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# The physical work environment's impact on wellbeing : the moderating role of time spent in building.

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# Chapter 1 Introduction

## 1.1 Rationale

According to McCoy and Evans (2005; p. 219) "changes in the physical environment provide a potentially powerful intervention tool for enhancing organised work". The built environment in which workers find themselves is the arena in which employees often need to complete their designated tasks. Furthermore, workers also spend a considerable amount of time in their respective workstations, thus it is important to investigate the effect that the physical building has on the employees. This view is supported by McCoy and Evans (2005) and Bergs (2002) who argue that employees spend a considerable amount of time in their places of work. As a result Bergs (2002) argues that the physical work environment within which employees work can have a substantial influence on the health and wellbeing of individuals. It also follows that an employee who is comfortable in their environment will feel good and be able to complete their tasks effectively.

This study will contribute to knowledge in the built environment field, as it will attempt to understand how employees in a particular building perceive their building. The study will however be different from other studies in this field as it will emphasize the role of time-spent in the building, which has often been neglected in previous research. With emphasis being placed on time spent in the building, the study will attempt to highlight the effects of the physical environment on employees more holistically. Thus, this study will also highlight the importance of perceptions of the physical environment and how it relates to the wellbeing of employees, whilst remaining cognisant of the duration of time employees spend in the building and the effects thereof.

According to Veitch, Charles, Farley and Newsham (2007) the results which link the advantages between the physical work environment and organisational outcomes have been mixed. This study will contribute to knowledge by attempting to illuminate the links between the physical work environment and employee wellbeing which ultimately influences organisational outcomes. Heerwagen (2002) argues that employers face a conundrum as they seek to enhance organisational performance by optimising the use of their facilities; however

they are reluctant to invest in the facilities until they have some proof that the investment will yield results. If this research is able to conclusively show that the improved built environment makes for a healthier (physically and psychologically) workforce, this research will help increase employer confidence in investing in the built environment as a crucial organisational strategy. Fundamentally the research will seek to explain how the improvement of the quality of the physical environment could have an influence on the wellbeing of the employees in that particular environment if statistically significant results are uncovered. The lesson to be observed from this study is that the physical work environment is not just about the housing of employees but rather an asset that can improve organisational outcomes (Veitch et al., 2007). Furthermore, employers who invest in the physical environment will be viewed as employers who are committed to the wellbeing of their workers. According to Heerwagen (2000; p. 17), "building designs that contribute to human well- being and performance may be perceived by decision makers as one of many strategies to attract and retain workers". It was also predicted that organisations with an environmentally-orientated culture were more likely to recruit and retain employees who inherently value the environment as people now often select jobs that match their attitudes (Heerwagen & Zagreus, 2005).

It is important to note that contemporary infrastructural development needs to take the needs of the environment into account. Heerwagen (2000) asserts that a green orientation in the design of buildings is crucial in creating a high standard of interior environmental quality, a healthy workforce, and general satisfaction. Thatcher and Milner (2011) argue that green buildings allow for a more comfortable and healthier workforce whilst contributing towards a more sustainable future orientation. Singh, Syal, Grady and Korkmaz (2010) argued that physical factors such as poor air quality, ventilation and thermal conditions in traditional office buildings had an adverse effect on employees' wellbeing and health. Birt and Newsham (2009) in a post occupancy evaluation of a green building showed that occupants were more satisfied with the air quality, ventilation, and thermal comfort in the green building. Green buildings address the concerns associated with the indoor environment whilst providing a healthy place to work in (Singh et al., 2010).

With this in mind the research will also reflect on the benefits of green building design on the health and wellbeing of individuals. Sustainable development will be the foundation upon

which this research is based. This is important because no engagement with the physical environment is complete without acknowledging the principles of sustainable development due to the immense challenges the world faces today with regard to global warming and severe climatic changes. Thus the study will also contribute to knowledge by investigating the investment and implementation of green buildings, in order for the sustenance of the globe and increasing employee health and wellbeing.

### 1.2 Aim of the study

The aim of the current study is to ascertain whether the individual's perceptions of the physical work environment within which they work, has an influence on the individual's physical and psychological wellbeing. Furthermore the study interrogated the influence of the duration of time spent in the building in order to see how this variable of time spent in the building affects the wellbeing of employees. Also the move from a conventional building to a new green building is expected to make the difference with regard to the employees' wellbeing at Nedbank. A number of Post Occupancy Evaluations (POE) studies have shown that a move from a conventional building to a green building was associated with increased user satisfaction with regard to the building (Birt, 2009; Fowler & Rauch, 2008).

### 1.3 Objectives

To be able to realise the aims of this study, the study attempted to achieve the following objectives. The primary objectives were to:

1. To investigate the perceptions and attitudes of employees towards their built environment.
2. To determine the environmental factors which influence the psychological and physical wellbeing of employees.
3. To understand the role of time employees spent in the building, and how it would influence their psychological and physical wellbeing.

# Chapter 2 Literature Review

## 2.1 Introduction

Concepts such as the physical work environment and wellbeing have received a considerable amount of attention in research in relation to one another. However it appears that physical wellbeing has received more attention in relation to the physical work environment, with a less substantive amount of research being focused on psychological wellbeing and the physical work environment. To add to this there has also been a considerable lack of literature on how time spent in a physical work environment relates to the wellbeing of employees. This study attempts to address these gaps by focusing on psychological wellbeing and how time spent in the physical work environment influences employee wellbeing. One of the aims of this study is to investigate the potential moderating role of time spent in building on the relationship between the physical work environment and employees' psychological and physical wellbeing. The literature review will also look at environmental issues, specifically sustainable development and how this concept meshes into the study, making it a practical and relevant study.

## 2.2 Sustainable Development and Green Buildings

Human activity has led to massive ecological problems which has now placed the future of mankind in jeopardy. To argue this point succinctly, human activity is not sustainable, and there is only one earth in which we can live (Moffat, 2000). Moffat (2000) lists a number of practices that could be utilised in order to reduce the carbon footprint of human activities on the environment; these include environmentally friendly technology, efficient use of current technology and reducing the usage of resources. Cole, Robinson, Brown and O'Shea (2008) also argue that the primary goal of human activity should be to move from a high carbon society to a lower carbon society. This shift from a high to a low carbon society will mean certain changes in behaviour and utilisation of resources will need to be enacted which will ultimately be of benefit to the environment.

There has been a global realisation that there is a need to manage the earths' non- renewable resources and not to exploit them. The Brundlandt Commission defined sustainable

development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Attainese, 2012; p. 2156). A key word that arises from within this concept is that of ‘develop’. To develop means “to expand or realise the potentialities of; bring gradually to a fully, greater, or better state” (Daly, 1990: p. 1). In essence there is a need to limit the rate of depletion of non- renewable resources whilst increasing the utilisation of renewable resources (Daly, 1990). As argued by Lockwood (2006) and Daly (1990) we need to take advantage of technology, technology which maximises the minimal use of resources or in other words extract as much as one can from as little as possible. There is a limit to resources, people need to learn to do more with less (Yazdi & Shakouri, 2012). Mankind has realised that it is not detached from the natural environment, but rather our existence is dependent on the environment. Humans do not exist outside of the physical environment, we are nothing without the environment we exist within and nothing can be done outside of the environment. Hopwood, Mellor, and O’ Brien (2005) argue that no one is exempt from the threat that environmental degradation poses to humans. To adopt a philosophical stance, it is also important to recognise that at the end of the day organisations are also users of the environment, they also have an obligation towards the conservation of the environment. It is no longer only about the economic bottom line but also considering the environmental repercussions of organisational behaviour. The onus needs to be shared amongst various stakeholders in society from the government, to organisations, to individuals. It has also become apparent, through this realisation, that the boundaries between the environment and the economy have become blurred (Hopwood et al., 2005). Thus any discussion on the economy becomes an environmental discussion and vice versa. The two are not independent of one another and there is a need to ensure that the pursuit of one does not disadvantage the other.

Yazdi and Shakouri (2012) argue that organisations are starting to be held accountable for their actions. Organisations often need to justify their actions and often act within a given set of parameters. As concern for the environment escalates, organisations also have to display to various stakeholders why they utilise the resources in the manner in which they do and how they are minimising the impacts on the environment. According to Kilbert (2004) buildings utilise 30% of energy in the USA, with such statistics in mind, it appears plausible to argue that organisations need to be drivers of the transition into a more environmentally orientated economy and world order in general. Buildings generally have been recognised as a possible

opportunity in which the ecological footprint can be mitigated (Cole et al., 2008). Green buildings are becoming a necessity for organisations. Top global corporations such as Toyota, Genzyme, Bank of America, and IBM have invested in green buildings (Lockwood, 2006).

Green buildings have become a growing trend as concerns about the environment escalate. According to Baird (2010), buildings have an influence on the environment. He argues that in recent years there has been a refocus on sustaining and protecting the environment, therefore the increased emphasis on green buildings (Baird, 2010). Beyond the environmental benefits Heerwagen (2000) argues that green buildings are designed to enhance the wellbeing of occupants. It is strongly believed that green buildings are associated with higher Indoor Environmental Quality (IEQ) in comparison with non-green standard buildings (Heerwagen & Zagreus, 2005). Consequently building occupants in the Heerwagen and Zagreus (2005) study were more pleased with the green building that they had moved into. This is an important finding as it highlights that during the time spent in the green building the employees were happy.

Organisations need to save resources and behave in a green manner in order to sustain the environment. According to Heerwagen, (2000; p. 20) "Green buildings can provide both cost reduction benefits and value added benefits". According to Kibert (2004) investing in green buildings makes economic sense, as the owners are able to save in the long run. Organisations also need to be cognisant of the fact that due to the increase in demand and less supply for resources, tariffs for necessities, such as electricity and water, are constantly increasing. It has thus become crucial for the organisation to find ways in which costs can be minimised. Yazdi and Shakouri (2012) support this assertion and argue that the energy crisis should be viewed as an opportunity in which the organisation can invest in technology that will save them on energy costs in the long term. As the search for viable alternative energy sources expands, organisations should involve themselves. The term green building is useful here as it provides us with an alternative conceptualisation of buildings which can be more beneficial to the environment. Pyke, McMahon, and Dietsche (2010; p. 4) define a green building as "a systematic effort to create, sustain, and accelerate changes in practice, technology, and behaviour to reduce building- related environmental impacts while creating places that are healthier and more satisfying for people". Kibert (2004; p. 491- 492) similarly

defined green buildings as "facilities designed, built, operated, renovated, and disposed of using ecological principles for the purpose of promoting occupant health and resource efficiency plus minimising the impacts of the built environment on the natural environment". Heerwagen (1998) argues that in order for buildings to be truly effective, they need to satisfy three conditions; environmental sustainability, organisational effectiveness, and human wellbeing. Green buildings are truly effective buildings as they are designed with the intent of realising these outcomes.

These definitions highlight that green buildings are designed with the environment in mind and all the side effects associated with the building are designed with the intention of minimising the negative impact on the employee and environment. This view is consistent with Attainese (2012), whose understanding of green buildings goes beyond considering humans in terms of comfort and productivity to looking at buildings from an architectural point of view in order to design appropriately for the end occupants. These definitions of green buildings are also consistent with the definition of sustainable development. It is apparent that green buildings are relevant in the short term as a key tenet of such a building is to increase the positive experience of the building occupant. Simultaneously whilst catering for the needs of the present user, the long term orientation of the building ensures that the environment is conserved in order to minimise the damage to the environment in favour of future generations. Yazdi and Shakouri (2012) support this assertion that sustainable development is concerned with improving the life conditions of people in the present and in the future. Attainese (2012) describes green buildings as high performance buildings which have a life cycle approach and a number of other characteristics including that of durability. Yazdi and Shakouri (2012) argue that there is a need to consider the short term and long term repercussions of decisions on the environment, social and economic sectors of society as a whole. A life cycle approach with characteristics of durability within green buildings feeds well into Yazdi and Shakouri's (2012) understanding of sustainable development. Altomonte (2008) argues that there is a need for an integrated approach to architecture as a decision in one sphere has a knock on effect in other spheres. This discussion highlights that green buildings are a way in which organisations can feed into a long term vision of sustainable development, which is imperative. Yazdi and Shakouri (2012; p. 472) summarise this discussion of green buildings and sustainable development succinctly arguing that it is about "balancing environmental protection and social responsibility with a healthy economy". This

can be practically applied in organisations through the development of an environmentally friendly physical work environment, which can be particularly advantageous to the health of the workers psychologically and physically.

### 2.3 The physical work environment

In this study, the work context in which workers find themselves and carry out their work tasks can be understood as the physical work environment. The physical work environment includes the tools and resources that people utilise to carry out their respective mandates (Bergs, 2002). For the purpose of this study however, the physical work environment refers to the physical building characteristics and the tools thereof.

#### 2.3.1 Indoor Environmental Quality

Research has looked at building characteristics in order to ascertain the influence of these on the employee. According to Abbaszadeh, Zagreus, Lehrer and Huizenga, (2006) it is important to find out whether buildings have an influence on occupants. Research in this area has mainly focused on observing the building characteristics that have an effect on the building occupants. Building occupants are defined as "'inhabitants', who may play an active role in the maintenance and performance of their buildings" (Cole et al., 2008; p. 324). Building characteristics that influence the building occupant are known as the Indoor Environmental Quality (IEQ) (Abbaszedah et al., 2006; Fisk, 2000). IEQ encapsulates a number of characteristics that influence the employee in their workplace. The characteristics of IEQ broadly include temperature, air quality, lighting and acoustics (Abbaszedah et al., 2006).

According to Roelfson (2002), the indoor environment of an organisation can be viewed generally as problematic. Building characteristics or building factors can be viewed as a hindrance in that they often disturb the flow of work as it should be carried out (Roelfson, 2002). According to Fisk (2000), it needs to be recognised that IEQ improvements mainly hinge on the design, operations, maintenance, and occupancy of the building. All of these factors need to be considered if a high standard of IEQ is to be adhered to by the

organisation. This view is supported by Parsons (2000), who argues that the environmental ergonomist needs to look at how different facets in the environment work together to influence people. Until the 1960's the impact of the built environment on the building occupants was largely ignored (Bitner, 1992). However environmental psychology developed as a field that looked at people in relation to their built environment. The development of this field can be attributed to the growing realisation of the need to consider human influences on the environment as discussed earlier. Now it is important to note that IEQ has a particularly large influence on the comfort, mood, and safety of individuals (Parsons, 2000).

Sustainability Victoria and Kandor Group (2006) argues that people spend 90% of their time indoors generally, Hedge (2000) supports this view by asserting that humans on average spend more than 95% of their time living indoors. Fisk and Rosenefeld (1997) assert that people spend approximately 90% of their lives at work. From this it is also possible to conceive that employees spend a considerable amount of their week days at work. Aries, Veitch and Newsham (2010; p. 533) assert that "Office employees spend most of their waking time inside the building which they work". These similar assertions indicate that there is a definite need to study people in relation to their environment based on the amount of time they spend in the building. With this in mind it is crucial that organisations invest heavily in their built environments in order to ensure that the time which their employees spend at work is pleasurable and beneficial to their health. Organisations need to ensure that discomfort that is associated with the built work environment is reduced in order to get the most out of their employees. Conditions of the built environment can influence people's behaviour and also affect their intentions to either avoid or seek new environments which they perceive as being more comfortable (Hedge, 2000). Bitner (1992) argues that people react in two ways to their environment, either through approach or avoidance behaviours. "Approach behaviours include all positive behaviours that might be directed at a particular place, such as desire to stay, explore, work and affiliate" (Bitner, 1992; p. 60). Avoidance behaviours are the opposite of this where people do not want stay, explore, work and affiliate (Bitner, 1992). It follows from this that organisations should strive to encourage approach behaviours in order to attract customers and employees and ensure that employees do their respective jobs. Furthermore it is argued that when an employee is satisfied at work they will reward their employer by working harder (Taris & Schreurs, 2000; Harter, Schmidt & Keyes, 2002). It becomes clear that organisations have to make a concerted effort to make their employees

happier in order to get the most out of them. A way in which this can be done is by improving the built environment in which they work, namely the IEQ.

### 2.3.2 Overall Comfort

Leaman and Bordass (2007) propose an order of importance regarding key IEQ factors that influence employees: overall comfort, temperature, ventilation, and noise. These factors are proposed to have an influence on the wellbeing of employees. According to Cole et al. (2008) these factors need to meet the building occupant's physiological needs to ensure optimum functioning. Leaman and Bordass (2007) however acknowledge that people have different preferences when it comes to issues of their comfort. This view is also supported by Parsons (2000) who acknowledges the effect of individual differences when looking at environmental design issues. People often have their own preferences and as a result this complicates the design process. Thus Parsons (2000; p. 582) argues "it is usual in practice to design for a population of users", conversely Heerwagen (1998) rebuts this argument and argues that a one size fits all approach is not necessarily the best option. However due to the practicality of designing for populations rather than individual preferences, issues of personal control come to the fore. It is important to note that in the workplace the degree of control is reduced in comparison to that of a residential building, so comfort desires cannot be expressed as readily in a commercial setting (Cole et al., 2008). It is also important to note that comfort for one person may result in discomfort for another person (Bitner, 1992) and as a result there can be no uniform approach to addressing the challenges regarding IEQ in an office environment. Leaman and Bordass (2007) assert that people like to adjust conditions in order to suit their needs. This view is consistent with that of Heerwagen (1998) who argues that people adjust their environment and behaviour in order to be comfortable. This view is also congruent with that of Roelfson (2002; p. 251), who argues that "there are indicators that if users are able to exercise greater control over the indoor working environment, there is an improvement in performance, involvement in the work and morale". Thus if people are able to exercise more control they are more likely to feel that they are comfortable and be more tolerant of their workplace (Cole et al., 2008). However it is important to note that even in the midst of this individualism, organisations still rely on issues of shared comfort in order to realise their environmental goals. Thus some individual comforts may be compromised for the greater good (Cole et al., 2008).

This discussion on open plan offices attempts to show the reader that there is no standard of IEQ that will satisfy all IEQ characteristics. Organisations rather need to find the best way in which the IEQ can be enhanced to the maximum with regard to that particular type of organisation. Therefore the physical building needs to support the desirable conduct and strategic goals of the organisation (Bitner, 1992). Social interactions occur within a physical context, the nature of that context influences the quality of the interactions, "communication patterns, group cohesion, and the formation of friendships and small groups can be influenced by the physical setting" (Bitner, 1992: 61). The office plan which an organisation adopts will reflect the nature of the relations within the organisation. Ultimately the office plan needs to support the strategy of the organisation and the work tasks of the employees. This shows how crucial the built environment is in ensuring that organisational outcomes are met.

### 2.3.3 Acoustic Concerns

It is important to note that this issue of personal control produces a design dilemma for some organisations as often organisations have adopted an open plan approach to their buildings. The conundrum which is faced by open plan offices is that, having an open plan office makes it easier to cater for IEQ; however personal control may be compromised (Leaman & Bordass, 2007) which then influences perceptions of comfort (Cole et al., 2008). Open plan offices make it easier for improving the quality of ventilation and pleasant views, however simultaneously this means that acoustic levels may increase (Birt & Newsham, 2009) and individual personal control is compromised. Acoustics levels are bound to be higher in these open plan offices which may prove disadvantageous, whilst lighting may increase because of the open plan design. Acoustic distractions include people talking, overhearing co- workers talking on their phones, and the lack of privacy (Heerwagen & Zagreus, 2005). An increase in acoustic distractions may disrupt concentration and further increase noise levels as people speak louder to make themselves heard. Open plan offices also have an influence on the social comfort of building occupants. Cole et al. (2008) define social comfort as the relationship between building occupants and a number of criteria which influence the perceived comfort of occupants within their work environment. These criteria include positioning of workspaces, sense of territory, status associated with open or closed office plans, proximity to windows, sense of privacy and communication, and the ability to interact

with others (Cole et al,. 2008). It is possible to conceive that all these criteria have an influence and are important to the building occupants and all these concerns need to be noted when designing adequate workspaces for building occupants.

### 2.3.4 Lighting

"The main purpose of indoor lighting has been to aid visually directed tasks in the absence of sufficient external light" (Mills, Tomkins & Schlangen, 2007; p. 2). Fisk (2000) asserts that light is crucial because it directs attention and influences the vision of the employees. According to Heerwagen (2000; p. 10), "different kinds of tasks may require different kinds of light, thus the issue of personal control becomes increasingly important". According to Fisk (2000; p. 554) "Lighting extremes will adversely influence performance". It is important to note that there has to be a distinction between daylight and artificial lighting. In the bid to be more sustainable it becomes integral that organisations utilise day lighting more in comparison to artificial lighting. Not just from an economic perspective but also the use of daylight is crucial in the comfort and wellbeing of the employee (Altomonte; 2008). Mills et al. (2007), Fisk (2000), and Heerwagen (2000) provide integral information on the importance of light as Altomonte (2008) would agree. However, over and above directing attention, light plays a crucial role in the general functioning of humans. According to Altomonte (2008), to feel healthy people have always needed to be in contact with their outside environment. As people increasingly spend more time indoors due to the context in which they find themselves, there is a need to attempt to minimise the negative repercussions of being indoors for long periods of time. Nature dictates the rhythm of humans; periods of activity have been reserved for the day time whereas night time is reserved for rest. Altomonte (2008), argues that light is associated with hormonal regulation; light moving through the eye helps notify the body about what is happening in the environment, therefore hormones and metabolism can be regulated appropriately. It becomes apparent when lighting is observed from this perspective that it does not only serve in visually aiding the completion of tasks but also in the regulation of hormones.

Mills et al. (2007) assert that daylight deprivation for office workers may adversely influence the health and wellbeing of employees. Altomonte (2008) and Hedge (2000) support this

view. The result of these lighting problems may result in eyestrains and headache complaints from employees (Heeerwagen, 2000). Aries et al. (2010) argued that lighting conditions in buildings also have an impact on circadian rhythms, thus in their study it was found that distance from a window can influence the quality of sleep. According to Heerwagen and Zagreus (2005), building users had a positive reaction to increased access to daylight. However within the same article Heerwagen and Zagreus (2000) argue that too much daylight creates visual challenges for employees even though they have a general liking to natural light (Birt & Newsham, 2009). Other problems associated with lighting may be reflections from windows (Heerwagen & Zagreus, 2005), high computer screen glare and flickering lights (Heerwagen, 2000; Hedge, 2000). Altomonte (2008), distinguished between two types of glare that results in visual strain; disability glare and discomfort glare. The former categorisation impacts on the employee's ability to complete the task whilst the latter results in a significant decrease in visual performance (Altomonte, 2008). Hedge (2000), uses the word asthenopia to describe eyestrain conditions that can be attributed to lighting conditions in the office. These problems posited by these various theorists above are all linked to the visual problems of poor lighting.

Altomonte (2008), argues that the impacts of a lack of daylight are not just visual but importantly they can be non- visual biological effects. These include poor quality of sleep outside of the work environment, decrease in alertness, mood changes, irritability and reduced performance. Lighting helps to accentuate the workplace and dictates the mood of the workplace. However day light has been described as best to accentuate these effects (Altomonte, 2008). In organisations there is a need to maximise the advantages which natural lighting presents to the organisation. Buildings need to maximise the use of day light and minimise that of artificial light. Proponents of natural lighting, such as Altomonte (2008), argue that artificial light is not as effective as natural light in regulating biological functioning. Furthermore day light has been found to improve health, efficiency, productivity and reduce absenteeism (Altomonte, 2008). A suggestion proposed by Altomonte (2008) is to utilise both natural and artificial lighting. Thus lighting should vary in the office just as lighting does on the outside as the day progresses. Daylight needs to be in accordance with the circadian rhythms, in order to keep workers orientated (Altomonte, 2008).

### 2.3.5 Temperature

Temperature has been a large research area with many writers contributing to the understanding of this variable on employees (Leaman & Bordass, 2007; Heerwagen, 2000; Fisk, 2000). Fisk (2000) argues that variations in temperature can have a significant influence on the performance of individuals. According to Hedge, Erickson and Rubin (1996), if the office building was perceived as too hot, people concluded that the indoor air quality was poor. Paul and Taylor (2008) support this view and argue that in summer if occupants felt too warm they perceived their work environment as poor. Office buildings need to find a middle ground because too warm conditions or too cold conditions can be disruptive. This assertion is consistent with the arousal hypothesis: "arousal hypothesis predicts optimum satisfaction and performance under conditions of moderate arousal" (Paul & Taylor, 2008; p. 1859). Warm conditions can influence the cognitive awareness of employees (Parsons, 2000). This view is supported by Sustainability Victoria and Kandor (2006) who argue that when a room is considered as too stuffy people fall asleep, thus their productivity is hampered. Conversely when it is too cold employees may struggle with mobility via numbness and loss of strength (Parsons, 2000). Rapid fluctuations in temperature and hot or cold spots within the same building were the most frequent complaints that where associated with temperature in buildings (Sustainability Victoria and Kandor, 2006). Temperature in buildings is important as it can be linked to a number of building characteristics such as air quality, humidity, and ventilation. This assertion is consistent with Hedge et al. (1996; p. 16) who concluded that "results show that inappropriate thermal conditions, both too warm and too cold, inadequate ventilation, especially lack of perceived air movement and sensations of stale air, distracting noise and glaring lighting were most disruptive to work". Furthermore building occupants tend to be most comfortable when indoor temperatures are reflective of what is happening outside (Brager, Paliaga & de Dear, 2004). Thus the movement of air from the outside into the building needs to change and shift as conditions outside the building change and shift.

### 2.3.6 Air movement

The easiest way in which appropriate air movement can be achieved is through the use of operable windows. Windows allow air to move through the building which is key in maintaining the thermal comfort of building occupants (Brager et al., 2004). Brager et al. (2004) argue that building occupants were not satisfied with centrally controlled air

conditioned buildings as these gave no opportunity for personal control, but rather preferred the variability associated with naturally ventilated buildings as this allowed for air movement. Thus operable windows would be crucial to Brager et al., (2004) as they are key in influencing temperature and air movement. According to Zhang, Arens, Fard, Huizenga, Paliaga, Brager, and Zagreus (2007) in summer, for example, high levels of air movement are preferred which compensate for warm conditions within the building. Thus conversely if building occupants felt cool, they would not prefer higher levels of air movement (Zhang et al., 2007). From this it becomes apparent that air movement can be a way in which significant energy savings can be accrued. This view is consistent with that of Zhang et al., (2007) whereby it is argued that the use of operable windows could open up avenues where the advantages of air movement could be maximised instead of relying heavily on air conditioning systems. Toftum (2004) also argues that air movement is a powerful tool which can be used as an energy saving mechanism that enhances the building occupants' experience in the building. It is also important for organisations to be cognisant of the level of activity which their employees function. Toftum (2004) argues that the effects of air movement on the employee are influenced by levels of activity at which the employee functions at. Therefore at higher levels of activity the effects of air movement can go unnoticed whereas at lower levels of activity such as office work the effects of air movement can be more telling (Toftum, 2004). It becomes apparent that the effects of air movement can have a number of effects on the general perceptions of air quality on the building occupants. Zhang et al., (2007) provides two reasons that could possibly explain that air movement can influence perceived air quality in a building. Firstly air movement can transport allergens from the body or surrounding office equipment and move it away from the breathing zone. Secondly fresh breezes from outside or ventilation can be associated with air movement, which enhances perceptions of air quality. These explanations illuminate the importance and relevance of understanding perceptions of air quality within the built environment.

### 2.3.7 Air quality and Ventilation

Air quality has been traditionally understood as dangerous when observing organisations in the industrial and mining sectors (Hedge, 2000). This assertion is intuitively logical as employees are often exposed to toxic gases and dusty conditions within these sectors. Hedge (2000) argues that there has been a growing realisation that even in safe work environments

such as office buildings, occupants can be exposed to toxic contaminants. Sustainability Victoria and Kandor (2006) argue that levels of Carbon dioxide and Carbon Monoxide are indicators of air quality and the workings of human and office equipment. Hedge (2000) argues that common office appliances are often responsible for causing air quality problems. Computers, paper, printers, photocopy machines and carpets are common equipment found within the office environment that contribute to the air quality problems in buildings. In a study carried out by Becker, Goldberger and Paciuk (2007) on school buildings, it was argued that occupant density resulted in the emission of carbon dioxide, water vapour, and body odour which affected the air quality. This assertion is also applicable to the work environment as employees also release bodily emissions whilst in the building. This view is also supported by Robertson (2002).

In order to combat the presence of these air quality problems there is a need for adequate ventilation, therefore fresh air needs to be constantly coming in from the outside of the building, whilst air with pollutants is being flushed out (Sustainability Victoria and Kandor, 2006). Thus the movement of air from the outside into the inside of the building is termed ventilation (Susser, Fine, Schupf & Stein, 1994). According to Becker et al. (2008), when conditions outside are mild, the ventilation system can remove additional heat or contaminants released by occupants and non-human sources within the building, conversely if external temperatures are too warm, the ventilation system can actively cool the building.

Natural or artificial ventilation techniques are essential in the removal of contaminants (Becker et al., 2007) which may be a function of the office equipment used in the building and the bodily emissions of inhabitants. This view is similar to that of Susser et al., (1994) who argues that ventilation is important because it allows the entrance of outdoor air into the building in order to dilute the levels of indoor contaminants caused by building occupants and non-human sources. In times such as winter it is often cold and as a result a ventilation system can remove most of the heat from the inside of the building resulting in heat loss and cold conditions within the building, creating draughts and lack of thermal comfort, it thus becomes more important to control ventilation in winter (Becker et al., 2007). A caution is presented by Susser et al., (1994) who suggests that adequate ventilation alone is not enough to mitigate poor air quality, but rather ventilation is only a part of the solution in improving

air quality. Mendell and Smith (1990) actually argue that ventilation can be associated with a number of risks that include insufficient fresh air ventilation, chemicals within the system itself to kill bacteria, and the recirculation of infectious diseases within the workspace. Thus ventilation systems should be closely monitored and observed constantly to reduce these risk factors.

Poor working conditions are not beneficial to both the employee and employer (Veitch, 2011). To ensure that employers get the most out of their employees, it is necessary that they remove obstacles that disrupt the rate of task completion. This view is in alignment with that of Veitch (2011), who argues that the workplace needs to be free of stressors in order to allow people to be productive. Organisations need to "... leverage workspace improvements that unleash the potential of their employees and organisation" (Gensler, 2008; p. 8). Carlopio (1996) argues that in order to achieve the vision of the organisation, organisations need to start at the base which means sorting out their built environment. Sustainability Victoria and Kador (2006) argue that settling for a poor IEQ highlights the organisation's laziness in aiming for improved business productivity. Ultimately it is important to note that the built environment can assist with the realisation of internal or external organisational outcomes (Bitner, 1992).

### 2.4 Psychological Wellbeing

Literature in the area of organisational psychology acknowledges the role of the physical environment on the wellbeing of employees (Klitzman & Stellman, 1989). However Veitch's (2011) review suggests that there is a disparity between the mental and physical with the latter receiving more attention in relation to the built environment. It is thought that the environment in which employees find themselves will have a considerable impact on their wellbeing. Thatcher and Milner (2011) support this view as they attempt to argue that occupant health, psychologically and physically, may be linked to the IEQ. Heerwagen (1998) argues that an effective building has a positive influence on the wellbeing and health of building users.

The study will look at wellbeing as defined by Danna and Griffin (1999; p. 364), who defined wellbeing as encompassing "...context-free measures of life experiences (e.g., life satisfaction, happiness), and within the organisational realm to include both generalised job-related experiences (e.g., job satisfaction, job attachment), as well as more facet-specific dimensions (e.g., satisfaction with pay or co workers)". From this definition it is apparent that wellbeing covers a broad area. Dienier, Suh, Lucas and Smith (1999, as cited in Taris and Schreurs, 2000; p. 122) argue that "subjective well-being is often constructed as a global, affective state". Danna and Griffin (1999) propose that we consider the whole person in their entirety when looking at issues of wellbeing. Thus similarly, according to Heerwagen (1998), wellbeing is associated with the quality of life, motivation, psychological state and social support. Heerwagen (1998) argues that if wellbeing needs are not catered for in a building the health of users can be affected. Seaward (1994, as cited in McGuire and McLaren 2009; p. 37) supports this view and defines wellbeing as a "balance between the physical, emotional, intellectual and spiritual aspects of a human being".

As a result, in this study, psychological wellbeing will be defined as the positive emotional state and positive appraisals of the employee within the workplace (Harter et al., 2002). Harter et al. (2002) argue that employers need to provide tangible benefits in order to enhance the wellbeing of their employees. Klitzman and Stellman (1989) found that the physical environment has an influence on the wellbeing of individuals. In their study, specifically noise and air quality were the leading causes of reduced psychological wellbeing (Klitzman & Stellman, 1999). Thus improvements in the physical work environment will lead to greater positive affect regarding the workplace which will have a number of repercussions on organisational outcomes. This view is supported by Harter et al. (2002; p. 205) who assert that "positive affect then relates to the efficient application of work, employee retention, creativity, and ultimately business outcomes". Miller Thayer (1995) argues that organisations need to ensure that employees find the building appealing so that they can hold positive attitudes towards their work. The way in which one responds to the environment affects their behaviour (Bitner, 1992). The response can be looked at in terms of a continuum ranging from pleasure to displeasure. When a pleasurable response to a particular building was found in users, people were more likely to spend more time and money in that building (Bitner, 1992). Heerwagen (2000; p. 26) supports this view and argues that workers had more positive comments in the newer building, as they often said statements such as "looking forward to

work", "in good spirits" and "excited about work". These comments were generally associated with green buildings.

It is important to understand what humans are naturally inclined to be attracted to when it comes to issues of the environment. If buildings are aligned to the natural inclination of humans then this will help boost the mood of building users. The concept of biophilia becomes relevant here. Biophilia can be understood as the theory that asserts that there is an instinctual link between humans and their natural environment (Hessen, 2009). The argument put forward by Heerwagen (1998) is that buildings that contain characteristics that are genuinely appreciated from nature will be more readily accepted in comparison to conventional buildings. Hessen (2009) acknowledges the fact that there is degradation in the natural environment. This degradation can be attributed to phenomena such as urbanisation and deforestation. Humans in contemporary society are surrounded by an artificial environment, with little or no exposure to the natural environment. This, according to Hessen (2009), is problematic as he believes that natural is right in comparison to the artificial.

Heerwagen (1998) and Hessen (2009) both assert that humans show a natural inclination towards savannah-like environments. Despite living in urban areas it is important that buildings need to incorporate features that are associated with savannah-like environments. Joye and van den Berg (2011) support this view and argue that the savannah habitat is preferred by humans as it is a place where humans primarily evolved. Heerwagen (1998) argues that buildings, with trees, water, and a natural flavour are more readily accepted. It becomes apparent from this discussion that nature is key in green buildings. Clark and Watson (1998, as cited in Heerwagen, 1998), found that positive moods are associated with the natural environment and social interactions associated with green buildings, whereas negative moods are elicited with what is perceived as hassles in the environment. An example of these hassles can be discomfort or distractions within the environment which influence cognitive functioning negatively (Heerwagen, 1998). The argument of Hessen (2009) is based on the evolutionary perspective. Joye and van den Berg (2011) suggest that the positive appraisal of humans towards the environment is an adaptive trait of the human species. The investigation of feelings becomes especially relevant in this study. According to Hessen (2009), interactions with nature, or similarly our environment, elicit feelings. These feelings

precede actions (Hessen, 2009). If an environment elicits negative feelings, people will want to avoid that environment, whereas, if the environment elicits good feelings people will want to associate with that environment. In summation it is also plausible to imagine that when people generally feel good they will generally have a positive appraisal of their lives generally. In studies by Kaplan, (1992) and Ulrich (1993; 1994, as cited in Heerwagen, 1998) it was found that when office workers had no access to nature the workers tended to be negative.

Boyden (1971, as cited in Heerwagen, 1998) lists a number of wellbeing needs in building design which, may result in stress if they are not incorporated into the building design. The wellbeing needs include, people wanting to engage in spontaneous social relations; freely moving between social phases; exercising; moderate noise levels; interesting visual environments, and an opportunity to be creative, expressing one's self, as well as cooperation and exploration (Heerwagen, 1998). These criteria are a mix of social and natural elements. Boyden (as cited in Heerwagen, 1998) argues that these wellbeing effects tend to have an indirect impact on workers. Failing to adhere to these wellbeing needs may result in a 'grey' life. Thus the effects of not catering for wellbeing needs can be similar to those proposed by Hessen (2009) if the building does not incorporate a natural element into the design of the building. The discussion on employees' needs and including natural elements to buildings is crucial because it highlights the need for sensory variation. According to Heerwagen (1998), environments that lack sensory variation are deemed as boring which results in passivity and lethargy with regard to the employee.

According to Veitch (2011), healthy organisations are characterised as having good communication and strong social support. It is important that the workplace design feeds into this ethos if organisations want to become healthy. The argument proposed by Veitch (2011) is that to improve the design of the workplace contributes towards the fostering of good social interactions and social cohesion, which reduces stress. This reduction of stress which is associated with improved social relations is one way in which workspace can be seen as playing a role in improving the mental health of employees. It also seems plausible to argue that since an organisation is made up of employees, if the employees are healthy then the organisation can be viewed as healthy.

## 2.5 Physical wellbeing

"The human body is not a passive system that responds to an environmental input in a way that is monotonically related to the level of the physical stimulus" (Parsons, 2000; p. 582). This assertion highlights that the body is actively engaged with the environment and during this process of engagement attempts to create homeostasis. According to Parsons (2000) the way the body responds to the environment will have a number of repercussions on health, comfort and productivity of the individual. The wellbeing and health of the individual thus will be implicated due to the response of the body. Hence physical health is another key concept that warrants a significant amount of attention in this study, because health complaints can often be a direct consequence of IEQ. Health does not encompass as broad a scope as wellbeing; rather it can be understood as part of general wellbeing (Danna & Griffin, 1999). Danna and Griffin (1999) define health as a term that covers physiological and psychological symptoms that are included within the medical field.

Therefore in this study any discussion on general wellbeing also includes health issues. McCarthy, Almeida and Ahrens (2011) assert that promoting wellbeing in the workplace can go a long way in the promotion of wellbeing in society at large due to the extensive amount of time people spend in their workplaces. This view is supported by Hillier et al., (2005) who argue that wellbeing is a social good as it is beneficial to the individual, community and society at large. Similarly, according to Baird (2009; p. 1083) "if buildings work well they enhance our lives, our communities, and our culture". This is a crucial assertion because if buildings are improved from the point of view of the users, the users will be able to effectively interact with the building and become a better employee.

According to Bergs (2002; p. 3) "an unhealthy building is usually an uncomfortable building". In order to enhance the wellbeing of employees, employers need to ensure that employees are comfortable in their workstations. Failure to do so can prove to be costly for organisations. Sick Building Syndrome (SBS) is one of the repercussions that are associated with low levels of IEQ and unhealthy buildings. Hedge et al., (1996; p. 3) assert that SBS "comprises a collection of non- specific symptoms including eye, nose, and throat irritation, mental fatigue, headaches, nausea, dizziness and skin irritation, which seems to be linked

with the occupancy of certain workplaces". Fisk (2000; p. 549) supports this view and argues that SBS symptoms are related to the IEQ and building characteristics, which have an impact on employees. Kibert (2004) attributed 40% of all illnesses to where people spend most of their time; for example, places such as the home, work, school, and churches.

SBS is one of the ways in which we can recognise that indoor and built environments have a direct influence on the behaviour of individuals. This view is supported by Danna and Griffin (1999), who argue that experiences in the workplace have an impact on the employees whilst they are at work. Complaints about IEQ-related factors are thought to be associated with health and wellbeing concerns. Green buildings become important as they are mandated with addressing poor IEQ and improving employee health (Singh et al., 2010). Bitner (1992) argues that these ambient conditions usually affect the five senses. Bitner (1992) summarised some key IEQ factors that have a physiological response. These include increased noise levels which can be regarded as uncomfortable. Noise can be understood as unwanted sound which ends up being a stressor or a nuisance (Stransfeld & Matheson, 2003). Noise has been predicted as having a negative short term effect on people such as increased heart rate and blood pressure (Stransfeld & Matheson, 2003). It is plausible to argue that when noise becomes too loud to deal with, this elevation in noise can become a stressor. Stransfeld and Matheson (2003) argue that there has been an association between hearing impediments and working in the industrial sectors. However in an office environment, which is the context of this study, the effects of noise may not be so obvious. Rather noise has somewhat of a subtle effect which can be seen as disruptive to communication resulting in annoyance and irritability, which ultimately manifests in symptoms of illness (Stransfeld & Matheson, 2003).

Temperature and air quality concerns can be linked with headaches, irritation, concentration lapses, and fatigue (Bergs, 2002; Sustainability Victoria and Kandor (2006). When the individuals are too hot, they often perspire and conversely low temperatures may result in shivering. The air quality in a building can affect the building occupant's ability to breathe easily. According to a review by Mendell and Smith (1990), from an analysis of six studies, they found that air conditioned buildings were associated with higher degrees of headache and sinus complaints. Singh et al., (2010) summarises that the physical repercussions associated with poor air quality and temperature, are the worsening of asthma and respiratory

allergies. This view is also supported by Robertson (2002; p. 72) who argues succinctly that "Any reaction to bad air can include headaches, throat irritation, and asthmatic symptoms". Furthermore building occupants can also experience draughts which can be uncomfortable for the building occupant. A draught has been defined as "an unwanted, local cooling of the skin caused by air movement" (Toftum, 2004; p.41). Robertson (2002) summarised the effects of poor indoor air quality into two categories. The first was mild reactions which include teary and red eyes, lethargy, and dry skin. Secondly allergic reactions, which include flu like reactions, such as blocked and runny noses and skin irritations similar to eczema (Robertson, 2002).

Essentially it becomes clear that these physiological responses affect an employee's ability to be able to carry out their particular role (Bitner, 1992). This view is supported by Niemla and Rauto, Hannula and Reijula (2002) who assert that the environment influences employees' responses and ultimately their performance. Niemla et al., (2002) cautions readers that, improvements in the office environment are not as clear cut as they would be in a more hazardous work environment. However, although the gains of improving IEQ are not as clear cut, there is still some consensus that improving the work environment ultimately improves productivity and occupant health (Niemla et al., 2002).

Singh et al., (2010) found employees' perception of their health to have improved since moving into the green building. The symptoms which were described as improved included, asthma respiratory ailments, depression and stress (Singh, 2010). From the literature review presented in this study it is apparent that the benefits of green buildings are tangible both at a local and a global perspective. The IEQ of a building will have a significant impact on the building occupants and will influence their desires to stay for longer periods of time within the building. Furthermore all the physical and psychological responses associated with IEQ highlighted here will influence the length of time employees would want to spend in a building. However with regard to the literature in the area of IEQ not enough attention focused on the role of time spent in the building and the influences of this variable on the relationships between IEQ and physical and psychological wellbeing.

## 2.6 Length of time spent in the Building

Time spent in the building is a key variable of this study. Length of time spent in the building will be understood as the duration or how much time the employees spend in the building. This variable is expected to play a role in the relationship between the physical work environment and wellbeing. From an intuitive point of view it can be argued that the more time an employee spends in a building the more profound the impact of the environment will be on his/ her wellbeing. Conversely if the amount of time an employee spends in the building is reduced, the effects of the physical work environment on the wellbeing of the employees are expected to be less profound. Bitner (1992) argues that there is a purpose as to why people are in a particular environment and that these purposes are subject to variation. Often employees have to be in the office in order to carry out their roles. It becomes crucial that approach behaviours are encouraged by the building. The appropriate physiological and positive emotional responses to the physical work environment may make employees want to stay longer within the building (Bitner, 1992). Studies in the service and hospitality industry provide a clear way in which time spent in a particular retail store or hotel is associated with IEQ. Bitner (1992) for example found that different variations and pitches of music including certain smells where associated with approach or avoidance behaviours. Time spent in the building was operationalized in this study through asking employees how much time they spent in the building weekly, how many hours were spent daily in the building, and length of time spent at their respective workstation?

In summation the literature review has looked at a number of studies in order to inform the reader of the importance of IEQ on the employee. The IEQ has been shown to be used by organisations to help the employee complete their tasks in conditions which are more comfortable and healthier. Furthermore improvements in the built environment of organisations are integral in the development of a greener society which is crucial in realising the global sustainable development agenda. With regard to this study in particular there is a gap in literature which has been identified where the role of time spent in the building has not been focussed on in detail by many authors. The focus on this gap in the literature coupled with the foundational premises of a movement towards a more sustainable society make this study particularly important and relevant.

## 2.7 Research questions

1. What is the relationship between perceptions of the physical work environment and psychological wellbeing?
2. What is the relationship between perceptions of the physical work environment and physical wellbeing?
3. Are these relationships moderated by time spent in building?

# Chapter 3 Methodology

## 3.1 Introduction

This chapter is concerned with providing an in depth explanation of the methods utilized in this study. The research design, sampling techniques, sample procedures and the instruments utilized to obtain the data will all be discussed in this chapter. The chapter will conclude with discussing the ethical considerations that underlie this study.

## 3.2 Research Design

In order to answer the research questions the study utilised a quantitative research methodology. This methodology yields numerical data in comparison with a qualitative methodology which yields more in-depth explanations on phenomena. According to Terre Blanche, Durrheim and Painter (2006), the quantitative methodology has been more readily accepted because of its generalisabilty and objectivity which makes it more scientific in nature, improving the chances of making causal inferences. Furthermore this is important because the current study is concerned with measuring the impact of the physical work environment on the wellbeing of employees in order to broaden the scope of knowledge regarding the physical work environments' influence on employee wellbeing.

In order to answer the research questions posed earlier the current study needs to adhere to a certain research design. Christensen (1988) defined research design as a strategy or blueprint, which is utilised in order to address a particular research question. This study was a non-experimental, cross-sectional, and correlation, research design. The current study was non-experimental as most of the criteria which indicate accurate experimentation were not met; there is no control group, manipulation of independent variables, or random assignment (Christensen, 1988). With this in mind Bailey (1987) argues that in a study such as this we should be cautious of assuming causality from the findings. The current study was a cross sectional study, in that it involves the observation of a sample at a specific point in time (Babbie, 2001), and finally a correlational design as it looks at a number of observations within the physical work environment and assesses the possible outcomes (Rosenthal & Rosnow, 2008). This study was concerned with investigating the impact of the physical work

environment on the wellbeing of employees. The sample was observed at a particular point in time six months after employees had moved into a green building in order to ascertain the impact of the building on a number of employee-related outcomes. Babbie (2001) argues that the problem with cross sectional designs is that they base their findings at one point in time which often is not an adequate representation of the bigger picture. With the brief outline of the design, it becomes apparent that causality cannot be assumed from the results of this study.

### 3.3 Sampling Technique

The sample used in the current study was obtained from two green buildings of Nedbank. The two green buildings were named Ridgeside and Phase II. These two buildings fall under the umbrella of Nedbank- a large financial institution in South Africa. However a third building Menlyn Maine was not utilised in this current study as this was the last building to be built; as a result data from six months into occupation was not available.

Regarding IEQ the Ridgeside building was aimed at increasing the amounts of fresh air moving into and through the building, designers also focused extensively on the lighting of the building. Flickering lights and glare from natural light were reduced whilst simultaneously there was an emphasis on having 60% of the office area being accessible to outdoor views. Lastly the Ridgeside building was also concerned with controlling noise and minimising the toxins that were released from office equipment such as furniture, carpets and printing machines. Similarly the Phase II building was also built with the intentions of increasing fresh air intake and reducing light flicker. Furthermore 80% of the office space has access to view the external environment. Lastly this building was also concerned with controlling noise levels and reducing toxins released by equipment and furnishings found in the office space. From this brief synopsis regarding IEQ features which were included in each building, it becomes apparent that Nedbank has invested heavily in the physical work environment. The behaviour of this organisation is in alignment with the growing trend of ‘going green’ globally, therefore it becomes necessary to investigate whether the consequence of ‘going green’ will pay off in the long run. In addition, the key purpose of the study was to investigate the influence of the physical work environment on these employees.

The green buildings in which employees are housed at Nedbank served as a key component in helping the current study attempt to answer the research questions.

Initially it is important to note that the current researcher did not have to go and gain access into the organisation, previous researchers had already collected data. Therefore this study was concerned with reporting on pre-existing data. Researchers had collected data at three different points in time in order to track the effects of the physical work environment over a longer period of time. However this study will attempt to track the impact of the green building six months after the move into a green building.

The researchers utilised a purposive sampling technique in order to attain the sample. Terre Blanche et al. (2006; p. 138) define purposive sampling as sampling that "depends not only on the availability and willingness to participate, but that cases that are typical of the population are selected". Researchers explicitly distributed the questionnaires to the employees who had moved into the green building, as this was the target population on which the research was based upon. This sampling technique of purposive sampling falls under the larger umbrella of non-probability sampling, which refers to any method that does not adhere to the principle of random selection of the sample (Terre Blanche et al., 2006). Questionnaires were solicited electronically. This means emails were sent to all employees who had moved into the green building. The onus of answering the questionnaires was placed directly on the employee and, researchers had no influence on coercing potential respondents to fill in questionnaires. As a result employees volunteered to answer the questionnaires as the choice whether they wanted to participate in the research or not was entirely theirs.

### 3.3.1 Sample

A total number of three hundred and forty nine participants (N=349) were found suitable to be utilised in the current study across the two green buildings. Of the total participants across the two buildings one hundred and twenty one (N= 121) were from the Ridgeside building, whereas two hundred and twenty eight (N=228) were from the Phase II building. Table 1 shows the demographic profile of the entire sample.

***Table 1 Demographic details of the sample***

| **Gender** | | **Percentage (%)** |
|---|---|---|
| **Male** | **117** | **34** |
| **Female** | **231** | **66** |
| **Race** | | |
| **Black** | **60** | **17** |
| **Coloured** | **31** | **9** |
| **Indian** | **81** | **23** |
| **White** | **172** | **50** |
| **Other** | **3** | **1** |
| **Organisational Level** | | |
| **Administration** | **138** | **41** |
| **Lower Management** | **70** | **21** |
| **Middle Management** | **92** | **27** |
| **Senior Management** | **33** | **10** |
| **Executive** | **7** | **2** |

Table 1 shows the combined demographic profile of the sample between the two buildings utilised in the study. Females made up the majority of the participants accounting for two hundred and thirty one (n=231) of the entire sample. White participants also proved to be the majority of the sample constituting one hundred and seventy two (n=172). From an organisational level perspective, administrative staff accounted for a majority of the respondents (n= 138). It is important to note that data was collected at three different points in time by the previous researchers, as a result employee numbers from other data collection points were utilised in order to determine the demographic profile of the this sample, at this particular data collection point.

*Table 2 Demographic details of the Ridgeside sample*

| **Gender** | | **Percentage (%)** |
|---|---|---|
| **Male** | **31** | **26** |
| **Female** | **89** | **74** |
| **Total** | **120** | |
| | | |
| **Race** | | |
| **Black** | **12** | **10** |
| **Coloured** | **11** | **9** |
| **Indian** | **54** | **45** |
| **White** | **41** | **34** |
| **Other** | **2** | **2** |
| **Total** | **120** | |
| **Organisational level** | | |
| **Administrative** | **62** | **52** |
| **Lower Management** | **24** | **20** |
| **Middle Management** | **28** | **24** |
| **Senior Management** | **5** | **4** |
| **Total** | **119** | |

This table shows that a significant proportion of the participants in this building were women (n= 89) making up 74% of the total sample whereas there were thirty one men (n=31) making up 26% of the entire Ridgeside sample. When looking at the racial profile of the respondents in the building it was found that, Indian people made up most of the population within the building making up 45% (n= 54) of the total Ridgeside sample. With regard to organisational level it was found that a significant proportion of the sample was made up of administrative staff, making up 52% (n=62) of the total Ridgeside sample. The respondents from this sample also reported an average age of 42 years with a standard deviation of 9.

*Table 3 Demographic details of Phase II sample*

| **Gender** | | **Percentage (%)** |
|---|---|---|
| **Male** | **142** | **62** |
| **Female** | **86** | **38** |
| **Total** | **228** | |
| **Race** | | |
| **Black** | **48** | **21** |
| **Coloured** | **20** | **9** |
| **Indian** | **27** | **12** |
| **White** | **131** | **58** |
| **Other** | **1** | **0.4** |
| **Total** | **227** | |
| **Organisational Level** | | |
| **Administrative** | **76** | **34** |
| **Lower Management** | **46** | **21** |
| **Middle Management** | **64** | **29** |
| **Senior Management** | **28** | **13** |
| **Executive** | **7** | **3** |
| **Total** | **221** | |

Similarly table 3 displayed that women made up the majority of the respondents, accounting for 62% (n= 142) of the total population. It is important to note that the Ridgeside building is located in the KwaZulu Natal province, whereas the Phase II building is located in Johannesburg, Gauteng. Regarding race, white people made up the most of the sample population accounting for 58% of all respondents. This large racial disparity between the two buildings can be as a result of the different location of the two buildings. Furthermore administrative staff accounted for most of the respondents in the organisational hierarchy (n= 76). This portion of the sample reported an average age of 42 years with a standard deviation of 10.

### 3.4 Procedure

It is important to note with regard to this current study that this study focused on reporting on pre-existing data. So the procedures outlined below will explain how the previous researchers collected the data which was then used in this current study.

The previous researchers who collected the data initially followed the following procedures. Firstly the company generated a random sample for the researchers, which was a list of their employees and their contact details; namely their e-mail addresses. Subsequently six months after the employees had moved into the green building, researchers then sent out emails with a link connecting the employee to the questionnaire which was sent to everyone on the list via email. The sample was given two weeks to respond to the questionnaire. A reminder was sent out to the whole sample after one week, and again the day before the deadline date. The survey contained a cover letter introducing the researchers and their affiliations, and a participant information sheet informing the potential respondents about the intention of the researchers and what the research was about. The participant information sheet also outlined a number of important details such as confidentiality and anonymity, which were required to be understood by potential respondents. When participants had completed the questionnaire they clicked submit. Clicking the submit icon was regarded as consent to participate in the study. Furthermore as data was collected at different points in time the employees had the option to give their employee number in order to help researchers in future to link the employee responses to other data collection points. However this was optional and even so the researcher would not be able connect the employee number to a name and thus the researcher would not know who the participants were. This is an important consideration from an ethical point of view. There was no need to know who the participants were, what was important was gauging their experience of the new built environment they had moved into. Consequently there was no need to acknowledge who the participants were. The reason for employee numbers being requested at data collection points was due to the nature of the larger study which this particular study falls under. Employee numbers would help the researcher track the experiences of the employee across the duration of the entire larger study.

The current researcher at this stage of the study only interacted with the raw data. Prior to conducting analyses it was necessary to clean the data and find out which participants had to be removed from the data sets. Originally in the Ridgeside data set there were one hundred and twenty seven respondents, during the data set clean up six respondents were removed. Similarly in the Phase II building there were two hundred and fifty four respondents, however twenty six respondents were removed during the data set clean-up process. The removal of respondents was mainly due to missing data. It was found often that many of the items within

the questionnaires had not been answered. Furthermore some respondents were left out as the manner in which they responded appeared irrational or there was a chain of repetitions in the responses suggesting the respondent was not reading the questions attentively, conclusively these were the main reasons that led to thirty two respondents being omitted from the study.

### 3.5 Measures

This section is concerned with explaining the instruments that this study utilised. Demographics, perceptions of the physical work environment, psychological and physical wellbeing and time spent in the building were the instruments utilised in order to answer the research questions.

#### 3.5.1 Demographics

In the questionnaires distributed there were demographic questions which respondents had to fill in, this was to help the researchers identify the type of sample researchers were working with. Further demographics included employee number, gender, race, year born, organisational level, department/unit, whether employees had changed office buildings in the last six to twelve months, if they answered Yes employees had to specify when they had moved (Month), and what office building the employees were in when filling in the questionnaire (see Appendix B).

#### 3.5.2 Psychological wellbeing

In order to ascertain the psychological wellbeing of employees, researchers distributed the Warwick-Edinburgh Mental Well-Being Scale (WEMWBS). The WEMWBS is concerned with identifying positive mental health. A high score on this scale indicates positive mental wellbeing (Tennant, Hiller, Fishwick, Platt, Joseph, Weich, Parkinson, Secker and Stewart-Brown, 2007). The WEMWBS is a fourteen item scale, which utilises a five point Likert-type scale ranging from (1) None of the time to (5) All of the time. Respondents were asked to answer each of the items with regard to how they had been feeling in the past month. An example of the items included, are phrased such as; “Please answer the following questions in

relation to how you have been feeling generally in the last month: I've been feeling optimistic about the future." According to Tennant et al., (2007) the WEMWBS showed an internal consistency of 0.91, test-retest reliability of 0.83 and good validity making it a suitable instrument to investigate the wellbeing of employees (see Appendix C). For this study the internal consistency was 0.93.

### 3.5.3 Perceptions of the physical work environment

Additionally in the questionnaire distributed there were fourteen items on employees' perceptions of the physical work environment. Items in this physical work environment questionnaire asked about the experiences of the employees with direct reference to specific ambient conditions which may influence the worker in their workspaces. The items used were those that were developed by Hedge et al. (1996). An example of how these items, regarding perceptions of the physical work environment, were phrased is as follows. "In the last month how often have you experienced the following conditions while in your office: Temperature too warm?" Just as in Hedge et al. (1996) these items were scored on a Likert type scale ranging from (1) never (2) 1-3 times/ month (3) 1-3 times/week and (4) every day. Hedge et al. (1996) did not comment on the reliability or validity of this scale (see Appendix D). However when a reliability analysis was run in this current study the Cronbach alpha was 0.84.

### 3.5.4 Physical wellbeing

A further sixteen items were utilised to ascertain the employees' physical symptoms of SBS experienced whilst at work in the last month. These sixteen items assessing the physical symptoms of SBS can be understood as the physical wellbeing measure. Items were phrased as follows for example; "In the last month how often have you experienced the following physical symptoms while at work: Headache in your forehead". Just as in Hedge et al. (1996) these items were scored on a scale ranging from (1) never (2) 1-3 times/ month (3) 1-3 times/week and (4) every day. However Hedge et al. (1996) did not comment on the validity and reliability of these scales (see Appendix E). When a reliability analysis was run for this study the Cronbach alpha was found to be 0.93

### 3.5.5 Time Spent in Building

To investigate the moderating variable effect, two of the three items were turned into composite measures by the researchers in order to ascertain the impact of length of time spent in building. The 3 items were "How many hours a day on average do you spend in the current building?", "How many hours per day on average do you spend working at your desk/work station?" and "How many days per week on average do you spend in the current building?" The item specifying the hours a day on average spent in the building was integrated with the average days per week spent in the building were utilised in the study as the composite measure of time (hours per day × days per week), this integration seemed the most intuitively plausible to enact.

## 3.6 Data Analysis

The study utilised two statistical methods in order to answer the respective research questions. To answer the first and second research questions, the study utilised a multiple regression analysis in order to establish the relationship between perceptions of the physical environment and the different aspects of wellbeing. Babbie (2001), defined the regression analysis as a method where the nature of the relationship between Y and X is investigated. Multiple regression methods are utilised when a dependant variable is influenced by a number of independent variables (Babbie, 2001). In summary the regression method was utilised to investigate the effect of the physical work environment on the psychological and physical wellbeing of the employees.

In order to answer the third research question the study utilised a partial correlation in order to establish the moderating effect of time spent in the building. As previously discussed there are a number of ambient conditions that have an impact on the wellbeing of people, however time spent in the building may influence these relations thus a partial correlation method will be utilised to investigate the possible moderating effect of time. Baron and Kenny (1986; p. 1174), define a moderator as a "variable that affects the direction and/ or strength of the relation between and independent or predictor variable and a dependent variable or criterion variable". The moderating variable in this study is time spent in building, thus the key feature of the third research question is to investigate whether this moderating variable has an

influence on the strength and direction of the relationship between the physical work environment and wellbeing. Partial correlations give researchers the opportunity to control the effect of one possible third variable (the moderator) in order to investigate the relationship between Y and X. In summation these two analyses namely: multiple regressions and partial correlations, were utilised in order to weigh how the study variables related to one another.

### 3.7 Ethical Considerations

O'Leary (2004; p. 50) asserts that "researchers are unconditionally responsible for the integrity of the research process". It is an integral component of research to acknowledge the wellbeing of the research participants when undertaking any form of investigation. The nature of this research does not harm or impede on any of the rights of the participants. However in order to be able to report on this pre-existing data it was necessary that the current researcher obtains an ethics clearance certificate. The ethics clearance certificate was obtained from the Human Research Ethics Committee (HREC), which ruled that the research was appropriate in order to be carried out. The clearance certificate that was received from the HREC serves as proof that the research held up to ethical scrutiny.

Prior to participating in the first phase of the study respondents were given a participant information sheet which highlighted that participation was voluntary and that, anonymity and confidentiality were guaranteed (see Appendix A). Thus this study is in alignment with the assertions of Christensen (1988), who argues that every participant has a right to privacy. To protect the rights of the participants the data was kept and stored safely away from public scrutiny. This view is also supported by Buckingham and Saunders (2004) who argue that participant replies should be dealt with in the strictest of confidence. Furthermore even though the respondents had the option of writing down their employee numbers in order to help track their responses across the data collection points, these employee numbers would not be used in order to identify individuals. Buckingham and Saunders (2004) argue that when personal information is given to the researcher it is important that the researcher does not divulge the identity of the participants. Respondents were free to participate and withdraw from the study. Failure to withdraw did not result in any punishment whatsoever.

As the study was concerned with reporting on pre-existing data the study did not interact with respondents. However due to interaction with the raw data sets, the current researcher ensured that these data sets were protected and were only accessible to the researchers through a password protected Microsoft excel spread sheet. Furthermore it was the duty of the current researcher to make the results of this study available to the company from which the samples were drawn. This was done by presenting an executive summary to the employees via the organisation as highlighted in the participant information sheet.

In conclusion this chapter was concerned with outlining a number of crucial action points and tools that were utilised in order to help answer the outlined research questions. The samples from both buildings and the combination of these samples were described in detail. Also procedures which past researchers followed and the role of the current researcher were explained. The measures utilised where also described and some of the psychometric properties were outlined, finally ending off the chapter with the ethical considerations which needed to be kept in mind in order to deem this research ethically legitimate.

# Chapter 4 Results

## 4.1 Introduction

This chapter will be concerned with presenting the results of the statistical analyses which were carried out. Firstly the results of the independent sample t-test will be presented in order to show why the two data sets from the two buildings were combined into one data set. A Pearson correlation table will be presented in order to show the relationships between the study variables. The regressions were run in order to observe the relationship between the perceptions of conditions of the physical work environment and psychological wellbeing and between perceptions of conditions of physical work environment and physical wellbeing. These were presented in order to observe whether the perceptions of the conditions of the physical work environment had any relationship with the dependent variables. Partial correlations were also run in order to explore the moderating role of time spent in building between the perceptions of conditions of the physical work environment and the dependent variables.

## 4.2 Results of the independent sample t-test

Firstly an independent sample t-test was run. In order to inform the decision pertaining whether to use the parametric or non- parametric equivalent test the assumptions of homogeneity of variance need to be adhered to. The following table presents the results of the homogeneity of variance test.

***Table 4 Homogeneity of variance***

| **Variable** | **F-statistic** | **p- value** |
|---|---|---|
| *Psychological wellbeing* | | |
| Equal variances assumed | 1.023 | .312 |
| *Physical wellbeing* | | |
| Equal variances assumed | .604 | .438 |

This table shows that there is equality of variance and it is thus appropriate to continue the analysis and use the parametric test for the independent sample t-test.

***Table 5 Independent sample t-Test***

| Variable | M | SD | t-value | p-value |
|---|---|---|---|---|
| *Psychological wellbeing* | | | | |
| Ridgeside | 49. 96 | 9.659 | 1.120 | .263 |
| Phase II | 48.81 | 8.854 | | |
| *Physical wellbeing* | | | | |
| Ridgeside | 47.39 | 9.643 | 1.508 | .133 |
| Phase II | 45.78 | 9.425 | | |

This analysis was carried out in order to indicate whether the buildings, Ridgeside or Phase II, made a statistical difference on the psychological and physical wellbeing of the employees. From table 5 it is apparent that the building in which one worked, did not make a difference on the scores of their dependent variable namely psychological and physical wellbeing. Occupants from the Ridgeside building did not score significantly higher on either psychological and physical wellbeing in comparison with occupants from the Phase II building. As the building had no influence on the outcome results, the occupants from both buildings were combined to create one large sample in order to answer the research questions. An additional independent sample t test was also run in order to investigate whether the building made a statistical difference on the perceptions of the conditions of the physical work environment. The following table highlights these results.

***Table 6 Independent sample t test investigating the differences between the conditions of the physical work environment***

| Variable | M | SD | t-value | p- value |
|---|---|---|---|---|
| *Too warm* | | | | |
| Ridgeside | 3.24 | .768 | 3.874 | .000 |
| Phase II | 2.81 | 1.041 | | |
| *Too cold* | | | | |
| Ridgeside | 2.14 | .977 | -7.232 | .000 |
| Phase II | 2.96 | 1.021 | | |
| *Too dim* | | | | |
| Ridgeside | 3.35 | .928 | .363 | .717 |
| Phase II | 3.31 | .905 | | |
| *Too bright* | | | | |
| Ridgeside | 3.53 | .898 | -1.532 | .126 |
| Phase II | 3.66 | .719 | | |
| *Ventilation* | | | | |
| Ridgeside | 3.44 | .912 | 5.211 | .000 |
| Phase II | 2.81 | 1.144 | | |
| *Too drafty* | | | | |
| Ridgeside | 3.24 | 1.057 | -3.505 | .001 |
| Phase II | 3.60 | .824 | | |
| *Air movement* | | | | |
| Ridgeside | 3.31 | .994 | 3.644 | .000 |
| Phase II | 2.86 | 1.124 | | |
| *Air dry* | | | | |
| Ridgeside | 3.45 | .829 | 3.083 | .002 |
| Phase II | 3.11 | 1.038 | | |
| *Air humid* | | | | |
| Ridgeside | 3.72 | .648. | 1.285 | .200 |
| Phase II | 3.61 | .781 | | |
| *Noise* | | | | |
| Ridgeside | 2.83 | 1.179 | 1.820 | .070 |
| Phase II | 2.60 | 1.067 | | |
| *Odour* | | | | |
| Ridgeside | 3.46 | .839 | 1.998 | .047 |
| Phase II | 3.26 | .922 | | |
| *Stale air* | | | | |
| Ridgeside | 3.55 | .806 | 3.333 | .001 |
| Phase II | 3.18 | 1.037 | | |
| *Dusty air* | | | | |
| Ridgeside | 3.44 | .884 | .489 | .625 |
| Phase II | 3.39 | .931 | | |
| *Shocks* | | | | |
| Ridgeside | 3.66 | .692 | -.447 | .655 |
| Phase II | 3.69 | .694 | | |

From this table it is apparent that there are differences in the perceptions of the conditions of physical work environment by building. Conditions such as temperature, ventilation, draft, air

movement, dry air, odour in the air and stale air all differed significantly by building. These results suggest that there may be a difference between the employees in their perceptions of the conditions of the physical work environment in the different buildings. To investigate this further towards the end of this chapter separate secondary analyses on each building will be performed to investigate the impact of each building on the study variables. The following table will present the correlation matrix in order to show the relationships between the study variables.

### 4.3 Results of the correlation matrix

***Table 7 Correlation matrix for physical work environment conditions on psychological and physical wellbeing***

| *Variable* | *Psychological wellbeing* | *Physical wellbeing* |
|---|---|---|
| Too warm *(r)* | .182** | .328** |
| *(p)* | .001 | .000 |
| Too cold | .075 | .203** |
| | .162 | .000 |
| Too dim | .182** | .288** |
| | .001 | .000 |
| Too bright | .150** | .295** |
| | .005 | .000 |
| Ventilation | .197** | .449** |
| | .000 | .000 |
| Too drafty | .104 | .297** |
| | .053 | .000 |
| Air movement | .208** | .455** |
| | .000 | .000 |
| Air dry | .212** | .486** |
| | .000 | .000 |
| Air humid | .128* | .396** |
| | .017 | .000 |
| Noise | .292** | .396** |
| | .000 | .000 |
| Odour | .225** | .378** |
| | .000 | .000 |
| Stale air | .216** | .464** |
| | .000 | .000 |
| Dusty air | .209** | .542** |
| | .000 | .000 |
| Shocks | .147** | .376** |
| | .006 | .000 |

(*) indicates statistically significant results at $p<0.05$

(**) indicates statistically significant results at $p<0.001$

Number of participants (n) for psychological wellbeing = 325

Number of participants (n) for physical wellbeing= 324

Table 7 shows the results of the correlations between the psychological and physical wellbeing of employees with the physical work environment conditions respectively. From this table it is evident that the correlations between the physical work environment conditions and psychological wellbeing are significant but rather low. These relationships are positively weak to moderate. Noise and psychological wellbeing appeared to have the highest

correlation at .292, this correlation coefficient is still weak. From this correlation matrix the nature of these relationships suggests that the relationship between psychological wellbeing and the conditions of the physical work environment are present.

Table 7 also presents the correlations between the physical work conditions and physical wellbeing. Looking at this section of the table the general trend that appears is that a number of the physical work environment conditions have a positive moderate to strong relationship with employee's physical wellbeing. Dusty air had the highest correlation at .542 at a level .001 significance which indicates a positively strong relationship between physical wellbeing and reduced dusty air. Ventilation, little air movement, dry air and stale air all had correlations which were above .4 this is crucial to bear in mind as these correlations are high.

Lastly from this correlation matrix, trends suggest that the relationships between the physical work environment conditions and physical wellbeing are more salient than that of physical work environment conditions and psychological wellbeing. The correlations between physical wellbeing and work environment tend to be higher than that of psychological wellbeing and the physical work environment conditions. The following table will provide the regression analyses for the total scores of dependant variable scales.

### 4.4 Results of the regression analyses – perceptions of the physical work environment onto the two dependent variables

***Table 8 Regression model for the total scores***

| *Variable* | *R-Square* | *Adjusted* | *F value* | *Sig. (p)* |
|---|---|---|---|---|
| Psychological wellbeing | .135 | .096 | 3.452 | .000 |
| Physical wellbeing | .474 | .450 | 19.913 | .000 |

From this table both models are significant $p < 0.05$. When the variance explained is interpreted physical wellbeing explains the most variance, 47.4%, which is particularly strong whilst psychological wellbeing explains 13.5% of the variance which is weak to moderate. The following two tables attempt to show the reader specifically which of the work environment conditions were salient in the model.

***Table 9 Summary of regression analysis of the different physical attributes of the workplace onto psychological wellbeing (n=325)***

| *Variable* | *B* | *t* | *Sig. (p)* |
|---|---|---|---|
| Too Warm | 1.035 | 1.540 | .125 |
| Too Cold | .408 | .740 | .460 |
| Too Dim | .701 | 1.212 | .226 |
| Too Bright | .473 | .687 | .493 |
| Ventilation | -.491 | -.557 | .578 |
| Drafty | .255 | .401 | .689 |
| Movement | .177 | .202 | .840 |
| Dry Air | 1.062 | 1.592 | .112 |
| Humid Air | -1.297 | -1.579 | .115 |
| Noise | 1.620 | 3.307 | .001** |
| Odour | .942 | 1.389 | .166 |
| Stale Air | .434 | .530 | .596 |
| Dusty | .024 | .031 | .975 |
| Shocks | .079 | .096 | .923 |

*R Square= .135*

Table 9 indicates the physical work environment conditions which had the most influence on psychological wellbeing. Moreover in this table it is apparent that many of the physical work environment conditions did not have a significant impact on the psychological wellbeing scores. All of the p- values were above the 0.05 cut off point except for noise. Noise was evidently the only significant condition ($t=3.307$, $p< 0.05$). This result seems intuitively plausible as differing levels of noise may affect the employee emotionally influencing perceptions of psychological wellbeing.

***Table 10 Summary of regression analysis of the different physical attributes of the workplace onto physical wellbeing (n=324)***

| *Variable* | *B* | *T* | *Sig. (p)* |
|---|---|---|---|
| Too Warm | .927 | 1.776 | .077 |
| Too Cold | 1.403 | 3.279 | .001** |
| Too Dim | .783 | 1.743 | .082 |
| Too Bright | .721 | 1.350 | .178 |
| Ventilation | 1.154 | 1.683 | .093 |
| Drafty | .920 | 1.861 | .064 |
| Movement | -.819 | -1.205 | .229 |
| Dry Air | 1.520 | 2.938 | .004* |
| Humid Air | .438 | .684 | .494 |
| Noise | 1.417 | 3.725 | .000** |
| Odour | .539 | 1.024 | .307 |
| Stale Air | .439 | .691 | .490 |
| Dusty | 1.899 | 3.165 | .002* |
| Shocks | .856 | 1.337 | .182 |

*R Square= .474*

This table also attempts to designate which physical work environment conditions have the most salient impact on physical wellbeing. By looking through this table briefly one can immediately note that the physical work environment conditions tend to have a larger impact on physical wellbeing in comparison with psychological wellbeing. This then signifies that the influence of the work environment manifests itself more readily on the physical wellbeing of the employee. Lastly this is also intuitively logical as the point of interaction between the employee and their built environment is physical in nature.

Cold temperatures were significant ($t= 3.279$, $p<0.05$) this shows that cold temperatures do have an influence on the physical wellbeing of employees. Dry air ($t= 2.938$, $p<0.05$) coupled with dusty air ($t= 3.165$, $p< 0.05$) in the building was also a central key point. These results signify that the air quality can have a number of influences on the physical wellbeing of the employee. The air in which the employee breathes in may have a number of immediate health implications which may explain why most of the significant variables are linked to the air quality of the building.

Finally noise was the other significant physical work environment condition which had an impact on the physical wellbeing of employees ($t=3.725$, $p< 0.05$). This result appears intuitively logical in the sense that different levels of noise may affect one physically in the short term or long term. It is also important to note noise also had an impact on psychological wellbeing. The reason for this is may be that the literal noise in the physical building has an impact on physical wellbeing which in turn manifests itself psychologically.

In summation tables 9 and 10 have attempted to show the reader which physical work environment conditions have an influence on the psychological and physical wellbeing of the employees. The following section will present the results of the partial correlation in order to understand the role of time spent in building on the study relationships.

### 4.5 Results of the partial correlation

A partial correlation analyses was performed in order to investigate the influence of time spent in the building; hours at the desk and the composite measure of hours in the building by amount of days of week spent in the building.

The results of the partial correlation of the total scores for the relationship between psychological wellbeing and the perceptions of the physical work environment total score prior to controlling for time was, $r= .300$ ($p<.001$). After controlling for the effect of time the relationship between psychological wellbeing and perceptions of the physical work environment was slightly weaker with $r= .294$ ($p< .001$). Conversely the total score for the relationship between physical wellbeing and the perceptions of the physical work environment total score prior to controlling for time was, $r= .689$ ($p<.001$). After controlling for the effect of time the relationship was still particularly moderate to strong even though it was slightly lower when time was not controlled, $r= .684$ ($p< .001$). Table 10 attempts to present the relationships between the perceptions of the conditions of the physical work environment and the dependant variables, before and after controlling for time.

***Table 11 Partial correlation matrix psychological and physical wellbeing with time partialed out (partial correlations in parentheses)***

| Variable | Psychological wellbeing | Physical wellbeing |
|---|---|---|
| Too warm | .182** | .328** |
| | (.170*) | (.313**) |
| Too cold | .075 | .203** |
| | (.079) | (.203**) |
| Too Dim | .182** | .288** |
| | (.180**) | (.294**) |
| Too Bright | .150* | .295** |
| | (.140*) | (.286**) |
| Ventilation | .197** | .449** |
| | (.189**) | (.439**) |
| Drafty | .104 | .297** |
| | (.106) | (.297**) |
| Movement | .208** | .455** |
| | (.200**) | (.442**) |
| Dry Air | .212** | .486** |
| | (.208**) | (.477**) |
| Humid Air | .128* | .396** |
| | (.129*) | (.405**) |
| Noise | .292** | .396** |
| | (.290**) | (.400**) |
| Odour | .225** | .378** |
| | (.220**) | (.378**) |
| Stale Air | .216** | .464** |
| | (.210**) | (.458**) |
| Dusty | .209** | .542** |
| | (.209**) | (.544**) |
| Shocks | .147* | .376** |
| | (.147*) | (.374**) |

(*) indicates statistically significant results at $p<0.05$

(**) indicates statistically significant results at $p<0.001$

Number of participants (n) for psychological wellbeing = 325

Number of participants (n) for physical wellbeing= 324

This table attempts to present the relationships between the perceptions of the conditions of the physical work environment and the dependant variables when the effects of time spent in building have been partialed out. However with regard to the psychological wellbeing and perceptions of the conditions of the physical work environment there seems to be no significant effect of time on these relationships. On the other hand when we observe the environmental condition of temperature being warm it is apparent that when time was

partialed out the significance was at .05, but when the effect of time was not controlled the significance was at the .001 level. Furthermore the correlation difference was the largest here and changed from .182 to .170. Apart from this result there seems to be no significant differences between the conditions of the physical work environment and psychological wellbeing when time has been partialed out. In summation the differences between psychological wellbeing and the perceptions of the conditions of the physical work environment were particularly small suggesting that time spent in building did not affect the strength of the relationships substantially.

Table 11 also projects the relationship between the perceptions of the conditions of the physical work environment and physical wellbeing. Evidently the effect of time also seems minimal in that when time is partialed out the strength of the relationships does not change significantly. Warm temperature seems to be influenced by time spent in the building more than the other relationships as when time is partialed out the correlation changes from .328 to .313. In conclusion there appears to be no significant differences regarding both the dependant variables; psychological wellbeing and physical wellbeing when the effects of time are partialed out. This suggest that time has no significant effect on the relationships investigated in this study. Furthermore the same secondary analyses were conducted on the buildings separately in order to investigate whether any significant results would emerge.

### 4.6 Secondary analyses

This section of the results chapter presents the results of the statistical analyses conducted thus far for each building in order to investigate whether differences emerge when each building is observed in isolation. Tables are presented consecutively by analyses followed by a brief explanation of the trends that emerge.

***Table 12 Regression model for total scores of Phase II building***

| *Variable* | *R-Square* | *Adjusted* | *F value* | *Sig. (p)* |
|---|---|---|---|---|
| Psychological wellbeing | .170 | .112 | 2.912 | .000 |
| Physical wellbeing | .492 | .456 | 13.755 | .000 |

***Table 13 Regression model for total scores of Ridgeside building***

| *Variable* | *R-Square* | *Adjusted* | *F value* | *Sig. (p)* |
|---|---|---|---|---|
| Psychological wellbeing | .294 | .191 | 2.851 | .001 |
| Physical wellbeing | .626 | .571 | 11.365 | .000 |

From table 12 and 13 it is apparent that the regression models in both buildings are significant, but slightly stronger in the Ridgeside building. However, these results seem to replicate the trend of the combined model where perceptions of the IEQ explain more of the variance on physical wellbeing than psychological wellbeing.

***Table 14 Summary of regression analysis of the different physical attributes of the workplace onto psychological and physical wellbeing in Phase II building***

| ***Variable*** | ***B*** | ***t*** | ***Sig. (p)*** |
|---|---|---|---|
| *Too Warm* | | | |
| Psychological | .778 | 1.011 | .313 |
| Physical | 1.687 | 2.675 | .008* |
| *Too Cold* | | | |
| Psychological | .323 | .486 | .627 |
| Physical | 1.254 | 2.300 | .022* |
| *Too Dim* | | | |
| Psychological | .223 | .316 | .752 |
| Physical | .333 | .576 | .565 |
| *Too Bright* | | | |
| Psychological | .438 | .482 | .630 |
| Physical | -.347 | -.465 | .642 |
| *Ventilation* | | | |
| Psychological | -.935 | -.937 | .350 |
| Physical | -.210 | -.257 | .798 |
| *Drafty* | | | |
| Psychological | -.278 | -.322 | .748 |
| Physical | .909 | 1.284 | .201 |
| *Movement* | | | |
| Psychological | -.459 | -.453 | .651 |
| Physical | -.558 | -.671 | .503 |
| *Dry Air* | | | |
| Psychological | 1.690 | 2.284 | .023* |
| Physical | 1.888 | 3.113 | .002* |
| *Humid Air* | | | |
| Psychological | -.698 | -.781 | .436 |
| Physical | .655 | .894 | .372 |
| *Noise* | | | |
| Psychological | 1.886 | 3.056 | .003* |
| Physical | 1.847 | 3.650 | .000** |
| *Odour* | | | |
| Psychological | -.276 | .-3.61 | .718 |
| Physical | .545 | .863 | .389 |
| *Stale Air* | | | |
| Psychological | 1.785 | 1.935 | .054 |
| Physical | .656 | .867 | .387 |
| *Dusty* | | | |
| Psychological | .332 | .361 | .719 |
| Physical | 2.011 | 2.669 | .008* |
| *Shocks* | | | |
| Psychological | -.206 | -.216 | .829 |
| Physical | 1.053 | 1.350 | .178 |

(*) indicates statistically significant results at $p<0.05$

(**) indicates statistically significant results at $p<0.001$

***Table 15 Summary of regression analysis of the different physical attributes of the work place onto psychological and physical wellbeing in Ridgeside building***

| ***Variable*** | ***B*** | ***t*** | ***Sig. (p)*** |
|---|---|---|---|
| *Too warm* | | | |
| Psychological | .619 | .447 | .656 |
| Physical | -2.243 | -2.454 | .016* |
| *Too Cold* | | | |
| Psychological | .886 | .859 | .393 |
| Physical | 2.038 | 3.006 | .003* |
| *Too Dim* | | | |
| Psychological | .946 | .950 | .344 |
| Physical | 1.454 | 2.226 | .028* |
| *Too Bright* | | | |
| Psychological | 1.292 | 1.199 | .233 |
| Physical | 2.428 | 3.438 | .001** |
| *Ventilation* | | | |
| Psychological | 2.847 | 1.484 | .141 |
| Physical | 4.012 | 3.170 | .002* |
| *Drafty* | | | |
| Psychological | .665 | .702 | .484 |
| Physical | 1.526 | 2.421 | .017* |
| *Movement* | | | |
| Psychological | 1.166 | .682 | .497 |
| Physical | -.406 | -.362 | .718 |
| *Dry Air* | | | |
| Psychological | -3.610 | -2.206 | .030* |
| Physical | -1.105 | -1.027 | .307 |
| *Humid Air* | | | |
| Psychological | -1.740 | -.917 | .362 |
| Physical | -.543 | -.421 | .675 |
| *Noise* | | | |
| Psychological | .812 | 1.029 | .306 |
| Physical | .145 | .280 | .780 |
| *Odour* | | | |
| Psychological | 5.764 | 4.040 | .000** |
| Physical | 1.986 | 2.115 | .037 |
| *Stale Air* | | | |
| Psychological | -3.997 | -2.372 | .020* |
| Physical | -.328 | -.295 | .769 |
| *Dusty* | | | |
| Psychological | -1.342 | -.976 | .331 |
| Physical | 1.597 | 1.771 | .080 |
| *Shocks* | | | |
| Psychological | 1.247 | .781 | .437 |
| Physical | 1.736 | 1.648 | .103 |

(*) indicates statistically significant results at $p<0.05$

(**) indicates statistically significant results at $p<0.001$

From table 14 and 15 it is evident that physical work conditions have the most salient effects on physical wellbeing in comparison to psychological wellbeing. The conditions of the physical work environment seem to influence physical wellbeing a whole lot more than psychological wellbeing in both buildings. There are a few physical workplace conditions which seem to influence psychological wellbeing and they differ by building, these conditions include; dry air, noise, odour, and stale air. Furthermore from the grouped results only noise has an influence on psychological wellbeing (see table 9), whereas in the results from the separate buildings dry air, odours and stale air seemed to have an influence on psychological wellbeing. The conditions of the physical work environment were more salient on physical wellbeing in comparison to psychological wellbeing in the grouped results (see table 10). A similar trend was replicated in the secondary analyses where the conditions of the physical work environment influenced physical wellbeing the most. The following tables will present the correlations in each of the buildings after controlling for the effects of time.

***Table 16 Partial correlation matrix- psychological and physical wellbeing with time partialed out in Phase II building (partial correlations in parentheses)***

| Variable | Psychological wellbeing | Physical wellbeing |
|---|---|---|
| Too warm | .117* | .379** |
| | (.178*) | (.362**) |
| Too cold | .067 | .157* |
| | (.067) | (.155)* |
| Too Dim | .171* | .292** |
| | (.172*) | (.306**) |
| Too Bright | .197** | .227** |
| | (.197*) | (.218**) |
| Ventilation | .195* | .431** |
| | .(196*) | (.416**) |
| Drafty | .114 | .263** |
| | (.114) | (.259**) |
| Movement | .206* | .448** |
| | (.207*) | (.434**) |
| Dry Air | .284** | .512** |
| | (.287**) | (.505**) |
| Humid Air | .159* | .388** |
| | (.160*) | (.397**) |
| Noise | .322** | .429 |
| | (.323**) | (.437**) |
| Odour | .161** | .347** |
| | (.161*) | (.350**) |
| Stale Air | .269** | .476** |
| | (.269*) | (.468**) |
| Dusty | .263** | .577** |
| | (.263**) | (.576**) |
| Shocks | .151* | .368** |
| | (.151*) | (.373**) |

(*) indicates statistically significant results at $p<0.05$

(**) indicates statistically significant results at $p<0.001$

***Table 17 Partial correlation matrix psychological and physical wellbeing with time partialed out in Ridgeside building (partial correlations in parentheses)***

| Variable | Psychological wellbeing | Physical wellbeing |
|---|---|---|
| Too warm | .172 | .144 |
| | (.163) | (.140) |
| Too cold | .174 | .412** |
| | (.167) | (.408**) |
| Too Dim | .198* | .277** |
| | (.188*) | (.284**) |
| Too Bright | .099 | .427** |
| | (.082) | (.420**) |
| Ventilation | .178 | .494** |
| | (.184) | (.501**) |
| Drafty | .124 | .393** |
| | (.122) | (.391**) |
| Movement | .186 | .449** |
| | (.172) | (.443**) |
| Dry Air | .047 | .426** |
| | (.037) | (.424**) |
| Humid Air | .055 | .412** |
| | (.067) | (.425**) |
| Noise | .232* | .324** |
| | (.232*) | (.324**) |
| Odour | .331** | .424** |
| | (.326**) | (.420**) |
| Stale Air | .084 | .431** |
| | (.076) | (.427**) |
| Dusty | .110 | .472** |
| | (.122) | (.483**) |
| Shocks | .144 | .399** |
| | (.122) | .390** |

(*) indicates statistically significant results at $p<0.05$

(**) indicates statistically significant results at $p<0.001$

From table 16 and 17, after controlling for the effect of time, it is apparent that time did not have a significant role on the relationships between the perceptions of the conditions of the physical work environment and the dependant variables. For the Phase II building as a whole it was found that there was a weak positive partial correlation between the physical work environment and psychological wellbeing, There was a weak to moderate positive partial correlation between the physical work environment and psychological wellbeing after controlling for time, r= .308 ($p< 0.05$), r= .306 before controlling for time. Conversely there was a strong positive partial correlation between the physical work environment and physical wellbeing after controlling for time, r=.669 ($P< 0.05$). r was at .676 prior to controlling for

time. Similarly for the Ridgeside building it was found that, r= .279 ($p< 0.05$), r was at .281 before controlling for time. Conversely there was a very strong positive partial correlation between the physical work environment and physical wellbeing after controlling for time, r=.712 ($p< 0.05$). r before controlling for time was at .711. In summation this suggests that even though the buildings were investigated independently the effect of time was still not statistically significant between the study variables just as when the buildings were combined into one larger data set.

To conclude this chapter has presented the results of statistical procedures which were run in order to answer the research questions. An independent sample t-test was performed in order to establish whether to treat the two buildings as separate case studies or as one case study. A correlation matrix was also carried out where the relationships between the study variables where presented. From this matrix it appeared that the physical work environment conditions had stronger relationships with the physical wellbeing of the employees rather than the psychological wellbeing of the employees. The regression analyses which were presented also tended to confirm this trend which emanated from the correlation matrix, with physical work conditions being most relevant on the physical wellbeing of employees and finally to investigate the role of time on the study relationships a partial correlation was conducted, which showed that time spent in building made no significant differences to the relationships between the independent and dependant variables.

# Chapter 5 Discussion

## 5.1 Introduction

The aim of this study has been to investigate the impact of the physical work environment on the psychological and physical wellbeing of the employee. This current chapter will attempt to provide the reader with a theoretical interpretation of the results that were found. The theoretical and practical implications of this study will be discussed in this chapter including a discussion on the limitations and the directions for future research to take on.

## 5.2 Discussion on psychological wellbeing

From the analyses that were performed the impact of perceptions of the conditions of the physical work environment on psychological wellbeing are rather low in comparison to physical wellbeing. This suggests that the impact of the physical work environment on psychological wellbeing is not so substantial. However there may be a theoretical explanation that may help shed light on the minimal effect of the conditions of the physical work environment on psychological wellbeing.

Briner (2000) argues that it is important that one understands the aspects of the workplace that affect psychological wellbeing. From table 8 none of the conditions of the physical work environment, except for noise, seem to have a significant impact on psychological wellbeing. On the one hand this finding seems to partially support Briner's (2000) assertion which states that there are some features of the work environment that affect psychological wellbeing. Klitzman and Stellman (1989) also support this view and argue that there are a number of aspects of the physical work environment that may influence the psychological wellbeing of office workers negatively. However from the results of this study it appears that many of the physical work environment features studied do not seem to influence psychological wellbeing. Thus the effect of the physical work environment on psychological wellbeing can be questioned. Furthermore it becomes crucial to acknowledge the reasons that have resulted in the study uncovering results that do not completely support the theoretical assertions of theorists such as Briner (2000).

According to Evans and Kantrowitz (2002) the links between psychological wellbeing and the building are indirect. Thus there are many interacting factors and multiple pathways that influence the relationship between the physical work environment and psychological wellbeing. The model which this study adopted was a rather simple linear route which attempted to link the building directly to psychological wellbeing. This linear or direct assumption is problematic because no casual pathway that can be assumed when looking at the relationship between the physical work environment and psychological wellbeing. Briner (2000) supports this view by arguing that the adoption of a general stress model is problematic. The problem with this statement is that, if something is perceived as negative it will have a negative impact on wellbeing. Similarly this is what the study attempted to do, the nature of the study attempted to provide a simple direct link between the building and psychological wellbeing. If the building occupants perceived the building negatively then they would have a negative psychological wellbeing.

This assertion is problematic in that it assumes causality. There are many other factors besides the conditions of the physical work environment that can influence psychological wellbeing. Briner (2000) utilises Warr's vitamin model in order to highlight that there are multiple factors that can have an effect on the psychological wellbeing of the employees. The underlying tenet of Warr's vitamin model attempts to "describe psychological features of the environment in terms of vitamins such that the presence of each in the environment is important for the psychological wellbeing but their effects on wellbeing will vary as their level increases" (Briner, 2000: p.301). Thus the underlying assumption of Warr's vitamin model is that some vitamins need to be taken in moderation, too little of or too much intake of some vitamins may be detrimental to one's health. Similarly in organisations too much or too little of some of these organisational vitamins may have a negative repercussion on the psychological wellbeing of individuals. Warr identified nine vitamins which may have a psychological impact on the employee.

For the purposes of this study only two of these vitamins will be looked at. The first one is physical security, this includes features such as the sound ergonomic design of the workplace, acceptable levels of noise and temperature, absence of danger, and generally good working conditions (Briner, 2000). The second vitamin is opportunity for interpersonal contact; this

includes a space that provides for sufficient quantity and quality of interaction, and privacy (Briner, 2000). From the description of the second vitamin it is clear that the study did not focus systematically on whether the work environment catered for issues of interaction which are key in the psychological wellbeing of the employee. Rather the study was more concerned with the design of the workplace which is encompassed within the physical security vitamin. Also it is important to note that this section of the discussion only utilised two vitamins from Warr's model which have an influence on the psychological wellbeing, there are seven other factors in the workplace that affect the psychological wellbeing of employees. These factors can include monetary incentives, social position, job demands, decision latitude, and environmental clarity to name but a few (Briner, 2000). This suggests that there are many other factors that affect the psychological wellbeing of the employee, indicating that the model which this particular study adopted was particularly simplistic. Thus there could be other workplace factors that affect the psychological wellbeing of employees which are not related to the physical work environment.

Evans (2003) also asserts that there is an indirect pathway that explains the link between the physical building and psychological wellbeing. Three factors that Evans (2003) associated with psychological wellbeing will be outlined in order to emphasise the weaknesses of the instruments which were utilised in this particular study. The following factors contribute to the psychological wellbeing of people namely; the role of control, social support, and restoration. If one does not have control over their physical environment there is a diminished sense of ownership and learned helplessness develops. Often then people accept things as they are and give up easily on the task at hand as they cannot control their immediate surrounding environment (Evans, 2003). The lack of social support can be associated with the physical layout of the organisation and office density, and how this facilitates support and interaction (Evans, 2003). This lack of social support relates to psychological wellbeing as it can have a number of impacts on employees often resulting in social withdrawal, and hampered communication. The last factor is restoration which is associated with natural landscapes and the serenity which the physical work environment provides for the employee in order to make them feel better (Evans, 2003). This summation of these factors above highlighted factors that may potentially influence psychological wellbeing. However these factors were not investigated by virtue of a narrow conceptualisation of the physical work

environment scale. This suggests that the choice of instrument and the study design may have been problematic.

Psychological wellbeing was assessed using the Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS). According to Stewart-Brown and Janmohamed (2008) mental wellbeing or psychological wellbeing in this scale was defined to encompass the individual's experience of happiness, life satisfaction, and positive psychological functioning which includes positive relations with others, and self-actualisation. With this in mind it becomes important to recognise the extent to which the physical work environment scale, which was utilised in this study, relates to how these factors of psychological wellbeing would be hindered. It is important to note that it would have been difficult to gauge all the factors of psychological wellbeing as defined by Stewart-Brown and Janmohamed (2008), except for that of positive relations with others. Relations with others in the organisation happens within a context, the argument put forward here is that these relations can be hindered or encouraged by that context, which is the physical work environment, for example the positioning of furniture may encourage or discourage interactions. This view is supported by Evans (2003: p.548) who argues that "Qualities of the physical environment can also interact with the social environment as they influence mental health". Stallworth Jr and Kleiner (1996) emphasise this point and assert that organisations are creating more and more seating areas to provide their staff with opportunities for random interaction and communication. This occurs in a bid to create friendlier environments that will intimidate individuals less and give them a space in which they can be creative and free to interact whenever they wish to. The physical work environment scale that was utilised failed to take this factor of social interaction completely into account.

According to Klitzmann and Stellman (1998) one of the leading contributors to reduced psychological wellbeing is noise. This was also confirmed by this study where noise had a significant impact on psychological wellbeing (see table 9). It is important to note that both the green buildings Ridgeside and Phase II were particularly concerned with controlling the noise within the building. As argued earlier green buildings are concerned with providing the occupant with a pleasant experience and enhancing their health (Kibert, 2004). Results from this study show the presence of a relationship between noise and wellbeing. This is important

in that it shows that the green buildings can be designed in a manner in which the noise levels within the building can still allow for occupant's wellbeing to not be compromised and allowing for optimum performance. This view is supported by Heerwagen (1998) who argues that green buildings usually allow for moderate levels of noise. Stallworth Jr and Kleiner (1996) argue that a contemporary workplace is likely to be chaotic and less secluded. An environment such as this may result in noise conditions which disrupt the employee. If noise conditions are too high then ultimately this can affect the quantity and quality of communication which is pivotal to the individual's psychological wellbeing. Thus what can be inferred from this result is that if noise levels become too high, psychological wellbeing will be reduced as this will affect the ability of individuals in the workplace to form good social relations amongst one another. Stansfeld and Matheson (2003) also support this view by arguing that noise often inhibits communication and activities of people. However Heerwagen (2000) argues that acoustical privacy is associated with psychological wellbeing. Leather, Beale and Sullivan (2003) assert that office workers would prefer to work in a place with little noise and distractions. This result shows the importance of how the physical work environment can affect social relationships to the detriment of psychological wellbeing.

Stransfeld and Matheson (2003) and Evans (2003) also argue that noise often results in annoyance or agitation. This is important to bear in mind because, if this assertion by Stransfeld and Matheson (2003) holds true, then noise affects the psychological mood of the individual. According to George and Brief (1992: p. 314) "moods provide the affective colouring for day-to-day events". Moods have an influence on the cognitive processes, attitudes and behaviours of people (George & Brief, 1992). Thus moods affect one's judgement and appraisal of phenomena. Evans (2003) argues that noise often results in negative affect. He further argues that in the presence of noise often individuals are less likely to help one another or interact with each other (Evans, 2003). This may explain the effect of noise on psychological wellbeing. However just as people's general mood states differ (George & Brief, 1992) so will their reactions to noise (Leather et al., 2003). Thus it is important to bear in mind that people will respond and react differently to differing noise levels. It thus becomes important to avoid causal assumptions that noise influences psychological wellbeing. However from this it becomes clear as to why the effect of noise is significantly related to psychological wellbeing.

### 5.3 Discussion on physical wellbeing

Vischer (2007) presents the term workspace stress in order to refer to the effects of the physical work environment on the employees. The concept of stress originally attempted to explain the area or part of the structure that experienced the most pressure placed on it by a load or other parts of the structure (Vischer, 2007). The results from table 10 ultimately predict which conditions of the physical work environment load the most on physical wellbeing. The results from table 10 suggest that cold temperatures, dry air and dusty conditions place the most stress on the physical wellbeing of people (see table 10). Moreover table 10 supports Bergs' (2002) assertion that most complaints in the building are generally about temperature and air quality. Cold temperatures and factors associated with air quality such as dry air, and dusty conditions were found to have the most profound impact on physical wellbeing. Noise was also found to have a profound impact on physical wellbeing, this result is also supported by theorists such as Evans (2003), Evans and Kantrowits (2002) and Klitzman and Stellman (1998).

Both green buildings in the study were concerned with increasing the amounts of fresh air moving into and through the building. This design imperative is particularly useful when observed with the results of the study in mind. Most of the significant physical work environment conditions were linked with issues of air quality. The green buildings in this particular study were concerned with providing quality levels of air which is reflected in the design efforts of each building, where carbon dioxide levels are closely monitored and toxins caused by interior wall paints, furnishings, and other office equipment are controlled. These considerations enacted in these buildings are congruent with Sustainability and Kandor (2006) and Hedge (2000) who argue that carbon dioxide levels from the building occupants and toxins released from general office equipment contribute to air quality problems. Green buildings address problems associated with air quality in order to enhance the working conditions and the occupant's general health. In summation the results from these green buildings show a relationship between wellbeing and air quality.

It is important to note that these aforementioned physical work environment conditions which have an impact on physical wellbeing can have tangible implications on the body of the

building user. Menzies and Bourbeau (1997: p. 1524) define nonspecific building – related illnesses as encapsulating "a heterogeneous group of work- related symptoms, including irritation of the skin and mucous membranes of the eyes, nose, and throat, headache, fatigue and difficulty concentrating". The physical work environment conditions which have been identified in table 10 can result in some of these nonspecific building- related symptoms. Lee, De Biasio and Santini (1996) argue that nonspecific building- related symptoms are not identified with a specific disease, but rather associated with interacting with buildings. This assertion is similar to that provided by Hedge et al. (1996) and Fisk (2000) who investigated SBS symptoms which can be understood as nonspecific building – related illnesses associated with occupancy of some particular buildings. The building conditions which had the most significant effect on wellbeing will now be discussed.

Just as many factors influence the relationship between the perceptions of the physical work environment and psychological wellbeing the same can be said about the relationship between physical wellbeing and perceptions of the physical work environment. Mitchell, Zhang, Sigsaard, Jantumen, Lioy, Samson, and Karol (2007) argue that characterising the interactions between the health of building occupants and the buildings which they occupy is a complex process. Loftness, Hakkinen, Adan, and Nevalainen (2007) assert that investigating the effect of the building on health is a multi-factorial process.

Lee et al., (1996) argues that there are three ways in which toxins enter the body. These include skin absorption, inhalation, and ingestion. Skin absorption has to do with toxins entering through the skin, inhalation has to do with breathing in toxins that end up entering the lungs and often being absorbed into the blood stream influencing health (Lee et al., 1996). For the purposes of this study it is essential to note that ingestion will not be investigated as it has to do with an individual's own behaviour. However it is important to bear in mind that it is the individual that decides what to take into their system which can be ultimately detrimental to one's own health. This is important to health. However it shows that there are other factors that can affect one's health which are beyond the scope of this particular study. Thus one cannot assume that poor physical wellbeing is the sole result of the physical work environment.

When one looks at the results of table 10 it becomes clear that all the conditions which were identified to have an impact on physical wellbeing seemed to be linked to the air quality in the building except, that of noise. With this in mind one can argue that the investigation of air quality is also a multifaceted discipline with multiple ripple effects. The effects can be economically detrimental to the organisation and personally to the individuals exposed to the poor air quality (Loftness et al., 2007). One of the factors that were found to impact on the physical wellbeing of employees was cold temperatures in the building. Hedge et al., (1996) argued that issues related to office environment temperature were also closely related to the office air quality. According to Lee et al., (1996: p. 4) "ambient temperatures that are too cool can cause occupant discomfort such as shivering, inattentiveness, muscular and joint tension". This view is similar to that presented by Parsons (2000) who argues that cold temperatures can cause numbness and strength loss. When individuals are situated in cold environments they often feel uncomfortable as they often lose body heat to the external environment (Lee et al., 1996). This can often result in flu-like symptoms.

Dry air was also another physical work environment condition which had an influence on the physical wellbeing of the employees. According to Bergs (2002) complaints about dry air are often associated with eye, throat, and nasal complaints. Lee et al. (1996) argues that dry air can be associated with ventilation problems within the building which result in lethargy, headaches and stiffness. Bergs (2002) suggests that if there is a prevalence of complaints about air being dry, it would be advantageous to have vegetation within the building. Plants allow for humidity through transpiration and the extraction of carbon dioxide from the air reducing complaints about the air being dry. This may also contribute to improving the psychological wellbeing of employees as presented earlier in this discussion.

Dusty air was also found to be one of the physical work environment conditions which had an influence on the physical wellbeing of the employees. Bergs (2002) and Lee et., (1996) argue that the presence of dust in the office requires one to question the quality of the air in general. Dusty air suggests that there are many contaminants in the air; many of these can have

varying levels of implications for the health of building occupants (Lee et al., 1996). These health ailments can range from sneezing to respiratory complications.

Menzies and Bourbeau (1997) assert that dust houses fungi, volatile organic compounds, and dust mites which can have adverse impacts on human health. The effects of dust can be easy to recognise as toxins are automatically inhaled into one's body. According to Lee et al., (1996: p.7) "fibres and particles greater than 5µm (microns) in aerodynamic diameter which enter the respiratory system are generally intercepted by mucous, nose hair and cilia in the trachea". Trapped particles are coughed or sneezed out, whereas the smaller fibres enter the respiratory system where the potential for physiological harm is greater (Lee et al., 1996). Mitchell et al. (2007) argue that the health effects of this can be both acute and chronic including asthmatic symptoms. This view is similar to that of Evans and Kantrowitz (2002) who argue that air problems or pollutants often result in bronchitis and asthmatic symptoms. Lee et al., (1996) assert that the physical wellbeing implications of dusty conditions include; headaches, shortness of breath and sometimes lung disorders. Menzies and Bourbeau (1997) argue that dusty air carries airborne toxins which are more common indoors and are heavily associated with adverse health, such as mucosal irritations and respiratory complaints.

Lee et al., (1996) and Menzies and Bourbeau (1997) acknowledge that office furnishings, carpets and clothing all have the ability to trap and carry dust. Heerwagen (2000) and Menzies and Bourbeau (1997) asserts that cleaning and maintenance of the building can help tackle the dusty air complaints that have been highlighted by building occupants. However Lee et al., (1996) cautions theorists who adopt this approach, as he argues for one to be cautious when proposing cleaning as the solution to tackling dust concerns. Lee et al. (1996) and Menzies and Bourbeau (1997) argue that cleaning activities; the products utilised or sweeping often disturbs dust, thus contributing to the dust particles in the air. Often equipment such as vacuum machines emits emissions which leave toxins in the air. Furthermore it is also argued that activities such as cleaning often are generally concerned with getting rid of large unharmful particles from view and not dealing with the smaller more harmful particles (Lee et al., 1996).

The final physical work environment condition to be discussed is that of noise. Noise has been discussed last in this section because it is not related to the air quality of the building. Evans (2003) argues that there is a need to have a distinction between two types of noise. Intermittent and constant noise need to be explicitly defined as these types of noises have different implications on individuals. Leather et al., (2003), for example, found that noise which was unpredictable tended to have the most harmful effects on people. Evans (2003) argues that constant or chronic noise can often result in the loss of hearing. In an office environment expecting such an extreme type of noise that results in hearing loss will be assumed to be improbable as the study was concerned more with investigating distracting noises. According to Evans and Kantrowitz (2002) noise acts as a stressor, Vischer (2007) asserts that noise results in a serious form of discomfort which is a similar assertion to that of Bitner (1992), and Stransfeld and Matheson (2003). The repercussions which may be of relevance in the workplace can include hypertension (Evans and Kantrowitz, 2003), self-reported fatigue and cardiac problems (Leather et al., 2003), increased blood pressure and heart rate (Stransfeld and Matheson, 2003). These symptoms associated with noise appear to be very serious, with the potential to be detrimental to the employee. However this was thought to be dependent on the amount of time individuals would spend in the building. With this in mind the study attempted to investigate the role of time spent in the building in order to ascertain how time influenced the study variables.

### 5.4 Discussion on time spent in building

This particular study found that time had no significant effect on the study variables. This particular finding may mean a number of things in the context of this study. A number of theorists such as McCoy and Evans (2005), Bergs (2002), and Lee et al. (1996) assert that people spend a considerable amount of time indoors. Lee et al. (1996) argues that work is predominantly an indoor activity. Furthermore it can be argued that it is standard practice for one to be in their office for the duration of the entire working day. This suggests that people may be accustomed to being indoors as life is now primarily lived indoors (Lee et al., 1996). It can be plausible to assume that people are becoming more accustomed to living indoors, thus making it difficult to uncover the temporal influences which could have affected the study. Furthermore, individuals in this study appeared to have standard working hours for a fixed amount of days per week. This lack of variation between the amount of time the

workers spend in the building may have caused time spent in the building not to have a significant effect on the study variables. With hindsight it is also important to note that the approach and avoidance behaviours as defined by Bitner (1992) can be irrelevant in the context of the workplace due to the fact that people are forced to go to work in order to survive. Ultimately as people are in their office buildings until the end of their working day this may result in activities which are enacted to cope with work such as taking more smoke breaks, longer lunch breaks, or destressing in the kiosk or canteen areas when they feel overwhelmed by conditions in their workplace. In summation the effects of the time spent in building maybe susceptible to control by adopting coping mechanisms. One can put on a jersey if it is too cold, or utilise earphones to reduce the effects of noise, purchase a plant for his or her table or clean their own surroundings, in order to make their time spent in the building more pleasurable.

### 5.5 Discussion of secondary analyses

Due to the nature of the results that emerged from the main research questions it was decided to perform the same statistical analyses on the two buildings separately to see if any other significant results would emerge. Thus this section of the discussion is concerned with briefly discussing the results that differ from results that emerged in the primary analyses.

Results from the secondary analyses which were run display the same trend that emerged from the main study. The effects of the physical work environment were more pertinent on physical wellbeing than on psychological wellbeing in both buildings. These results tend to confirm the results found in the primary analyses, which also contribute to the evidence that there is a physical work environment effect on the physical health of office workers (Klitzman & Stellman, 1989). It is important to note that some physical work environment features came out as significant in the secondary analysis; these features will be the focus of this discussion in order to give the reader a theoretical justification of the results that emerged.

In both the Phase II building and Ridgeside buildings warm temperatures were found to have a significant influence on the physical wellbeing of the building occupants. According to Hedge et al., (1996) when people perceived the temperature to be too warm, the office environment air quality was perceived as poor. This view is also supported by Bergs (2002), who also adds that warm temperatures can be particularly uncomfortable for office users. Sustainability Victoria and Kandor (2006) and Parsons (2000) argue that warm temperatures result in building occupants feeling sleepy and their cognitive awareness being diminished. Furthermore in the Phase II building dry air was found to have an influence on the psychological wellbeing of employees. According to Klitzman and Stellman (1989) this result is not strange as problems with air quality are known to workers as the leading cause of health hazards which may ultimately make them more anxious or concerned about their own wellbeing.

In the Ridgeside building office workers had a problem with lighting which was shown to have a significant effect on the physical wellbeing of the employees. It is important to note that the result that emerged from this study show that brightness and dimness are related to physical wellbeing. It can be suggested that these results are indicators of the office environments inability to vary its lighting as the day progresses (Altomonte, 2008). It is plausible to find that in the afternoon as the day draws to an end it becomes too dim, which can have a number of health effects on individuals such as eyestrains and headache complaints (Heerwagen, 2000) as they squint in order to see better for example. Whereas during the day it is too bright in that there are reflections from windows and glares on computer screens (Heerwagen & Zagreus, 2005; Heerwagen, 2000) which strains the eyes often resulting in tired, irritated, or watery eyes (Bergs, 2002).

Furthermore it was also found that ventilation also had an effect on the physical wellbeing of the office workers. Ventilation is important as it is concerned with the movement of fresh air into the building (Susser et al., 1994). If there are complaints about ventilation in the building it should come as no surprise when odour in the air and stale air are said to be affecting the psychological wellbeing of office workers in the Ridgeside building. The results of the study are indicative of the relationship between air quality and physical wellbeing in the Ridgeside building. Addressing the ventilation concerns will go a long way in addressing the

perceptions of air quality. The results of the study show there is a relationship between perceptions of air quality and perceptions of wellbeing. As asserted by Sustainability Victoria and Kandor, (2006) a constant supply of fresh air is required in order to flush out air pollutants from the building.

Lastly, partial correlation procedures were carried out in each building in order to investigate the moderating effects of time on the study variables in both buildings (see tables 16 and 17). The results found in this analysis resembled those of the main primary partial correlation analysis where there was no moderating effect of time.

### 5.6 Theoretical and practical implications

According to Mitchell et al., (2007) as people spend more time indoors it becomes important to investigate the health repercussions that can result from the prolonged amount of time spent indoors. Mitchell et al. (2007) also advocates for more research into understanding the exposures that are most likely to affect the person in the building in order to help create interventions which are relevant and make the experience with the building better. The current study has shown the importance of indoor conditions on the psychological and physical wellbeing of the employees. Many of the findings in this study are in alignment with the theory in the area of the physical work environment and wellbeing. Essentially this study has contributed to knowledge in this area as it has shown that some physical work environment conditions are more salient than other conditions on the wellbeing of individuals. As this study investigated the physical work environment of Nedbank on the wellbeing of their employees, the factors which have been identified as having an effect on the wellbeing of employees can be addressed more easily, with theoretical support. This is also relevant for other studies of this nature once the physical work environment conditions which affect the employees have been identified then interventions can be made directly at the problem.

It is also important to bear in mind that this study was looking at the physical work environment conditions from the confines of the sustainability paradigm. Thus for example

one of the conditions which affected physical wellbeing was that of cold temperatures. In order to increase temperature may require a heating system which results in more energy expenditure. This dilemma according to Mitchell et al. (2007) calls for difficult tradeoffs. Thus it is suggested that studies such as these utilise a number of experts from a variety of fields in order to get a holistic point of view, such as engineers, building users, health officials, environmental specialists, and psychologists (Mitchell et al., 2007).

According to Pfeffer (2009) organisations are primarily concerned with sustainability only if it reduces organisational costs. However the focus is not where it should be regarding the social externalities created by the workplace. There is too much of a focus on the physical influence of the organisation on the physical environment and physical wellbeing of the employee. Pfeffer (2009) utilises the term 'limited visibility of consequences' to explain the lack of attention given to social pollution. For example sweat shops, dramatic climate changes, oil spills and fracking procedures in the Karroo are vivid ways of seeing the impacts of the organisation on people and the environment. Thus these receive more attention and public outcry, whereas in the office environment it takes a significantly longer period of time to see these effects on people. Diseases and disorders associated with the workplace have multiple factors affecting them therefore they receive less coverage (Pfeffer, 2009). This makes studying the effects of the physical work environment a strenuous but necessary task in the bid for developing a more sustainable world order. The study will now look at the weaknesses of the study which if addressed will strengthen the study considerably.

### 5.7 Limitations

This particular study was concerned with reporting on archival data. One of the problems with this was that the current researcher was directed by data, thus it was particularly difficult to be flexible in that the researcher had to alter the methods and general orientation of the study so that the pre-existing data sets could fit in with the desired nature of the study. In other words the researcher did not enter the research field neutral and objective but rather was led by preconceived ideas of the study area which was in turn influenced by the fact that the current researcher had the pre-existing data sets

One of the stumbling blocks of this study is that it failed to practically acknowledge that different buildings are susceptible to different upgrades and innovations. In the context of this study both Ridgeside and Phase II buildings underwent similar design initiatives. However some of the design initiatives such as reducing flickering lights and emissions from office equipment were not included in the perception of the physical work environment scale which was utilised in this study. By critically analysing the perception of the physical work environment scale it seems generic and as a result may not cater for specific buildings with specific design initiatives. This limitation made the study appear superficial and general as design initiatives did not specifically link with the scale that was utilised. It is plausible to argue that the issues which were addressed by the organisation in the newer buildings were not covered in the instruments that were utilised in this study. Thus it would be advantageous to identify the factors that make each building green and from there design an IEQ scale that will cater for the specific building as there are many methods and innovations which allow for a building to be green.

Another limitation has to do with the time frame of the data collection. The data utilised in this study was taken from the first data collection point which was six months after the move into the green building. It is possible that employees were perhaps still excited about the move and thus may have replied to the questionnaires in a socially desirable manner. Furthermore the manifestation of physical health ailments may appear more readily than psychological ailments, as a result of this the time frame in which the data was collected was perhaps not sufficient to gauge the full extent of the psychological problems which could be associated with the perceptions of the conditions of the physical work environment. A similar view is proposed by Thatcher and Milner (2011) who argue that a period of six months may not be sufficient time to measure the true effects of the move into a green building. It is also important to note that people often carry illnesses which may not have necessarily anything to do with the physical work environment, rather the conditions people suffer from may be exacerbated by office environment but not as result of the actual physical work environment. Furthermore time in the office may be exacerbated or negated by time spent in other places, as individuals are not just in the office. In summation it is important to note that people may have other life problems which influence their wellbeing hence the physical work environment may not be solely responsible.

The manner in which psychological wellbeing was operationalised was also a limitation. The argument put forward here it is that the scale neglected spaces, or how the building allows for interaction which affects psychological wellbeing. Theoretically the study showed that the physical work environment affected the psychological wellbeing in terms of factors that influence how people relate to one another and interact within the confines of their environment. Thus buildings which marginalised interaction and communication would influence psychological wellbeing negatively, and whilst those that facilitated interaction and communication would influence psychological wellbeing positively. However the scale utilised in this regard remained solely focused on the ambient conditions neglecting factors such as office layout, furnishing, views and opportunities for control of their physical work environment which can affect psychological wellbeing (Briner, 2000; Evans, 2003; Stallworth Jr & Kleiner, 1996).

The final limitation is that this study only had access to the design intention. Thus this study was particularly based on what the buildings were designed to incorporate and what was likely to come to fruition based on this intent and not on necessarily the commissioning of the building. This is a limitation as the study did not focus on whether the building met the requirements stipulated in the design process. This is important to bear in mind as the ideas may seem plausible but need to be actually seen in reality, there was a need to observe what was installed into the building and whether this equipment worked properly for example. Furthermore readers need to bear in mind that the IEQ design can be hampered by the use of inappropriate furniture or poor office layout. Whilst a theoretical appreciation of the office space has been provided in the study, it would have bolstered the arguments in this study had links been provided as to how the IEQ efforts align or misalign with the office space. The study will now present directions for future researchers in order to help guide researchers who are interested in the field of the physical work environment on wellbeing.

### 5.8 Directions for future research

It is proposed that a better measure of psychological wellbeing be utilised. The WEMWBS is concerned with general happiness and life satisfaction as clarified by Stewart-Brown and

Janmohamed, (2008). This makes it rather difficult to intuitively link psychological wellbeing with perceptions of the physical work environment. It would be advisable to narrow down the definition of psychological wellbeing and the psychological wellbeing scale utilised in order to tap into factors that can influence relations with others in the workplace. Conversely it is proposed that the scale utilised to measure the physical work environment conditions was too narrow thus it would be important to utilise one which goes beyond focusing on issues related to air quality and noise, and move towards a scale that investigates the physical office layout.

Furthermore it would also be useful to define baselines that are concerned with physical work environment conditions as per the arousal theory presented by Paul and Taylor, (2008). This will force researchers to objectively define what constitutes too much or too little of a condition thus making it easier to find out what dosage of a certain condition results in decreased wellbeing. Also Mitchell et al. (2007) argues for the objective measures of physical wellbeing. As can be seen in this study, only self-report questionnaires were utilised this is often problematic as it can result in self-report bias.

The final recommendation is to increase the observation time of the study. As earlier mentioned one of the weaknesses was that the study observed employees six months after the move into the green building, this was perhaps not sufficient time to gauge the repercussions of the move. It is proposed rather that future researchers focus more on the study variables in a longitudinal framework and not vis-à-vis a cross sectional framework. Tracking the individuals over a prolonged amount of time may prove more beneficial.

### 5.9 Conclusion

In conclusion this study attempted to investigate the perceptions of the conditions of the physical work environment which would affect psychological and physical wellbeing respectively. The results of this study found the effects of the physical work environment to be more pertinent on physical wellbeing in comparison to psychological wellbeing. This result however could have been the result of an instrumental weakness which characterised the study; this was discussed in the limitations section in greater detail. The study was also

concerned with investigating the moderating effect of time spent in building between the physical work environment and psychological and physical wellbeing respectively. Partial correlation analyses were conducted in order to investigate the moderating role of the time spent in building, however the results which were found showed that time spent in building was not a significant variable between the study variables relationships. In summation the results from this study have reaffirmed some of the work done by previous researchers in the area of the physical work environment. More research is needed in this area with specific reference to psychological wellbeing in order to uncover significant results which could have been overseen in this current study due to instrumental weaknesses.

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# Appendices

## Appendix A: Participant Information Sheet

Psychology

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Hello,

We are Professors Andrew Thatcher and Karen Milner from the Psychology Department at the University of the Witwatersrand. This study looks at the impact of green buildings on employees work functioning. Nedbank has the first GreenStar accredited building in South Africa and we would like to investigate whether this will have any impact on your well-being and effectiveness at work. You are invited to participate in this study.

Participation in this study will involve completing the attached questionnaire which should take approximately 10 minutes now (Time 1) and again in approximately six months time (Time 2). Participation is voluntary, and no one will be advantaged or disadvantaged for choosing to participate or not. There are no direct benefits to participants anticipated from participation in this study. While there is a question asking for your employee number this is to enable us to connect your Time 1 responses to your Time 2 responses and to collect certain biographical information. At no point will we have access to your name or any other identifying information about you other than what you provide us and as such, you will remain anonymous.

Your completed surveys will not be seen by anyone other than us (the researchers) and your responses will be saved in a neutral and secure database which is password protected. Thus,

your confidentiality is guaranteed. Your responses will only be looked at in relation to all other responses which means that feedback given to Nedbank will be in the form of aggregated responses and not individual perceptions. An executive summary of the results of this study will be made available to you via your organisation. The University also will have the option to publish the aggregate results once the study is complete in a student's research report and/or as a research publication in a journal.

If you choose to participate, please click on the link at the bottom of this page. Submitting your responses will be taken as your consent to participate in this study. You may withdraw from the survey at any point before pressing the submit button by closing the survey.

Your participation in this study would be greatly appreciated. This research will contribute to our understanding of how our built environment contributes to our well-being and effectiveness as employees in organisations.

Best regards,

Andrew Thatcher (andrew.thatcher@wits.ac.za) & Karen Milner (Karen.milner@wits.ac.za)

## Appendix B: Questionnaires

### BIOGRAPHICAL DETAILS

Employee Number:

Gender:

Race:

Year born:

Organisational level:

Department/unit:

Have you changed office buildings in the last six to twelve months?

If Yes, when did you move? (Month)

What office building are you in now?

How many hours a day on average do you spend in the current building?

How many hours per day on average do you spend working at your desk/work station?

How many days per week on average do you spend in the current building?

## Appendix C- Warwick-Edinburgh Mental Well-Being Scale (WEMWBS)

Please answer the following questions in relation to how you have been feeling generally in the last month

| | None of the time | Rarely | Some of the time | Often | All of the time |
|---|---|---|---|---|---|
| I've been feeling optimistic about the future | | | | | |
| I've been feeling useful | | | | | |
| I've been feeling relaxed | | | | | |
| I've been feeling interested in other people | | | | | |
| I've had energy to spare | | | | | |
| I've been dealing with problems well | | | | | |
| I've been thinking clearly | | | | | |
| I've been feeling good about myself | | | | | |
| I've been feeling close to other people | | | | | |
| I've been feeling confident | | | | | |
| I've been able to make up my own mind about things | | | | | |
| I've been feeling loved | | | | | |
| I've been interested in new things | | | | | |
| I've been feeling cheerful | | | | | |

## Appendix D- Perceptions of the physical work environment

In the last month how often have you experienced the following conditions while in your office?

| | Never | 1-3 times /month | 1-3 times /week | Every day |
|---|---|---|---|---|
| Temperature too warm | | | | |
| Temperature too cold | | | | |
| Lighting too dim | | | | |
| Lighting to bright/ glaring | | | | |
| Insufficient ventilation | | | | |
| Too drafty | | | | |
| Too little air movement | | | | |
| Air too dry | | | | |
| Air too humid | | | | |
| Distracting ambient noises | | | | |
| Unpleasant odour in the air | | | | |
| Stale air | | | | |
| Dusty air | | | | |
| Electrostatic shocks | | | | |

## Appendix E- Physical wellbeing scale

In the last month how often have you experienced the following physical symptoms while at work?

| | Never | 1-3 times /month | 1-3 times /week | Every day |
|---|---|---|---|---|
| Excessive mental fatigue | | | | |
| Headache in your forehead | | | | |
| Dry eyes | | | | |
| Irritated or sore eyes | | | | |
| Tired/strained eyes | | | | |
| Nervousness or irritability | | | | |
| Tiredness or lethargy | | | | |
| Stuffy or congested nose | | | | |
| Sore or irritated throat | | | | |
| Runny nose | | | | |
| Hoarseness | | | | |
| Dry skin | | | | |
| Dizziness | | | | |
| Wheezing or chest tightness | | | | |
| Nausea | | | | |