effects of natural environments with the intent of linking the man-nature versus wellbeing paradigm.

O'Craven et al. (1997) assert that attention enables the processing of vast quantities of information received by the visual system through the selection of subset of the received information for further processing. The selection process depends on
either the properties of the stimulus or on a voluntary choice by the individual. However, directed attention phenomenon as described by Kaplan (1995) plays a major role in human capacity for selectivity in information processing and it is fragile, hence, capable of instigating fatigue. On the other hand, the consequence of fatigue precedes the need for attention restoration in order to facilitate a return to effective functioning state, and this can be achieved through contact with nature (Tennessen and Cimprich, 1995).

The term restoration encompasses the process that facilitates peoples recovery from stress acquired whilst trying to meet demands of everyday life (Hartig et al., 2011). Modern day environments are only created to suite everyday living and working which offer no restorative health benefits (Thompson, 2011). In contrast, nature related environments like forests, wilderness and mountains are considered to possess significantly the possibility of enhancing restoration from stress through passive and active contact. In other words, natural environments play an essential role in human functioning through the process of restorative experiences (Kaplan, 1992; Ulrich, 1979). These experiences can be elicited consciously or unconsciously depending on the active or sensory state of the individual.

Typically, natural environments are distinct from everyday urban settings and are endowed with attributes like water (Bulut et al., 2010), vegetation, foliage and forests (Hartig, et al., 2011). They are also coherent and rich, having trails to walk, paths for exploration and compatible connections with the settings such as hiking, observation and peaceful meditation (Berto et al., 2010). Our everyday urban settings are almost devoid of such endowments. However, the visual qualities of the undulating mountains, captivating grasslands, riveting waterscapes and prominent forest groves of the Obudu mountain landscape environment, Nigeria, constitute an inspiration in the conceptualization of this study. It is therefore pertinent to ask to what degree the mountain landscape environment would influence recovery from directed attention and stress.
1.2 Problem Statement

Several studies evaluating encounters with wilderness and forest environments have been supportive of the restorative and therapeutic effects of nature (Cole and Hall, 2010; Kaplan, 1992; Staats and Hartig, 2004; Tsunetsugu et al., 2013). Most of the previous research aimed at measuring health outcomes of the experience of natural environments involved participants viewing through a window or viewing nature scenes through video, picture slides and simulations. For example, Ulrich (1984) accessed post-surgical patients in a hospital room with a view through the window of natural settings predominantly composed of trees. He investigated whether a view of natural settings have more positive effect on the patient’s emotional states and recovery rate than built structures essentially made up of a featureless brick wall. Similarly, Raanaas et al. (2012) in a longitudinal quasi-experiment comprising three distinct types of window views from patient’s (undergoing rehabilitation) rooms examined the health benefits of a bedroom window view to natural environments. Though their result suggests that view of natural scene have more therapeutic influence on recovery, it was not established whether physical contact with a real-life multi-stimulus natural environment will yield faster recovery time for such patients. Very few of these studies have considered interactive engagements like walking, running, seating and gardening within the natural environments.

Laboratory and quasi experiments have been engaged to explore the suggestion that contact with and experiences of natural environments enhance wellbeing better than experiences of other environments. Ulrich (1979) building on these notion evaluated the effects of visual contact with outdoor environment through an experiment which involved showing color slides of outdoor environments to two groups of mildly stressed subjects. Findings support the opinion that individuals feel significantly better after exposure to nature scenes rather than urban scenes lacking in nature elements. Recently, van den Berg et al. (2014) engaged the use of photo/video depictions to examine the restorative effect of different types of urban public spaces with various levels of naturalness. Results show substantial difference in recovery of wellbeing within varying conditions of nature.
However, these studies which have been largely carried out in confined environments in order to control experimental variables focused mainly on the sights and not the multi-sensory aspects. To further lend credence to research in the area of restorative environments, Hartig et al. (1997) in a multi-dimensional study provided an insight into the means for measuring psychological factors in favour of restorative experiences. On-site experiences, video simulations of walk through natural and urban settings and photographic slide simulations of different settings were deployed as a multifaceted methodological strategy to ground a dependable perceived restorativeness scale (PRS).

Seemingly following up on past research, Herzog et al. (2003) attempted a new approach to the measurement of restorative potentials of environments by creating and validating several Likert-scale items to measure four components of a restorative environment (Kaplan, 1995). In the study, color slides of urban and field environments were employed as stimuli for rating the restorative components of environments. Also, Han (2010) through a study carried out to ascertain the relationship and the differences that exist between scenic beauty, preference and restoration employed the use of landscape slides as visual stimuli. Moreover, natural habitats are rich in sensory attributes and act as a vehicle for information to all human sensory systems—sight, sound, touch, taste and odour (Heerwagen, 2009). Hence, the drawbacks and methodological limitations in these studies are not farfetched as only visually represented landscapes influenced the assessment of researchers.

Very few research in the assessment of nature and human wellbeing relationships have adopted the real site methodology with the combined psycho-physiological mode of measurement. A study by Cole and Hall (2010) provided insights into the possibilities of stress reduction and restoration of mental fatigue in wilderness. Using a cross-sectional study design, the study tried to evaluate the effect of congestion and length of time spent in the wilderness. This was based on assessments of how much restoration was experienced and the degree to which components of the environment associated with restoration were experienced. Measured using a four-page questionnaire after wilderness trips, respondents reported substantial reduction in stress and tension coupled with mental restoration.
Building upon existing research on human physiological responses in natural and urban field settings, Hartig et al. (2003) compared psycho-physiological stress recovery and directed attention restoration using repeated measures of ambulatory blood pressure (ABP), emotion and attention (Berto, et al., 2010; Herzog et al., 1997; Sahlin et al., 2014; Tennessen and Cimprich, 1995). In order to ascertain the influence of viewing images of natural scenes on individuals, Chang et al. (2008) analyzed the psychological and physiological responses of participants while viewing visual stimuli of wild land scenes. Participant’s psychological responses were measured by the perceived stress scale (PSS) (Cohen et al., 1983; Lee, 2012; Shosha, 2012) while physiological responses were measured by blood volume pulse (BVP), electromyography (EMG) and electroencephalography (EEG) (Sharma and Gedeon, 2012). Findings suggest that substantial level of agreement exists between the psychological measures of restorativeness and the three physiological responses.

On the whole, the body of knowledge has expanded with researchers exploring more on the psycho-physiological benefits of interacting with varying real forest environments using multiple measures (Horiuchi et al., 2014; Ochiai et al., 2015; Tsunetsugu, et al., 2013). Agreeably, whilst quite a number of studies have been carried out on the restorative benefits of forests and wilderness environments, mountain landscape environments have received little attention. Researchers situating mountain landscape environments as study context have focused more on estimating visual properties and aesthetic values with regards to preference and perception (Beza, 2010; Lindemann-Matthies et al., 2010; Schirpke et al., 2013a; Schirpke et al., 2013b; Tveit, 2009). So far, no previous study has investigated the restorative benefits of contact with mountain landscape environment. Therefore, extensive research remains to be carried out in the investigation of the mechanism and intricacies of the link between restorative environments, human response and wellbeing. Hence, a synergetic approach in the measurement of the psycho-physiological responses of individuals within a real-life multi-stimulus mountain landscape environment is required. This is in order to further extend research in the environment and human well-being domain. The Obudu mountain landscape environment in Nigeria, endowed with rich, multi-stimulus landscape features offers a veritable platform for this study.
1.3 Research Gap

In order to make a contribution to research in the area of restorative environments and human response, the gap of this study is formulated from the following:

I. Previous studies have been done in quasi (confined or laboratory) environments which involved participants viewing through a window or viewing nature scenes through video, slides and simulations. This approach is adopted basically to control experimental variables and focus is mainly on the sense of sight not multi-sensory. Thus, stimulating vital senses (smell, sound, touch, sight) which are likely to act as precedence to mental restoration and a balanced physiological experience have not been adequately considered.

II. Most of the research carried out on real-site nature related environments has been largely done in forests while mountain environments have merely been mentioned as part of slides or video simulations. In an attempt to situate mountain landscape environment as study context, very few researchers have only investigated its visual properties and aesthetic values. Extensive work remains to be carried out to cover the full range of benefits that exists in the mountain landscape environment in relation to human wellbeing.

III. Generally, a large volume of studies depended on psychometric self-report measures to determine the magnitude of psychological human response to environmental stimuli. Consequently, these psychometric self-report measures driven by consciousness, observation and mood states may be unable to detect physiological reactions to environmental stimuli (Chang and Chen, 2005). Further, objective measures of physiological responses such as skin temperature, brain waves (EEG, ECG), hand and finger movements, pupil diameter, blood pressure, heart rate and respiratory rate are likely to reduce the chances of subjective bias in the perception and reporting of events.
Table 1.1: Evaluation of some studies, environments and methods employed

<table>
<thead>
<tr>
<th>Author/Year of publication</th>
<th>Research environments</th>
<th>Environmental Stimuli</th>
<th>Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ochiai et al. (2015)</td>
<td>Real site</td>
<td>Forest bathing</td>
<td>Blood pressure, urinary adrenaline, serum cortisol, Profile of mood states (POMS), Total mood disturbance (TMD)</td>
</tr>
<tr>
<td>van den Berg et al. (2014)</td>
<td>Laboratory</td>
<td>Picture/video presentations of urban green spaces</td>
<td>Profile of mood states (POMS)</td>
</tr>
<tr>
<td>Tsunetsugu et al. (2013)</td>
<td>Real site</td>
<td>4 forested and 4 urban locations</td>
<td>Profiles of mood states scale (POMS), Blood pressure (BP) and Heart rate (HR)</td>
</tr>
<tr>
<td>White et al. (2013b)</td>
<td>Laboratory</td>
<td>Slide show with virtual reality forest.</td>
<td>Electrocardiogram (EKG), blood (BP), heart rate (HR) and the respiratory sinus arrhythmia (RSA)</td>
</tr>
<tr>
<td>Martens et al. (2011)</td>
<td>Real site</td>
<td>Wild and tended urban forests.</td>
<td>Multidimensional scales in a pre-post-treatment setting using questionnaires</td>
</tr>
<tr>
<td>Annerstedt et al. (2010)</td>
<td>Real site</td>
<td>Broad leaved and coniferous forests</td>
<td>Mail administered survey questionnaire</td>
</tr>
<tr>
<td>Berto et al. (2010)</td>
<td>Laboratory</td>
<td>Picture slide of natural and built environments.</td>
<td>Sustained attention task. (SART), Posner’s attention-orienting paradigm, Incidental memory task</td>
</tr>
<tr>
<td>Bulut et al. (2010)</td>
<td>Quasi</td>
<td>Photographs of waterscapes.</td>
<td>Scenic beauty estimation (SBE)</td>
</tr>
<tr>
<td>Cole and Hall (2010)</td>
<td>Real site</td>
<td>Wilderness</td>
<td>Questionnaire based items</td>
</tr>
<tr>
<td>Han (2010)</td>
<td>Laboratory</td>
<td>Landscape slides as visual stimuli.</td>
<td>Revised perceived restorativeness scale (RPRS), Short version Revised perceived restorativeness scale (SRPRS)</td>
</tr>
<tr>
<td>Berman et al. (2008)</td>
<td>Real site/Quasi</td>
<td>Walk in the park/pictures slides of urban and natural sites</td>
<td>Digit Span Task, Attention network task, Positive and Negative Affect Schedule (PANAS)</td>
</tr>
<tr>
<td>Chang et al. (2008)</td>
<td>Laboratory</td>
<td>Viewing visual slides of wild land scenes as stimuli</td>
<td>Perceived stress scale, blood volume pulse (BVP), electromyography (EMG) and electroencephalography (ECG)</td>
</tr>
</tbody>
</table>

IV. Finally, very few research in the assessment of nature and human wellbeing relationships have adopted a synergetic approach of the mix of real site and psycho-physiological mode of measurement. Evaluation of some studies, research settings, environmental stimuli and methods employed is shown in Table 1.1. Only five out of thirteen studies were carried out in real site research environments. Whereas one study was carried out using a combination of real and quasi research environment, seven studies were laboratory or quasi based.
Only three of the studies involved physiological measures while ten utilized psychological self-report measures. In addition, the table also shows that the environmental stimuli mainly involved forest, wilderness, urban green spaces and water. No study was found on the restorative benefits of contact with mountain landscape environment.

1.4 Research Aim

The aim of this study is to examine the mechanism and intricacies of the link between restorative environments, human response and wellbeing in a mountain landscape environment. Therefore, mountain landscape environments are regarded as restorative in terms of the enhancement of wellbeing.

1.5 Research Objectives

1) To identify the feature(s) of the mountain landscape environment potentially influential to human perception and psychological response;
2) To investigate the magnitude to which mountain landscape environments can stimulate human psychological and physiological well-being; and
3) To determine the significance of the ambient mountain landscape environment conditions on human physiological wellbeing.

1.6 Research Questions

1) What feature of the mountain landscape environment yield higher restorative benefits in terms of psychological wellbeing?
2) What degree would the mountain landscape environment influence recovery from directed attention and stress?
3) What aspects of the ambient mountain landscape environment conditions combine to elicit human physiological wellbeing?

1.7 Research Scope and Limitations

The focus of this study is on the psycho-physiological benefits of mountain landscape environment as stimulus for restoration of directed attention and stress mitigation. The Obudu Mountain landscape environment with its characteristic plant materials, non-threatening wildlife (birds, squirrels, and butterflies), sights and sounds of moving water, views to the horizon and fountains influenced its choice as study environment. To ascertain its restorative potentials the mountain landscape environment is compared with the urban environment where the study respondents originated from. This comparison involves the interactive engagement of respondents with both environments within a 7-day experimental period. However, the use of a real mountain landscape environment instead of quasi, though novel is a courageous attempt given the procedural complexities and resources involved. The study engaged measures that involve the psycho-physiological processes underlying the pathways linking the potential benefits of restorative environments and human response.

1.8 Significance of the Research

With regards to the problem statement and research gap, research into the psycho-physiological factors affecting stress and wellbeing have been actively conducted mainly in countries within the global north such as the United States of America and Europe (Andreou et al., 2011; Herzog et al., 2009; Honold et al., 2015; Kaplan, 1995; Sahlin, 2014). The global south especially Africa have recorded quite a few number of research in this context (Chang, et al., 2008; Sarkar and Mukhopadhyay, 2008; Takayama et al., 2014). Hence, the necessity to experiment with samples from this region in order to add to the existing body of knowledge which supports the link between restorative environments, human response and wellbeing. This would further substantiate claims of the universality of restorative responses.
In addition, a large percentage of these studies have been carried out within a small scope of landscape types. Given the multi-stimulus nature of Obudu mountain landscape environment, engaging samples using objective measures of psycho-physiological wellbeing like blood pressure, pulse rate and respiratory rate offer enough justification for landscape planners and architects for further nature related interventions. Policy makers, designers and developers within the locus of creating buildings and cities would eventually refer to available evidence pertaining to the potentials of mountain landscape environments as a promoter of mental wellbeing.

1.9 Conceptual Framework and Research Methodology Outline

With regards to the link between nature experience and wellbeing, the benefits of contact with the mountain landscape environment on psycho-physiological states are explored. A basic assumption guiding research in this area relates to how cumulative effects of contact with environments having restorative qualities can enhance human wellbeing more than those without restorative qualities (Hartig, et al., 2011). Therefore, aspects of this assumption in relation to mountain landscape environments involves visual and physical interaction, psycho-physiological response and the span of time required for cumulative effects of restorative experience to manifest. The conceptual framework of the study is shown in Figure 1.1.

![Figure 1.1: The conceptual framework of the study](image)

Figure 1.1: The conceptual framework of the study
The study is made up of multiple inter-related research design in order to address the research problem and achieve the objectives. A quantitative methodological approach was employed to explore the full range of psychological and physiological aspects of human wellbeing. It involved cross-sectional and interrupted time-series between group experimental surveys. This was based on a cause and effect phenomenon comparing contact with the urban and mountain landscape environment. Respondents comprising samples from the urban population co-opted through random convenience method were engaged in both the cross-sectional and interrupted time-series within group experimental survey. The study utilized psychometric questionnaires, physical measures of physiological indices and instrumented measures of ambient environment conditions to elicit data. The data obtained was analysed using descriptive and inferential statistics. Findings from the three dimensional data was triangulated and presented in the form of narrative including tables and figures. A summary of the research methodology outline is as shown in Figure 1.2.

Figure 1.2: Research methodology outline
1.10 Thesis Structure

The thesis is structured into seven chapters as follows:

**Chapter 1** commenced with the research background, problems statement as well as highlights of the gaps identified in the area of restorative environments, human response and wellbeing. It also highlighted the research aim, objectives and questions established to guide the direction of the study. Other sections in the chapter include, scope and limitation of the study, significance of the study, conceptual framework and research methodology outline. The overall thesis structure is presented at the end of the chapter.

**Chapter 2** reviews the background of theories concerned with restorative environments and their link to human response and wellbeing. The review heralds the presentation of the research underpinnings which include Stress Recovery Theory (SRT), Aesthetic-Affective Theory (AAT) and Attention Restoration Theory (ART). Further, a review of literature from the perspectives of medical geography and environmental psychology is established with regards to studies pertaining to restoration of wellbeing. In addition, this chapter explains the meaning of restorative environment and the different study sites used in the study of restoration.

**Chapter 3** reviews the relationship between health, mental wellbeing and stress. It assessed the influence of the environment with regards to health and mental wellbeing. Also, the meaning and types of stress as well as its sources are established in this chapter. Additionally, a literature on stress response and the concept of homeostasis in human beings forms part of the chapter. Furthermore, human responses are highlighted based on the components of psychological and physiological stress response system.

**Chapter 4** presents the research methodology approach utilized in examining the restorative benefits of contact with the mountain landscape environment. The chapter explains the study design, parameters, unit of analysis and sampling strategy.
Additionally, the study locations, data collection procedure and validity and reliability assessment are elucidated.

**Chapter 5** discusses the results in relation to the findings of the study. The chapter is divided into three main sections. First, the results and findings on the features of the mountain landscape environment potentially influential to human perception and psychological response are interpreted. Next, results and findings pertaining to the magnitude of mountain landscape environment stimulation on human psychological and physiological wellbeing are discussed in detail. And lastly, results and findings of the effect of the urban and mountain landscape ambient environment conditions are articulated and discussed.

**Chapter 6** concludes the thesis with a discussion on the overall findings including the theoretical and policy implications of the body of work. Additionally, the study limitations and suggestions for further research are outlined.
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