MASTERS DEGREE IN ORGANISATIONAL PSYCHOLOGY
UNIVERSITY OF THE WITWATERSRAND

THE IMPACT OF INDOOR PLANTS ON WELL-BEING IN THE WORKPLACE

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A research project submitted in partial fulfilment of the requirements for the degree of MA by coursework and Research Report in the field of Organisational Psychology in the Faculty of Humanities.

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March 2016

DECLARATION

I declare that this research project is my own, unaided work. It has not been submitted before for any other degree or examination at this or another university.

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ABSTRACT

There is international growing evidence to support the notion that indoor planters positively impact employees' emotional states, personal health, work engagement as well as their overall perceptions of their work environment and ultimately impacting employee productivity. However this ground-breaking research has never been conducted within a South African Work Environment. Consequently the following study adopts a quasi-experimental study in order to investigate the impact that indoor plants may have on employee physical well-being, psychological well-being, work engagement and their overall perception of their work environment. Furthermore, the researcher aimed to assess whether the employees connectedness to nature influenced the impact the plants had on them, thus assessing how this covariate may impact the relationship between the absence and presence of plants and the above mentioned dependent variables. A Sample of 32 Global Service Management Centre (GSMC) employees from an internationally recognised organisation, Business Connexion, were assessed over a period of 12 weeks. The first assessment was conducted in the no plant condition, while the final assessment was conducted once the plants were installed in the whole office area. Additionally, SE Controls were positioned throughout the office area in order to measure the fluctuations of the air quality once the planters were installed. The results of a series of Wilcoxon Sign Rank Tests as well as Spearman's Rank Order Correlations indicated no significant results; however upon closer evaluations of the individual scale items the researcher identified several statistically significant results that were unpacked and discussed. The readings from the SE Controls indicated either an improvement or stabalisation of the air quality variables that were being assessed in the current study.

KEY WORDS

Indoor Planters, Psychological Well-Being, Physical Well-Being, Employee Engagement, Perceptions of the Work Environment, Connectedness to Nature, Air Quality, Business Connexion, Bidvest Execuflora, SE Controls

ACKNOWLEDGEMENTS

I would like to thank all the participants for taking the time to partake in my study. I would also like to thank the representatives from Business Connexion, Bidvest Execuflora and SE Controls for making this research possible.

I would also like to thank my research supervisor Professor Andrew Thatcher for his continuous support and guidance throughout my postgraduate studies.

Lastly I would like to thank my family and friends for all their love, support and encouragement throughout my journey.

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

While ecological considerations within the organisational built environment have a tendency to stress on building "green", health and well-being considerations of the work place are difficuclt to quantify and have often been given less attention (Smith and Pitt, 2011). There is, however increasing acknowledgment that attaining sustainable development within the built environment goes beyond building "green", to concentrating on developing sustainable workplaces (Smith & Pitt, 2011). Numerous studies have established that there are a multitude of factors within the workplace that impact productivity (Relf, 1990; Kaplan, 1993; Ellison, 2013). Several of these factors are understood to be human factors such as interrelated topics of employees' motivation and engagement, job satisfaction and employee wellbeing; it would therefore be in the employers' best interest to support these factors in order to assure cost effective operation (Kaplan, 1993).

Understanding the benefits of interior plants within the workplace is important in order for horticulturalists to sell their services (Lohr, Pearson-Mims &Goodwin, 1996). Lohr et al (1996) postulate that adding plants into the workplace positively impacts productivity and satisfaction in addition to lowering blood pressure and contributing to reducing stress. Furthermore, individuals feel that contact with plants add a restorative and calming sense to the human spirit (Lohr et al.,1996). This extensive belief is evident in the prevalent landscape in residential communities as well as in theme parks, office environments, retail spaces and many other sectors within the tourist industry (Relf, 1990; Shoemaker, Randal, Relf &Geller, 1992). Due to today's jobs relying more on technology and becoming highly technologically complex, the occurrences of stress-related illnesses among employees in the workplace is increasing (Sethi, Caro & Schuler, 1987). Subsequently, it is important for researchers to understand the relationship between plants and humans and how they are believed to impact human attitudes, psychological responses and well-being (Relf, 1990; Ellison, 2013). Research suggests that work environments that are labelled as "windowless" are also associated with decreased job satisfaction in addition to employees rating their physical work conditions as less than stimulating and pleasant; however when plants were

introduced into this work environment, the research showed that there was a significant increase in satisfaction as well as work environment perceptions (Finnegan &Solomon, 1981; Laviana, Manson & Rohles, 1983; Shoemaker, Randal, Relf &Geller, 1992).

1.2 South African Context

According to Stats South Africa (2015) the employment rate in South Africa is approximately 46%. A large portion of these employed individuals work in an office environment, mostly eight hours a day and five days a week (StatsSA, 2015). For many this means that their work environment most likely has a major influence on their health and well-being (Bergs, 2015). Studies in the Netherlands confirm that it is important from the organisation's perspective to consider the quality of the workspace in which their employees are expected to be productive (Bergs, 2015). The quality of the workspace can give rise to considerable direct and indirect costs, where direct costs are explained as energy and waste treatment and indirect costs are understood as employee non-productivity, lack of engagement and increased sick leave (Bergs, 2015).

According to a horticulturalist from a well-known South African Organisation; South Africa, in comparison to countries such as Australia and Holland, is understood to be behind when it comes to the importance of indoor plants and their environmental benefits (The SA Mag Online, 2014). There is evidence of research concerning this area of study in countries such as Australia (Burchett, Torpy & Tarran, 2013), USA (Wolverton, Johnson and Bounds, 1989), Norway (Fjeld, Veiersted, Sandvik, Riise, Levy; 1998), and India (Bhavan & Nagar, 2008); however there is no evidence of research concerning how the work environment may benefit from introducing interior landscaping in South African Organisations. It would be of importance to consider the impacts of the plants in South African organisations because according to the World Health Organisation (2008) the air quality in South Africa may differ to that of Delhi and Holland where previous research has been conducted; therefore these results may posit interesting outcomes. To the researchers' knowledge, this research will be the first of its kind within the South African work environment. It is important for the researcher to accurately gather and analyse the data for this research, as the results may be utilised for organisations that may be considering installing indoor plants in order to improve employee wellbeing, among other things as well as to increase the organisations

ratings in the recently launched Green Star Interiors tool provided by Green Building Council South Africa.

This research report examines how the absence and presence of plants impact the employees' perceptions of their work environment, the extent to which health and well-being problems and dissatisfaction with the work environment (no plants vs. plant) may influence the employees' engagement and in turn their productivity. Additionally, with the help of SE controls the researcher also examines the air quality in the office and how that may transform once plants are introduced into the workspace.

1.3 Chapter Organisation

The following research project is organised into chapters. The first chapter offers an introduction to this study.

Chapter two covers the literature review of this study; this section encompasses the necessary literature and theories as well as acknowledges relevant previous studies that have been conducted. The topics and variables discussed in the literature review are: Biophilic design in the workplace, psychological and physical wellbeing, perceptions of the work environment, work engagement and connectedness to nature. Lastly, this chapter introduces the Research questions that the researcher aims to answer in the study.

Chapter three contains the methods of this research, this chapter also includes the research design, participants and setting, the procedure followed, instruments used, an introduction of the analysis that was conducted and ethical considerations. Moreover, this chapter discusses the types of plants that were introduced into the work environment as well as the way in which the planters were positions and the way in which the horticulturalist selected the correct quantity of planters. This chapter goes on to explain the importance of air quality within the work place while focusing on several factors including carbon dioxide, temperature, relative humidity, and volatile organic compounds.

Chapter four introduces the results of the study, first and foremost, the researcher tabulates the abbreviations of all the variables to be tested in order to make it easier for the reader to understand. At this point, the descriptive stats of the sample are discussed using tables and graphs that illustrate the details of the sample of Business Connexion employees. These

details include, age, race, gender, tenure and the amount of time the participants spend at their desks on a daily basis. This chapter goes on to introduce the results captured from the SE Controls that were positioned throughout the office area. These results are illustrated through tables . Furthermore, this chapter introduces the reliability and normality tests that were conducted prior to the main analyses. These results lead to the decision of the researcher conducting Wilcoxon Sign Rank Tests as well as Spearman Rank Order Correlations in order to assist the researcher to answer the research questions introduced in Chapter 2.

Chapter five contains the discussion that expands on the results identified in chapter four. The discussion has been divided into sections that systematically assist in answering the research questions of this study. These sub sections include: the absence and presence of plants and the air quality, the absence and presence of plants and their impact on employee wellbeing, the absence and presence of plants on psychological wellbeing , the absence and presence of plants on physical wellbeing, the absence and presence of plants on perceptions of the physical work environment, the absence and presence of plants on employee engagement and the impact of connectedness to nature. Furthermore, this chapter discusses the study's limitations, recommendations and future research as well as the theoretical and practical implications

Lastly, Chapter six rounds up the study by introducing the conclusions that were drawn once the research was completed.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The following literature review is an expansion of the concepts that are relevant to this particular study, these will usher the foundations for the theoretical framework utilized in this study. The key concepts that will be discussed include; biophilic design in the workplace: plants in organisations, psychological and physical well-being, perceptions of the work environment, work engagement, and connectedness to nature. Additionally, the researcher will expand on the organisations in which she collaborated with in order to make this research possible. These include; Business Connexion Bidvest Execuflora, which will give the research the opportunity to give more detail with regards to the plants particulars, position of plants and plant types that were selected for this study. Furthermore, the researcher will expand on the SE Controls that were installed in the workspace as well as how they measured air quality characteristics such as carbon dioxide, temperature and relative humidity. The term volatile organic compounds will be defined prior to the researcher listing all the research questions that were highlighted in the current study.

2.2 Biophilic Design in the Workplace: Plants in Organisations

The "Biophilia Hypothesis" proposes that there is an instinctive bond between human beings and other living systems (Wilson, 1984). The term biophilia literally means the love of nature, thus suggesting the integrated attraction between humans and the natural world (Wilson, 1984). Stemming from the concept of biophilia is biophilic design, which is seen as the response to the human need to have contact with nature in a built environment (Campbell & Wiesen, 2011). In today's contemporary built environment, individuals are becoming isolated from the beneficial experience of natural systems, even though it is these natural settings that individuals find appealing and aesthetically pleasing, amongst other benefits offered by nature (Campbell & Wiesen, 2011). Industrial and organisational psychology possesses on-going interest in not only individual factors that may influence a business; but also in the environmental factors that may affect a business's outcomes (Campbell & Wiesen, 2011). More specifically, industrial psychologists are interested in the interaction among the individuals and their work environment due to the fact that research

suggests that this relationship may be a crucial element of both an employee's success and the happiness in their role within the organisation (Campbell & Wiesen, 2011).

The concept known as biophilia is believed to emphasise the connection between humans and nature. People have been bringing plants into indoor settings for centuries, however there is very little that is acknowledged about the plants and their psychological benefits on the individuals within that indoor environment (Bringslimark, Hartig & Patil, 2009). The idea of integrating nature into the built environment through biophilic design is mostly considered as a luxury within the workplace rather than an economic investment into employees' heath, well-being and workplace performance (Bringslimark, Hartig & Patil, 2009). Complaints by white collar workers have been on the rise since the seventies, this is a result from the introduction of new office equipment as well as the increase of open- plan spatial concepts, advanced climate control equipment such as air conditioners, upscaling and computerisation (Bergs, 2015). According to Bergs (2015) the activities completed within the office spaces have also developed considerably, however the buildings themselves have not been adapted accordingly. Bergs (2015) suggests that there is evidence of a shift from routine work to work that demands high levels of concentration in addition to the aid of equipment that is required to be ergonomically incorporated into the workplace.

One of the largest developments within the corporate environment in the last decade is known as the green movement (The SA Mag Online, 2014). An appropriate and fascinating emerging research area known as green ergonomics explores the connection of humans with nature as well as how nature may facilitate well-being, health, effectiveness and productivity (Thatcher, 2013). Keeping in mind the concept of green ergonomics, research suggests that horticultural professionals are able to build upon this concept and create platforms that introduce nature into the workplace (Ellison, 2013). The role of nature in the workplace has been researched in a limited context in the past, however the few studies that have been conducted in the context of hospitals, prisons and residential (Moore, 1981; Ulrich. 1984; Verderber, 1986) settings, have unanimously found that indoor plants play an important role in human wellbeing (Kaplan, 1993). According to Kaplan (1993), very little research has been devoted to the role of plants in the context of the workplace even though

a large percentage of the population spends a considerable amount of time at their place of work.

A study conducted in Germany concluded that due to the instillation of indoor plants within an organisation, employee morale significantly increased (Conklin, 1974; Conklin, 1978). Additional studies have shown that the well-being of people, as well as their psychological and physiological stress levels may be influenced by their surroundings, thus illustrating the importance and the positive impact that the instillation of indoor plants had on the relief of stress (Ultrich et al., 1991; Ultrich and Parsons, 1992). Further studies suggest that the presence of indoor plants within the work environment boosted employee productivity by as much as 10% to 15% (Scrivens, 1980; Marchant, 1982). Additionally, Lohr et al. (1996) suggested that productivity increased by 12% since the introduction of interior plants in the workplace. More recently, Australian research proposed introducing the concept of "greening the great indoors" in order to promote urban greenery which would be appropriate in a place of work bearing in mind that the workplace is where most of the population spends a substantial amount of time (Burchett, Torpy & Tarran, 2013). Burchett et al (2013) report the importance of plants within the workplace as, despite what many individuals may think, it has been proven that the urban indoor air is generally more polluted than the outdoors due to the fact that outdoor air is believed to diffuse inside and the pollution load is thus amplified by the indoor sources (Brown, 1997; Cavallo et al, 1997; Environment Australia, 2003). Generally the carbon dioxide levels within a work environment are higher because of the occupants naturally exhaling (Burchett et al., 2013).

Research conducted by a well-known professor within the field and her colleagues at the Agricultural University in Norway suggests that plants within the office environment reduced approximately 12 ill feeling symptoms such as headaches, fatigue, coughs, dry skin and sore throats among others that are linked to Sick Building Syndrome, by an average of 23% (Fjeld, Veiersted, Sandvik, Riise, Levy; 1998), Additionally it was found that complaints regarding coughs and fatigue were reduced by between 30% and 37%, respectively, while the reported level of dry throats as well as dry or itchy skin decreased by approximately 23% when plants were present in the organisation (Fjeld, Veiersted, Sandvik, Riise, Levy; 1998). Thus, this study suggests that there was a significant improvement in employee health as well as a reduction in ill feeling symptoms of discomfort, which were a result from the

introduction of foliage into the organisation or more specifically the office spaces (Fjeld, Veiersted, Sandvik, Riise, Levy; 1998).

According to research conducted by Bhavan and Nagara (2008) from the Central Pollution control board in Delhi, Kamal Meattle, a business man based in India, was believed to be allergic to the highly polluted air in Delhi, which resulted in decreased lung capacity that concerned his doctors (Bhavan & Nagar, 2008). However with the help of findings presented by NASA regarding the importance of indoor plants their ability to filter and produce all the required fresh air needed, Meattle was able to improve the air quality within his organisation in Delhi by introducing three essential plants into his organisation (Bhavan & Nagar, 2008). These plants are known as the Areca Palm (Chrysalidocarpus), which is believed to conduct a great amount of air cleansing during the day; the mother-in-law's Tongue (Sansevieria trifasciata), which is responsible for converting carbon dioxide to oxygen specifically at night; finally the Money Plant (Epipremnum aureum), which is responsible for filtering out and removing formaldehyde and other volatile organic compounds (VOC's) from the air (Bhavan & Nagar, 2008). Meattle's business, Paharpur Business Centre has been his "testing grounds" for several years; he has introduced over 1200 plants into his 50 000 square foot building occupied by approximately 300 employees (Lewis, 2009). It has been reported that Paharpur Business Centre has essentially been rated as Delhi's healthiest building by the Indian Government, as studies have shown that after spending approximately 10 hours in this building one's body would work better than before (Lewis, 2009)

2.3 Psychological and Physical Well-being

Landesman (1986) suggests that one's quality of life is regarded as the sum of several life condition measures that may be experienced by an individual. He explains that these life conditions may include; personal circumstances such as wealth and living conditions, social relationships, functional activities, economic influences, and physical health (Landesman, 1986). Health is regarded as one of the most significant values in one's life, and according to Keyes (2013), is regarded as a form of human capital. Experts from the university of California explain that physical wellbeing is regarded as an individual's ability to maintain a healthy quality of life that allows us to continue with daily routine activities, minus the

physical stress and fatigue (University of California, 2016). When considering physical welling in the workspace, it is understood that an individual would be classified as “healthy” if they did not have any sort of building contracted diseases (Burge, 2004).

One of the negative health and well-being aspects within the workplace is referred to as Sick Building Syndrome (Hedge, Erikson, & Rubin, 1996; Smith & Pitt, 2011). This phenomenon came to light when organisations started with airconditioner instillations that were believed to contribute to poor ventilation, as windows were being shut in order to allow for the airconditioners to work which in turn resulted in an increase in indoor pollutants; thus it is believed that the environmenal conditions that airconditioners create lead to employees experiencing symptoms relating to illness (Smith & Pitt, 2011). These symptoms include eye, nose and throat irritation; dry skin; mental fatigue; headaches and a cough (Hedge, 1996). Research also suggestes that these symtoms disappear soon after the individuals leave the building environment (Rooley, 1997). Sick building syndrom is significant when trying to assure wellbeing in an organisation, this also affects employee satisfaction which in turn may affect their decision making skills as well as their productivity in addition to increasing absenteeism (Heath, 2015).

Psychological Wellbeing has been the centre of several research domains for over 20 years (Ryff & Keyes, 1995). The study of psychological wellbeing has been guided by two primary outsets of positive functioning. The first outset dates back to Bradburn (1969) who distinguished between positive and negative affect, and furthermore defined happiness as a balance between them. The second primary outset of psychological wellbeing emphasises life satisfaction as a key indicator of psychological wellbeing (Ryff & Keyes, 1995). Researchers believed that life satisfaction was thought to compliment happiness and positive functioning (Andrews & McKennell, 1980; Andrews & Whitney, 1976; Bryant &Veroff, 1982). In the 1940’s, the World Health Organisation defined health as “a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity (WHO, 1947, p.1). Furthermore, in 2001, the World Health Organisation refined the definition of mental health by proclaiming that mental health is “a state of well-being in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community” (WHO, 2001, p.1). According to Ryff and Keyes (1995), the existence of multiple

frameworks that served as a theoretical foundation towards psychological well-being allowed for them to generate a multidimensional model of wellbeing. This model assessed the scales of wellbeing with the measure of six elements that influence positive functioning (Ryff & Keyes, 1995).

Table 1: Definitions of Theory Guided Dimentions of Wellbeing, According to Ryff and Keyes (1995).

SIX ELEMENTS OF WELLBEING ACCORDING TO RYFF AND KEYES	
Self-Acceptance	Reflects a positive attitude towards self and past life.
Positive Relations	Possesses quality relationships with other individuals.
Autonomy	A sense of self-determination and independence.
Environmental Mastery	The ability to manage life's demands
Purpose in Life	A sense or belief of meaning in life, with goals and direction.
Personal Growth	Openness to new experience, growth and development.

The concept of employee wellbeing has been a dominant concern within organisations, however research regarding the benefits of indoor plants on individual wellbeing is moderately new, there is confirmation of increasing evidence that biophilic designs are believed to impact the workplace positively in terms of reducing stress and anxiety, improving the quality of work, increasing levels of self-reported wellbeing, increasing work engagement and increasing presenteeism, motivation, and creativity (Heath, 2015) Research has suggested that there are several factors that could possibly impact an employees' well-being in the workplace (Bergs, 2015). These have been tabulated below:

Table 2: Factors influencing employee well-being and several health complaints (Bergs, 2015)

FACTORS IMPACTING EMPLOYEES WELL-BEING IN THE WORKPLACE	
Ambient Factors	**Health Complaints**
Temperature Fluctuations	Dry / Irritated Eyes
Dusty Air	Itchy Throat
Odour in the Air	Itchy / Dry Skin
Increased Humidity	Rash
Ventilation	Runny / Stufffy Nose
Sun Reflection	Fatigue
Noise	Headache

Studies conducted in the Netherlands suggested that 35% of office workers were dissatisfied with their work climate and approximately 20% of those employees complained of health complaints (Preller, Zweers, Brunekreef, & Boleij, 1990). There were several health concerns that arose in these studies; a study conducted in government agency buildings suggested that 28.1% of the employees complained of dry and irritated eyes; 24.1% of building occupants complained of irritated nose and throat (Preller et al., 1990). Furthermore, the government building agency employees' complained about several factors of the work environment that they believed were hindering their well-being. 43.3% of the employees complained of dry air, while 21.7% of the building occupants complained of temperature fluctuations (Preller et al., 1990). Additionally, 27,9% of the employees complained of the stuffy and poor air quality, and 23.2% of the employees complained of the noise levels (Preller et al., 1990). According to Wilson et al.,(2004), the results of this Dutch study link closely with results of comarable foreign studies. Conclusions from studies of this kind generally conclude that the buildings or the workplace in which these employees are expected to work are regarded as unhealthy or uncomfortable (Bergs, 2015). According to Woods and colleagues (1987), he estimates that 20% to 30% of Western European and North American buildings and office spaces are considered as "problems" as it is recorded that more than 30% of the occupants express health complaints.

Well known researcher in the field, Tove Fjeld (2000) conducted a study that simultaneously measured the impacts of plants on well-being in three different environments; the first being among office workers, the second being among hospital employees, more specifically within the radiology department, and the third beng among school children in a school environemnt (Fjeld, 2000). Just as was done in this study, Fjeld took measures from ther participants in two conditions, the first being no plants condition and the second being the plants installed condition. Fjeld (2000) was able to conclude that across all the environments that were assessed for her study, that there was an overall increase in well-being when plants were present within the areas. According to the offie workers, radiology department employees and school children, their health and discompfort symptoms decreased by 21% 25% and 21% respectively (Fjeld, 2000). More specifically, Fjeld (2000) reported that on average neuropsychological symtoms decresed by 22% for office workers, 27.5% for radiology employees and 15% for school children. While Mucus

membrane symptoms decreased by 26.25% for office workers, 23% for radiology employees and 20% for the school children (Fjeld, 2000). Additionally, skin symptoms decreased by 12% for office workers, 17% for radiology employees and 15% for school children (Fjeld, 2000). The researcher compliled the tables below that provides further information regarding the impact that plants had in Fjeld's study.

Table 3: Percentage reduction of Neuropsychological Symptoms from participants in all three environments.

REDUCTION OF NEUROPSYCHOLOGICAL SYMPTOMS ACROSS TOVE FJELD'S 2010 STUDY			
Symptom	**Office Environment**	**Radiolody Department**	**School Environemnt**
Fatigue	18%	32%	9%
Feeling Heavy-Headed	18%	33%	15%
Headaches	18%	45%	37%
Dizziness/Nausea	18%	25%	-
Concentration Problems	16%	2.5%	16%

Table 4: Percentage reduction of Mucus Membrane Symptoms from participants in all three environments.

REDUCTION OF MUCUS MEMBRANE SYMPTOMS ACROSS TOVE FJELD'S 2010 STUDY			
Symptom	**Office Environment**	**Radiolody Department**	**School Environemnt**
Itching/ Irritated Eyes	16%	15%	30%
Runny/Stuffy Nose	28%	11%	-
Dry or Hoarse Throat	24%	31%	36%
Cough	37%	38%	17%

Table 5: Percentage reduction of Skin Symptoms from participants in all three environments.

REDUCTION OF SKIN SYMPTOMS ACROSS TOVE FJELD'S 2010 STUDY			
Symptom	**Office Environment**	**Radiolody Department**	**School Environemnt**
Dry of Flushed Facial Skin	23%	11%	25%
Scaling or Itching Scalp or Ears	9%	19%	-
Hands with Dry, Itching or Red Skin	4%	21%	21%

In general it seems that plants might produce two health and wellbeing outcomes, the first being, a direct impact by changing the air quality and improving health and the second being, an indirect impact through psychological restoration. Research conducted in Europe indicated that the simple presence of naturual elements such as plants in the work environment are believed to buffer against the negative impacts of on the job stress as well as positively impacting employees' general well-being (Velarde, Fry & Tveit, 2007). Velarde et al. (2007) concluded that office workers who worked in environments with natural elements such as greenery reported a 13% higher level of well-being than individuals who worked in a "concrete forest". These findings show that specific design elements such as plants that are often overlooked by organisations are closely linked to workplace well-being which ultimately may result in increased productivity from the employees, a positive impact for the organisation (Kjellgren, Buhrkall, 2010).

According to Evensen, Raanaas, Hagerhall, Johansson and Patil (2015), it has been suggested that computer work can be mentally fatiguing and stressful, leaving employees with a constant need for psychological restoration. The sample of the current study is specifically call centre employees that are based at their work stations all day working infront of their computers dealing with customer IT queries, therfore suggesting stressed and fatigued employees taking part in this study. Hartig, van den Berg, Tomalek, Bauer, Hansman and Waaseth (2011) suggest that contact with nature has been shown to have a psychologically restorative effect on building occupants, therefore emphasising the importance of installing the plants in the call centre environment.

Hartig et al. (2011) explain that restoration can be understood as the process in which depleted psychological resources are renewed, many times with the help of the natural environment, thanks to its inherent restorative qualities. Stress Recovery Theory (SRT) suggests that people respond positively to environmental features such as plants and water features (Ulrich, 1983; Ulrich et al., 1991). According to this theory, once people view the natural environment, it initiates the restorative process by reducing arousal levels and counter negative affects (Ulrich, 1983; Ulrich et al., 1991). Alternatively, the Attention Restoration Theory (ART) utilises a cognitive approach to describe the benefits of nature to humans. According to Kaplan and Kaplan (1989, 1995), directing attention to a work task depends on inhibition, which is the ability to keep out other competing stimuli. This process

is regarded as a highly resouce-demanding task, resulting in mental fatigue that may arise following intensive periods of directing attention to a task (Evensen et al., 2015). Elements of nature such as indoor planters offer facinating visual features that catch our attention. These "soft" fascinations do not rely on inhibition and are believed to give one's directed attention capacity a chance to recover. In addition to providing easily processed stimuli, these elements of nature are believed to offer a psychological distance from work tasks and can meet a potential need for restoration if individuals are mentally fatigued (Kaplan & Kaplan, 1989; 1995). Several studies that have emperically assessed the restorative impacts of implants include those by Harting et al., (2003) and van den Berg et al., (2007).

2.4 Perceptions of the Work Environment

Research has suggested a rapid change in the developments of offices spaces, these fast changing environments require organisational support, rapid technological development and implementation, as well as the need of the employees to balance their independent work, collaborations and additional work process (Lee & Brand, 2005). Studies have suggested that open plan offices have been shown to improve employees' perceptions of their physical work environment. However, along with these improvements, there have been several documented issues surrounding open space offices (Lee & Brand, 2005). Several of these documented issues surround ambient features within the office space, these include, noise, lighting, temperature and the existence of plants (Crouch & Nimran, 1989; Larsen et al., 1998; Veitch & Grifforg, 1996).

According to the World Green Building Council (2015), the physical work environment is made up of several factors that are believed to influence the way in which employees perceive their work environment. These factors are tabulated below:

Table 6: Factors Influencing Perception of the Work environment

Factors Influencing Perception of the Work Environment	
Indoor Air Quality and Ventilation	• VOC Pollutants • Carbon Dioxide • Aroma • Ventilation Rate or Fresh Air • Moisture Content

Thermal Comfort	• Indoor air temperature • Relative humidity
Lighting and Daylight	• Daylight • Lighting Quality • Glare
Noise and Acoustics	• Privacy and interference • Vibrations
Biophilia and Views	• Connectedness to Nature • Views of the outdoors • Indoor Plants

Furthermore, researchers suggest that the elements of the physical environment that have been mentioned in table 6 are believed to influence employee attitudes, behaviours, satisfaction and performance (Crouch & Nimran, 1989; Larsen et al., 1998; Veitch & Grifforg, 1996). An experiment carried out by Larsen et al. (1998) revealed that upon the installation of indoor planters, employees' productivity and attitude toward their work environment increased. Additionally, this research suggested that the overall mood within the office as well as task completion revealed positive results with the presence of the planters within the office environment (Larsen et al., 1998). Larsen et al (1998) go on to explain that self-reported perceptions of the performance as well as the perceptions of the work environment increased relative to the number of plants that were installed within the office area. This is supported by additional research suggesting that participants reported higher levels of mood, perceived office attractiveness and increased comfort when plants were present (Han, 2009).

2.5 Work Engagement

Pech and Slade (2006) have suggested that employee disengagement is increasing and thus it is imperative to begin improving the workplace in order to positively influence employee well-being and work engagement. Engaged employees are described as having an energetic as well as effective connection with their work; they are believed to view their work as challenging rather than stressful (Bakker, Schaufeli, Leiter and Taris, 2008). Pech and Slade (2006) maintain that often the symptoms of disengagement such as lack of interest and high absenteeism are highlighted rather than attempting to improve employee engagement. There is no universal definition or conceptualization of engagement in literature. According

to Harter, Schmidt and Hayes (2002), engagement is characterised by an employee's passion towards their work in addition to a sense of relatedness or belonging to the organisation. These emotional and cognitive elements are said to positively influence employee behaviour towards opportunities for organisational advancements (Harter, Schmidt &Hayes, 2002). Specialists within this field often describe engagement as the notion of organisational commitment as well as role behaviour (Bakker et al., 2008). Additionally, according to Schaufeli and Bakker (2004), engagement is frequently associated with experiences of satisfaction, motivation, commitment and advocacy towards one's work and the organisation.

Maslach and Leiter (2008) explain that work engagement is the opposite of burnout and is thus located on the opposite end of the spectrum. Opposing the concept of burnout, work engagement refers to a positive and practical concept associated with work (Shahpouri, Namdari, & Abedi, 2015). Work engagement is believed to include three dimensions that are referred to as vigor, absorption and self-dedication (Shahpouri et al., 2015). Vigor is understood as ones energy levels their ability of resilience of mind while working (Shahpouri et al., 2015). Furthermore, dedication is explained as one's intense engagement in their work, sense of significance, enthusiasm and challenge (Shahpouri et al., 2015). Lastly, absorption is explained as one's concentration and satisfaction surrounding their job (Bakker, Schaufeli, Leiter and Taris, 2008). Work engagement in organizations' is regarded as vital due to the fact that enthusiastic employees would most likely experience an increase in positive emotions which would result in increased well-being, happiness, enjoyment and ecstasy. It is believed that employees are able to transfer these emotions and ultimately their work engagement to their colleagues Bakker, Schaufeli, Leiter and Taris, 2008).

Furthermore, a study in Norway concluded that office areas that included the natural elements of plants were believed to result in fatigue prevention as well as higher concentration and attention (Raanaas, Horgen-Evensen, Rich, Sjostrom & Patil, 2011). Reis, Arndt, Lischetzke, and Hoppe (2015) add that individual differences in work engagement outcomes have been shown to be related to outcomes such as organisational commitment to improve wellbeing as a factor towards employee engagement. Therefore it would be interesting to investigate in the curent study how employee engagement may be impacted

by the instillation of the plants aimed to increase employee wellbing, within a South African context.

2.6 Connectedness to Nature

Notorious ecologist Leopold (1949) introduced the idea that humans had an important relationship with the land they inhibited. Adding to this theory, Wilson (1984) proposed that humans have an intrinsic need to feel connected to their natural environment and in turn may benefit from the exposure to nature. Building on these theoretical frameworks highlighting the connection with nature, Mayer and Frantz (2004) developed the one dimensional scale known as the connectedness to nature scale, which is believed to measure an individual's level of connectedness to the natural environment. Mayer and Frantz (2004) found that individuals who experienced a greater connection with nature were most likely to feel satisfied with their lives.

A considerable amount of literature has been published in social and behavioural sciences over the last three decades examining the human-nature relationship (Degenhardt, 2002; Schultz, 2001; Mayer and Frantz, 2004; Orr, 2004; Nisbet et al., 2009). The study of connectedness to nature (CNS) is mostly concerned with understanding the way in which people identify themselves within the natural environment as well as the importance of the relationships they may form with nature (Restall & Conrad, 2015). It is evident in the literature that CNS is also commonly referred to as nature connectedness (Schultz, 2002), nature relatedness (Nisbet et al, 2009), love and care for nature (Perkins, 2010), dispositional empathy with nature (Tam, 2013) or emotional affinity towards nature, among others (Kals et al., 1999).

Connectedness to nature theory suggests that a relationship with the natural world is understood to directly affect an individual's physical, mental and overall wellbeing due to the fact that there are certain benefits involved with being exposed to nature as well as related positive experiences involved with the natural world (Tauber, 2012). According to Louv (2008), an individual's direct experiences with a natural setting is believed to have insightful emotional effects on individuals, especially within the work environment. Understanding the way in which individuals' relationships with nature form as well as how they influence personal values and attitudes could provide insight into how the natural

environment may impact their behaviours (Restall & Conrad, 2015). Furthermore, Schultz (2002) suggests that an individual's "values" towards nature may underpin their psychological and physiological responses to their setting. Kamitsis and Francis (2013) add that exposure to nature is indeed associated with psychological wellbeing; while Daniel et al. (2007) conclude that an individual's values of natural areas such as plants within an indoor environment may impact their feelings of community as well as their connectedness to their environment and the work they are involved in.

The following study included the measure of an individual's connectedness to nature as a covariate measure in order to assess how the relationship between the absence and presence of plants may impact the various dependent variables that were being measured throughout the study. The thinking behind including connectedness to nature scale in this study is supported by Atchley, Strayer and Atchley (2012) who suggest that the natural environment plays an important role in the way in which individuals think, feel and behave.

2.7 Air Quality

The World Green Building Council (2015) emphasises that air is a basic human need, however the quallity of the air is vital. Instinctively we may say that the sea breeze air or the country air is cleaner and fresher than the air quality within our cities and ultimately in the work environment. This varied air quality is believed to have a significant impact on health, well-being and productivity (World Green Building Council, 2015). Therefore the quality of air within homes, offices, schools, public buildings, and health care facilities are among the areas in which people spend a large part of their life, thus is an essential determinant of their well-being (World Health Organisation, 2008).

The World Green Building Council (2015) highlights the well-being and productivity of good indoor air quality within the work environment. It is understood that two of the many key characteristics of good workspace air quality include low concentrations of Carbon Dioxide and pollutants as well as good ventilation and temperature rates (World Green Building Council, 2015). Behzadi and Fadeyi (2012) posit that indoor air is not considered to be cleaner than out door air, furthermore, they expand by explaining that indoor air may even be more polluted than the outdoor air, however occupants are generally not concerned

with this detail due to the fact that the indoor air pollutants are less “visible” and many times may not even have a scent. Research has concluded that in addition to well-being implications, exposure to poor quality air and air pollutants within the workplace do have impacts on the employee’s performance, engagement and productivity (Wargocki et al., 2007; Wyon, 2004).

Recent studies conducted in the school environment shows that the main sources of the student’s health issues are rooted from the poor air quality not only in the classrooms, but also in their homes (Dietz et al., 2000; Jaakkola et al., 1999; Husman et al., 2002; Silverstein et al., 2001). There is evidence of poor indoor air quality resulting in occurrences of asthma, contagious respiratory and allergic illnesses in children, resulting in increased absenteeism and decreased performance (Dietz et al., 2000; Jaakkola et al., 1999; Husman et al., 2002; Silverstein et al., 2001). Iddon and Hudleston (2012) go on to explain that poor air quality is made up of various contaminants that are believed to be damaging to our health, this highlight the importance of improving air quality in schools and organisations. The World Green Building Council (2015) identifies that although the best option, it may not always be the easiest to dilute indoor air pollutants at the source, therefore suggesting that organisations come up with solutions or strategies to minimise the air pollutants that are regarded as harmful to building occupants. The current study suggests the instillation of indoor planters within the work environment in order to assist in minimising harmful indoor air pollutants as well as to purify the indoor air quality for the building occupants, aside from being aesthetically pleasing in the open plan monotonous office area.

The National Aeronautics Space Administration (NASA) researched, in the early 1980’s, the ability of plants to improve indoor air quality (Wolverton, Johnson and Bounds, 1989). Dr Wolverton et al (1989) from NASA suggested that since the beginning of time human’s existence on earth has been reliant on the earth’s natural life support system. This human and plant interaction is essential, thus it is obvious that when humans attempt to isolate their building environments away from this ecological system, problems will arise (Wolverton, Johnson and Bounds, 1989). However the solution to this problem is simple, if humans are going to move into closed office environments, then it is obvious to take along nature’s life support system too (Wolverton, Johnson and Bounds, 1989).

2.7.1 Carbon Dioxide

Carbon Dioxide (CO_2) is a colourless, odorless, non-flammable gas that is a product of cellular respiration that is present in the atmosphere at 0.035% (Nelson, 2000). When discussing worker safety and CO_2, the Occupational Safety and Health Administration have set out permissible exposure limits for individuals that are at risk of coming in contact with large amounts of CO_2, however this is not relevant for the office environment concerned within this study due to the fact that there are no everyday activities that would result in dangerous exposures of CO_2. Nonetheless, the researcher has chosen to clarify these exposure limits for the reader's interest. According to the Occupational Safety and Health Administration, the accepted limit of CO_2 exposure for individuals is 5000 parts per million (ppm) over an 8 hour working day, which is equivalent to 0.5% by volume of air (Bezadi & Fadeyi, 2012).

The Green Plants for Green Buildings Association (2016) suggest that employee concentration and productivity are impacted negatively when elevated levels of CO_2 are present in the work environment. Generally large organization's are made up of a large amount of people that occupy a well-sealed building, which is believed to result in drowsy employees (Green Plants for Green Buildings Association, 2016). However if there are plants present within the organisation, it is suggested that CO_2 levels are decreased therefore creating a healthier workplace for the employees (Burchett, Torpy, Tarran). During photosynthesis plants are understood to naturally extract CO_2 and exchange it with fresh oxygen (Green Plants for Green Buildings Association, 2016). It is understood that when plants release water vapor from their leaves, they pull air down into their roots and convert other substances in the air into a source of food and energy (Green Plants for Green Buildings Association, 2016).

2.7.2 Temperature

Temperatures within an office environment may always be considered to be too high or too low depending on a person's perception of thermal comfort and personal preference. According to the South African Labour Guide (2013), most organisations aim to maintain a comfortable thermal office environment in summer or winter with air conditioning systems, that are understood to be the "lungs" of the building as the system draws in outside air,

filters it, heats or cools it, humidifies it and circulates it around the building. Common complaints regarding thermal temperatures within the work environment are about individual comfort, more specifically, some employees may be too hot, while others may be too cold (South African Labour Guide, 2013). This issue is common in almost every organisation with installed and functioning air-conditioning units.

The way in which building occupants experience the indoor temperatures depends on several factors such as clothing, body type and individual preferences among others; therefore it has been advised to set a comfortable or reasonable temperature level that would be acceptable within the office environment (South African Labour Guide, 2013). South African Hygienists have recommended that generally temperatures should range between 21°C and 26°C. More specifically, they recommend that indoor office environment temperatures in summer should range between 21°C and 24°C and in winter they should range between 24°C and 26°C (South African Labour Guide, 2013). Furthermore, it is important to understand that the higher temperature guidelines for winter conditions are not always accepted by employees within the organisation due to the fact that they believe it is too warm and occupants are more likely to get sick within those environments due to the fact that bacteria thrive in warm environments despite the myth that colder environments cause illness (Fernandez-Canero, Urrestatazu, Salas, 2012). Subsequently, Spanish regulations in office buildings, indoor air quality is only believed to be good in an indoor environment once temperatures and humidity levels are maintained within the range of 20°C - 24°C and 30% - 60% respectively (Fernandez-Canero, Urrestatazu, Salas, 2012).

An analysis of 24 studies that focused on the relationship between temperatures and performance indicated that there was a 10% reduction in performance at two temperature levels, 15°C considered to be too low and 30°C considered to be too high (Wargorcki, Seppänen, Andersson, Boerstra, ClementsCroome, Fitzner K and Hanssen, 2006). This result leaves little double as to the impact that thermal comfort may have on employees. A more recent study conducted by Lan, Wargocki, Wyon and Lian (2011) indicated a reduction in performance of 4% at cooler temperatures as well as a reduction of 6% at warmer temperatures, thus highlighting the importance of maintaining a medium thermal comfort level within the work environment. Therefore the relationship between thermal comfort

and indoor air quality is clear as there is significant impact on employee and workplace satisfaction (World Green Building Council, 2015).

The current study's aim is to install indoor plants into the work environment and assess whether the presence of these plants impact or stabalised the temperatures experienced within the office area. There have been several studies that have been conducted that have reported that the presence of indoor plants have reduced and stabalised temperature levels to appropriate readings for the environment (Wolverton Environmental Services, 1991; Wolverton & Wolverton. 1993; WHO, 2000).

2.7.3 Relative Humidity

An office environments' relative humidity is dependent on external conditions. Alamusaed (2011) posits that when the external environment is experiencing low relative humidity, the inside relative humidity is most likely to assume low humidity levels. Water vapour or otherwise known as relative humidity is generally not considered to be an indoor contaminant of serious indoor health problems (Arundel, Sterling, Biggin & Sterling, 1986). Arundel et al. (1986) go on to explain that a certain level of humidity is necessary within the indoor environment for some level of comfort.

It is understood that either very high or very low humidity levels are likely to cause physical discomfort (Bergs, 2015). Humidity levels that are considered to be too low (below 20%) are believed to result in eye irritation, while humidity levels that are considered to be high are believed to reduce the severity of asthma (Brown, 1997; Bringslimark, et al., 2009; Butchett, 2015). There have also been reports of individuals complaining of dryness of the nose and throat during relatively low humidity's (Arundel et al., 1986). Researchers suggest that indoor relative humidity levels should be kept above 30% in order to prevent drying eyes, throats, and nasal mucus (Carrer, Alcini & Cavallo, 1999; Cavallo, Alcini & Carrer, 1997; Costa & James, 1999). According to Kjaergaard and Wolkoff (2007), relative humidity is a parameter that is believed to majorly impact indoor air quality and ultimately employee wellbeing. Therefore it is essential to stabilise indoor humidity levels in order to create appropriate indoor air quality that would ultimately impact organisations productivity. The current study installed plants into the work environment in order to assess several variables

against the absence and the presence of the plants. One of the areas that was recorded and considered and was relative humidity. Several international studies have reported that the presence of indoor plants has reduced and stabalised humidity levels to appropriate readings for the environment (Wolverton Environmental Services, 1991; Wolverton & Wolverton. 1993; WHO, 2000).

2.7.4 Volatile Organic Compounds

Volatile Organic Compounds (VOS's) are believed to be released from solid materials (Behzadi & Fadeyi, 2012). VOS's are understood to be present both in outdoor and indoor environments, however research suggests that the level of indoor VOS's may exceed those in an outdoor environment due to the fact that there is a restricted indoor capacity as well as insufficient ventilation and air-conditioning (Behzadi & Fadeyi, 2012). Several indoor building contaminants that emit VOS's are cleaning products, wall paints, air fresheners, perfumes and even printer ink. Generally VOS's are recognised by their distinct odour (Levine & Hodgson, 1996). Although temporary exposure to low concentrations of VOC's may not be dangerous, continuous and enduring exposure like in closed environment such as the workplace may result in several mutagenic problems and in extreme cases cancer (Son, Breysse, & Yang, 2003).

It is understood that it is not possible to eliminate VOC's altogether, however, research has suggested that there are certain plants (e.g. Epipremnum aureum) that are available to be installed in the workplace, or any other indoor areas for that matter that assist in reducing the areas VOC's (Lewis, 2009). Research suggests that VOC's are a common cause of "Sick Building Syndrome" (Carrer et al., 1999), which will be assessed in this study.

Unfortunately, the researcher was unable to measure the levels of VOC's within the office environment at the time this research was carried out due to the lack of appropriate measuring systems. However between the period of the completed data collection to the period of completing of this research report, appropriate measuring systems have been sourced, thus giving the opportunity to future researchers to either replicate and expand on this research or to further research the sphere of the significances VOC's and the way in which the presence of plants may impact the levels of VOC's within the office environment.

2.8 Graphical Model of Current Study

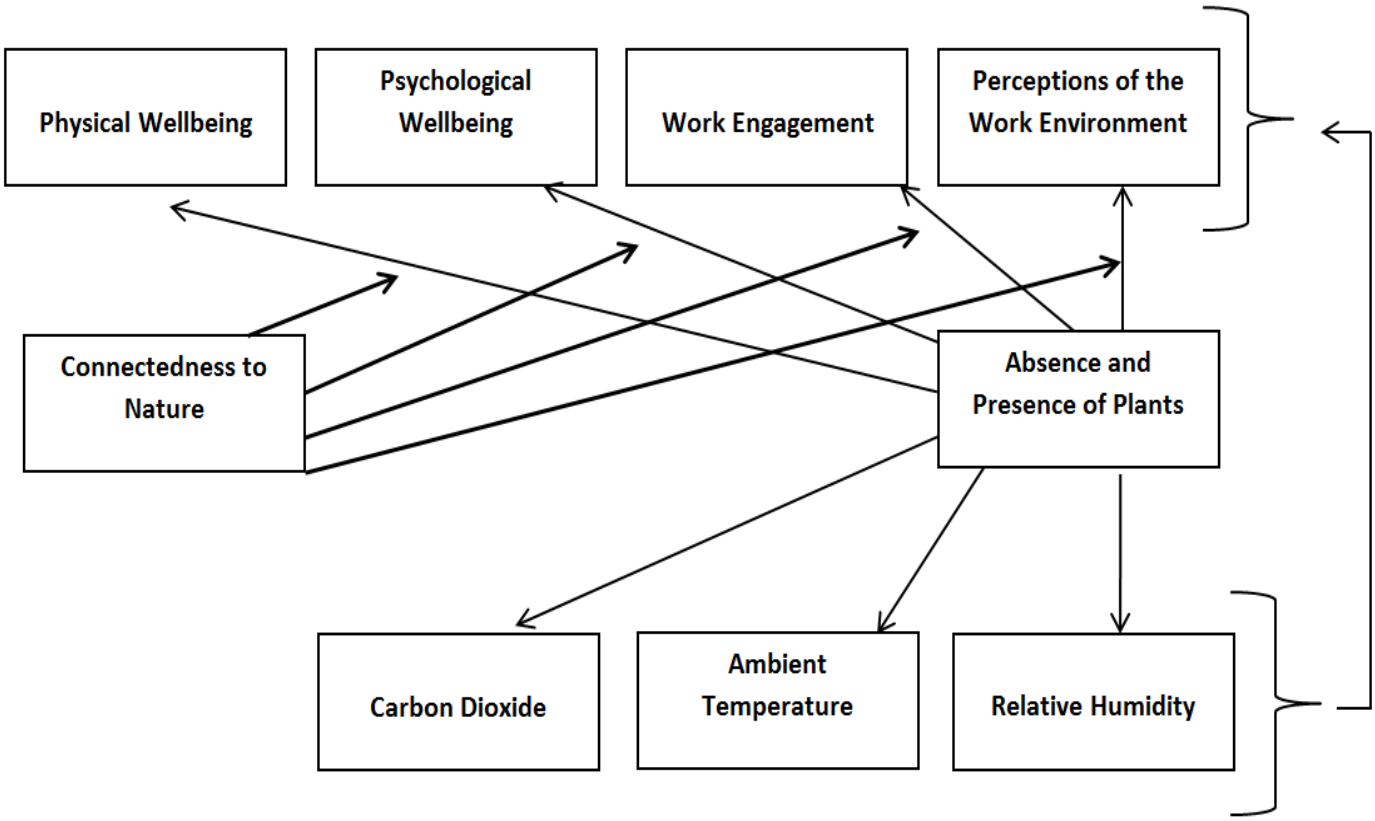

Figure 1: Graphical Model of what the current study is investigating

2.9 Research Questions

I. How does the absence/presence of indoor plants impact the psychological wellbeing of the participants?

II. How does the absence/presence of indoor plants impact the physical wellbeing of the participants?

III. How does the absence/presence of indoor plants impact perceptions of the physical work environment?

IV. How does the absence/presence of indoor plants impact work engagement?

V. Does the participants' level of concern for the environment moderate these relationships?

VI. How does the absence/presence of indoor plants impact the workspace ambient temperature, relative humidity, and carbon dioxide?

CHAPTER THREE: METHOD

3.1 Introduction

The following chapter introduces the method undertaken in order to investigate the relationship between the variables that were addressed in the study. First and foremost, this chapter will outline the issues regarding the research design, followed by the sample and research procedure. The measuring instruments will be discusses as well as the various analyses that were used in order to answer the research questions posed. Lastly, ethical considerations will be presented.

3.2 Research Design

This study is classified as quantitative as it will be subjected to various forms of statistical analyses (Stangor, 2011). A quantitative approached such as this is concerned with drawing statistical conclusions about the relationship among variables in an objective and quantifiable manner. This study is also considered to be a quasi-experimental study due to the fact that there is evidence of independent variable manipulation and a control (contrast) group; furthermore, there is no evidence of random assignment (Creswell, 2009), as the office space will just be divided into two sections (intervention group and contrast group). Additionally this research is regarded as a repeated measures, longitudinal, within-subjects study; as the same participants will be assessed three times over the 10 to 12 week designated period. This study aimed to examine the relationships that existed between the variables under investigation

3.3 Participants and Setting

The participants that were selected for this study were the employees of a large technology company, more specifically, participants were from the Global Service Management Centre (GSMC) within the organisation (a call centre environment). The GSMC is a 24x7 management service with automated processes that provides first, second and third line support services across all IT services that include the management of third parties (Business Connexion, 2015). This department is made up of two departments; the service desk facility that is accountable for responding to logged telephonic or email incidents; and the command centre which monitors the infrastructure of its clients' environment according to the information technology information library (ITIL) and is responsible for managing and

restoring any service interruptions that may occur, by suggesting the correct support groups (Business Connexion, 2015). There are 120 employees within this specific department, therefore the researcher aims to fully assess (three assessments) as many volunteers from this group as possible. The sample for this study is considered to be a non-probability convenience sample due to the fact that this department has been selected by the organisation to be tested.

Even though the sample size was 120 employees, the researcher was unable to control the amount of surveys or assessments that would be completed and returned due to the fact that participation was voluntary. Below is a summary table that highlights the amount of assessments distributed by the researcher to the employees versus the number of assessments or surveys that were collected by the researcher. However after carefully assessing the data, it was discovered that only 32 matched assessments were viable to be used for the study, due to the fact that the researcher had to assure that the participants had completed a survey before the plants were placed in the workplace as well as while the plants were present in the workplace.

Table 7: Summary Table Highlighting vs distributed assessments collected assessments.

SURVEY SUMMARY							
	Surveys Distributed by Researcher	**Surveys Returned to Researcher**	**Incomplete Surveys**	**Total Surveys Considered for Analysis**	**N Area 1**	**N Area 2**	**Response Rate**
1st Survey	*120*	*76*	*2*	*74*	*36*	*40*	*63.3%*
2nd Survey	*120*	*76*	*1*	*75*	*39*	*37*	*63.3%*
3rd Survey	*120*	*82*	*6*	*76*	*50*	*32*	*68.3%*

3.4 Procedure

Initially it was required for this study to be approved by the University of the Witwatersrand's Human Research Ethics Committee (HREC Non-Medical) (Appendix E). Once ethics clearance was obtained it was the researcher's responsibility to approach Business Connexion (BCX) in order to formally obtain permission to enter the organisation

(Appendix F). Furthermore a preliminary project plan was presented to the representatives at BCX in order to discuss and agree on the time frame of the study. Additionally, formal non-disclosure documents were presented, approved and signed by the organisation as well as the researcher and respective research supervisor (Appendix G).

First and foremost the researcher in collaboration with horticulturalists at Bidvest Execuflora divided the selected office area at the BCX call entre into two naturally visible sections; these were referred to as area 1 or intervention group and area 2 or contrast group (Appendix A). These office areas were treated as two separate areas for the purpose of this study. In the first week of the study, which took place in the week of the 4th of May 2015, Bidvest Execuflora removed all the existing planters from both of the allocated office areas in order to prepare the environment for the study. During this week, representatives' from SE Controls installed four SE control systems in both of the areas; there were two allocated in each of the concerned areas. These SE Controls were appropriately labelled in order to assure they were correctly identified during the analysis procedure. The SE control units were branded as follows:

Table 8: SE Controls situated in the area of study

SE CONTROLS UNITS INSTALLED IN THE BCX WORKSPACE		
Unit	**Label**	**Position**
1	Far End	Area 2
2	Water Cooler	Area 2
3	Open Plan Area	Area 1
4	Corner Clocks	Area 1

The Researcher allowed for a three week time frame between removing the planters and the first assessment. On the 22nd of May 2015, between 10:00 am and 16:00 pm, the first survey was handed out, by the researcher to all the employees within the intervention as well as the contrast groups (i.e. the assessment is made up of all the measures mentioned in section 3.5 of this chapter – Appendix H to Appendix M) additionally; the researcher attached the participant information sheet to this assessment (Appendix N). This document briefly explained the scope of the study; however a level of deception was expected in order

to avoid biased responses. Furthermore, this document notified the participants that participation was voluntary and their right to withdraw their information while completing the assessments or at any given point in time, provided they had provided the researcher their employee number, without any repercussions.

During the week of the 25th of May Bidvest Execuflora installed the trial indoor planters into the intervention office area; the plants that were installed were carefully considered and finalised by the Execuflora team. The contrast office area did not receive any trail planters into their workspace at this point. Once again after a 3-week period of time, the researcher returned on the 8th of June 2015, between 10:00 am and 16:00 pm to conduct the second assessment to both office areas in order to see how the absence and presence of plants within the workspaces impacted the employees. Once the researcher collected all the relevant assessments, the Execuflora team returned during the week of the 15th of June 2015 in order to install the remainder of the trial planters into the contrast groups' workspace; no changes were made to the intervention group planters.

On the 8th of July between 10:00 am and 16:00 pm, researcher returned to BCX in order to carry out the final assessment on all the participants (intervention group and contrast group). This assessment measured the impact of the presence of the indoor plants on all the participants. Once the research collected all the final assessments, participants were informed of the true scope of the study. Shortly after this assessment Execuflora removed all the trial planters from Business Connexions' Global Service Management Centre.

It is important for the researcher to highlight that there were 120 employees that were placed in the area in which the study took place, however not all of the employees were willing to participant in the study and complete the surveys that were distributed to them throughout the 12 weeks of the data collection process as illustrated in table 7 above.

As reported above, there were three assessments carried out for each area within the BCX office space in which the study took place. Area one received plants first and area two only received them three weeks later; However assessments were given to all the participants at all three times of the study in order for the researcher to assess the participants' change over time in the two conditions. Upon capturing the data, the researcher came across

several concerns that lead to a decision change in the assessment of the data collected. One of the problems that arose was the fact that participants were not positioned at the same desk and consequently in the same areas of the workspace throughout the study; even though this was discussed with the manager prior to the study, who assured that all employees would be positioned in the same work stations throughout the study. However, specifically the descriptive statistics showed discrepancies. This unforeseen problem resulted in the researcher to only utilise two measures of each participant throughout the whole workspace, the first measure being the assessment completed when their office are contained no plants and the second being when the office areas had plants. This pre-test and post-test allowed the researcher to measure how the presence of the plants impacted the employees

After the SE Controls were removed from the workspace at BCX, the air quality data that was captured was exported onto Excel and was "cleaned" in order to become appropriate data for the study. First and foremost, the researcher was task to sift through the SE Control data and assure that the same amount of data was captured by each unit in order to guarantee that there would be a fair comparison among the data captured. Additionally, it is important to mention that the SE controls automatically captured the air quality recordings for the room temperature, humidity and carbon dioxide levels every 15 minutes, however the researcher chose to only look at the hourly measures. After careful consideration, the researcher decided to not remove the weekend or the evenings data recording from this data set due to the fact that there is a 24 hour call centre assist department within the selected office space, thus there are always employees occupying the area.

Once all the assessments were completed, data was extracted and sorted into an excel spread sheet in order to proceed with SPSS data analysis. The researcher was expected to present the results of the study to the organisation before the end of August 2015.

3.5 Instrumentation

The study made use of several existing and well known scales in order to assist in collecting the appropriate data. Primarily, a demographic questionnaire was issued in order to capture biographical information of the sample. The Warwick-Edinburgh Mental Well-being Scale

(Tennant et al., 2007), Sick Building Syndrome Questions (Hedge et al., 1996), Perceptions of Physical Work Conditions (Hedge et al., 1996), Ultrecht Work Engagement Scale (Schaufeli et al., 2006) and Connectedness to Nature Scale (Mayer & Frantz, 2004) were selected by the researcher to assist in gathering the appropriate data.

i. Demographic Questionnaire (Appendix H)

A self-developed questionnaire was given to the participants in order to capture the demographic characteristics that made up the sample. This questionnaire will be made up of close-ended as well as open-ended questions that will request information such as gender, age, organisational level, and tenure and average time spent in the office area. Employee numbers were requested in order to assist the researcher to match the three assessments.

ii. *The Warwick-Edinburgh Mental Well-being Scale (Appendix I)*

The Warwick-Edinburgh Mental Well-being Scale (WEMWBS) was developed by researchers at the University of Warwick and Edinburgh to assist in the measuring of mental well-being of adults (Stewart-Brown & Janmohamed, 2008).

Psychological well-being was assessed using the Short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS) (Stewart-Brown, Tennant, Tennant, Platt, Parkinson & Weich, 2009). This 7 item scale is an updated and shortened version of the 14 item Warwick-Edinburgh Mental Well-being Scale developed by Tennant, Hiller, Fishwick, Platt, Joseph, Weich, Parkinson, Secker and Stewart-Brown (2007). The SWEMWBS measures mental well-being including hedonic elements (happiness, joy, contentment) and eudemonic elements (autonomy, positive relationships, purpose in life) (Taggart et al., 2013), using a 5-point Likert scale where 1=none of the time; 2=rarely; 3=some of the time; 4=often and 5=all of the time (Stewart-Brown et al., 2009). All items within the scale are positively worded items that asses both the above mentioned elements of mental well-being; due to all these items being scored positively (Tennant et al., 2007). Stewart-Brown et al. (2009) reported that the internal reliability of the SWEMWBS had dropped to 0.845 from the 0.906 that was reported for the WEMWBS in a general population. Furthermore, a good criterion-related validity was also reported.

iii. *Sick Building Syndrome Questions (Appendix J)*

According to Hedge et al (1996), sick building syndrome is understood to be characterised by various symptoms that are thought to be associated with the occupancy of the building. Some of these symptoms include eye, nose and throat irritation; mental fatigue; headaches; nausea; dizziness and skin irritation (Hedge et al., 1996). This set of 15 questions assesses various physical well-being factors that are related to Hedge et al.'s (1996) Sick Building Syndrome scale. Thatcher and Milner (2014) report that this 4 point frequency scale measures over the previous month, in other words the 4 point scale measure is broken down to "never", "1-3 times a month", "1-3 times a week" and "everyday". It is important to mention that the scores for all 15 items were required to be reversed in order to make then appropriate for the data analysis process. Berglund and Gidlof-Gunnarsson (2002) reported that the internal reliability of the Sick Building Syndrome scale has been reported in several forms of research. Cronbach's alpha values ranged between 0.72 and 0.91 in majority of the instances (Berglund and Gidlof-Gunnarsson, 2002).

iv. Perceptions of Physical Work Conditions (Appendix K)

Perceptions of the physical work environment were assessed using a further 14 item set of questions that have been extracted from Hedge et al (1996). According to Thatcher and Milner (2014), this set of questions or conditions require the participants to specify the frequency of negative characteristics within their work environment. The conditions are measured on a 4 point frequency scale that specifically looks at occurrences over the previous month; "never", "1-3 times a month", "1-3 times a week" and "everyday" (Thatcher & Milner, 2014). It is important to mention that all 14 items required for the scores were to be reversed in order to make then appropriate for the data analysis process.

v. Utrecht Work Engagement Scale (Appendix L)

Work engagement is measured through self-report questions that are grouped into three constituting aspects of work engagement (subscales) that are known as vigour (6 items), dedication (5 items) and absorption (6 items) (Schaufeli, Bakker & Salanova, 2006). Originally the Utrecht Work Engagement Scale included 24 items, however after various psychometric assessments utilising two different samples or students and employees; it was

concluded that several of the items were unreliable and therefore eliminated from the scale (Schaufeli et al., 2006). Therefore this study will be utilising the revised 9 item Utrecht Work Engagement Scale. These mentioned subscales are understood to reflect the underlying dimensions of work engagement (Schaufeli et al., 2006), hence their importance. All 9 items are scored on a 7 point frequency rating scale that ranges from 0= never to 6= always (Schaufeli et al., 2006). Additionally, internal consistencies were tested in several countries; these results reflected that Cronbach's alpha values ranged between 0.70 and 0.80 in majority of the cases (Schaufeli et al., 2006).

vi. Connectedness to Nature Scale (Appendix M)

This measure, designed by Mayer and Frantz (2004), is intended to examine participants' emotional and observed connection to nature. Research emphasises that in order to accurately address environmental issues, it is important to assess an individual's connection to the broader natural world (Mayer & Frantz, 2004). This 14 item scale requires participants to respond on a 5-point Likert-type scale, where 1 is strongly disagree and 5 is strongly agree. Example items include "I often feel a sense of oneness with the natural world around me" and "I often feel disconnected from nature" (reverse scored). Additionally the scale's reliability or Cronbach alpha is 0.84 (Mayer & Frantz, 2004). It is important to mention that the scores for several items were required to be reversed in order to make then appropriate for the data analysis process. Similarly to a study conducted by Mayer and Frantz (2004), three items were reversed scored (item 4, 12 and 14) before conducting any analysis in the current study. .

3.6 Materials

i. *Plants Particulars*

The horticulturalists worked hard to make calculated decisions in terms of the quantities of plants, types of plants as well as the positioning of the plants in the said office area within this study. The horticulturalists wanted to ensure that they met or exceeded the minimum requirements as set out the by Green Building Council Interiors tool technical manual. According to the horticulturalists, the Green Building Council Interiors tool technical manual explains that one plant unit needs to be provided for every $50m^2$ or regularly occupied

space. Alternatively, a number of plants equalling 0.5 plant units per full time employee or building occupant needs to be installed in the office area (see table 6); generally horticulturalists look at the option that is best fit for the environment in context. Additionally, at least 70% of the plants incorporated into the "fitout" are required to be suited to the indoor environment and most importantly are required to be selected from a preapproved list of plants that have scientifically proven to demonstrate and produce substantial benefits to indoor air quality.

Table 9: Plant units for typical planting applications.

PLANT UNITS FOR TYPICAL PLANTING APPLICATIONS	
Plant Type	**Number of Units**
10-15cm Grow Pot	0.33 Units
20cm Grow Pot	0.5 Units
25-32cm Grow Pot	1 Unit
40cm Grow Pot	2 Units
55cm Grow Pot	4 Units
70cm Grow Pot	8 Units
Bed & Vertical Planting	Determine number of equivalent grow pots and divide by this to provide plant units

This study was carried out in an office space that occupied an area of 1018m^2 (Appendix A). Thus it was decided that a total of 44 plant units were required to be installed in order to meet minimum requirements as set out the by Green Building Council Interiors tool technical manual. The horticulturalists finalised that the office area required 8 urbi square pots (Appendix B) that were made up of 2 plant units each, thus resulting in a total of 16 plant units. Additionally, 28 screen planters (Appendix C) were installed, each of which contained 1 plant unit, therefore offering a total of 28 plant units. This decision meant that the horticulturalists provided 1 plant unit for every 32m^2 of occupied office space, this is well within the minimum requirements specified by the Green Building Council.

ii. Position of Plants

Plants were carefully positioned as close to the employees as possible (Appendix D). With the tight open plan layout that we were provided with, the horticulturalists were restricted in terms of the number of larger plants that could have been provided. As a result only 8

urbi Square pots were used with plants, and screen planters where used to make up the shortfall in plant units that allowed the horticulturists to bring the plants right into the workspace of the employees.

iii. Plant Types

Horticulturalists carefully selected the plants that were fitted in the workspace at BCX. Certain environmental characteristics were essentially considered prior to selecting the appropriate plants. In terms of suitability to the work environment in the form of light levels, people movement, air-conditioning and aesthetics were considered, resulting in the selection of the following plants that were utilised (Figure 2):

1. *Sanserveria trifasciata*, or more commonly known as mother in law tongue and bedroom plant, was selected primarily for its ability to produce oxygen even when the lights are turned off (Image 2).
2. *Chamaedorea seifrizii*, or more commonly known as the read palm, was selected for its excellent ability to filter VOC's from the air (Image 1).
3. *Aglaeonema*, or more commonly known as Silver Bay, was selected for its ability to handle low light conditions, filter VOC's and provide great aesthetics (Image 3).
4. *Phlebodium aureum* was selected for its aesthetics, hardiness and suitability to the environment (Image 4).

Image 1: *Chamaedorea seifrizzi*

Image 2: Sanserveria trifasciata

Image 3: *Aglaonema "Silver*

Image 4: *Phlebodium auereum*

Figure 2: Selection of plants that were utilised in the current study.

At total of 4 x 40cm Sanserveria trifasciata, 4 x 40cm Chamaedorea seifrizii, 56 x 15cm Aglaeonema "Silver Bay" and 56 x 15cm Phlebodium aureum where placed throughout the BCX office space allocated for this study.

iv. SE Controls

A previous study conducted in primary schools in Dubai posited that increased CO_2 levels have a direct effect on learning as well as the ability to perform tasking within the school environment (Behzandi & Fadeyi, 2012). Air quality and occupant comfort levels are highly dependent on other factors such as air temperature and humidity, additionally the ability to

accurately monitor and measure these variables is key (World Green Building Council, 2015). In mid-2012, SE Controls launched the *NVLogIQ*, an integrated monitor, room controller and data logger, which is believed to incorporate new building ventilation and controls algorithms (Iddon, 2015). The small wall mounted devise can be used as a standalone system or networked to give individual room control with global signals that include wind, rain and security closing (SE Controls, 2015). The NV LogIQ Room Controller has integrated sensors, switches, as well as a backlit LCD display that projects the following information:

- CO_2 monitoring and level display
- Temperature monitoring and level display
- Humidity monitoring and level display
- User control via inbuilt switches with ten increments of operation
- Output signal for external devices such as central heating control
- Lock function to prevent misuse
- Continuous data logging for performance analysis

Iddon and Hudleston (2012) conducted a study in UK classrooms utilising the *NVLogIQ* in order to assess how the poor air quality within the class rooms were measured and compared to the reduced academic performance as well as the increasing health problems that were experienced by the students. Through the measures of Carbon Dioxide levels, temperature and humidity levels, it was discovered that there was insufficient building ventilation that resulted in the poor air quality that was impacting the performance and wellbeing of the learners (Iddon & Hudelston, 2012). This research highlighted the importance of the use of the *NVLogIQ* SE Controls system in the current study in order to measure the air quality within the workplace in the no plant condition as well as in the plant condition, this would then allow the researcher to assess how the plants have assisted in purifying the air quality within the office area and how this may have impacted the employees physical wellbeing, psychological wellbeing, perceptions of their physical work environment and their work engagement.

3.7 Data Analysis

Due to the study's quantitative nature, it was appropriate to primarily run descriptive statistics that included obtaining means, frequencies, standard deviations, as well as the

appropriate tests in order to assess Normality, this result would ultimately guide the researcher to whether or not parametric or non-parametric statistical tests would be utilised. These Descriptive statistics were also used for categorising, summarising and describing the study's sample and quantitative data collected.

The assumptions that are believed to be common to all techniques were assessed in order to assess whether or not the researcher should run a parametric or nonparametric analysis. These assumptions are listed and explained below.

i. Level of measurement

This assumption reveals that the dependent variables are measured at the interval or ratio level. In other words a continuous scale would be utilised rather than discrete categories (Pallant, 2013).

ii. Random Sampling

The assumption discloses that all scores are obtained using a random sample from the population, however Pallent (2013) explains that "this is often not the case in real-life research" (p. 213).

iii. Independent Observations

The following assumption explains that the observations that make up the data should be independent from one another (Pallant, 2013). More specifically, Pallant (2013) explains that each participant can only be counted once, in other words they cannot appear in more than one category or group. However, according to Stevens (1996), there are several situations that may violate this assumption. One of these violations is believed to be evident in the current study due to the fact that the researcher is measuring the same participants at two different time throughout the study.

iv. Normal Distribution

This assumption assumes that the populations from which the sample is taken is normally distributed (Pallant, 2013). There are many instances where this assumption may not be met, however if the study's sample size is large enough (generally over 30 participants), it is believed to be robust enough to "tolerate"

this violation (Pallant, 2013). However this should be considered carefully due to the fact that many of the parametric tests are believed to have appropriate nonparametric alternatives that could be used instead.

v. Homogeneity of Variance

Parametric techniques assume that samples are obtained from populations with equal variances (Pallant, 2013). In other words, the variability of the scores for each of the groups is assumed to be similar. This is tested in the outputs, however it is important for the researcher to note that in order to meet this assumption one would hope to find the test to be non-significant (Pallant, 2013). Consequently, if the result was found to be significant, the variances of the two groups would not be equal.

Upon completion of testing the assumptions above, the researcher discovered that although several of these assumptions were met, the researcher acknowledges that the sample for the current study was small and thus suspecting that this may compromise the homogeneity of variance. Therefore after careful consideration, it was decided to continue with the statistical analysis utilising a non-parametric equivalent to the anticipated matched-paired t-tests that were going to be run. Consequently in order to answer the first four research questions, the researcher was tasked to run four separate Wilcoxon "matched pairs" Signed Rank Tests in order to assess whether or not the absence and presence of plants within the work environment impacted the employees' psychological well-being, physical well-being, perceptions of their work environment and their work engagement. This is supported by Pallant (2013) who suggests that nonparametric tests such as the Wilcoxon Signed Rank Test is appropriate for data sets that are made up of small samples, which is the situation that the researcher is faced with in this particular research.

Wilcoxon "matched pairs" Signed Rank Tests is a non-parametric test that was designed for the use of repeated measures data sets (Pallant, 2013). Typically this type of test is used when the participants within a sample are measured on two occasions or under two different conditions (Pallant, 2013). This test is regarded as a non-parametric alternative to the matched pairs or repeated measure t-tests, however instead of comparing the means

like the t-tests would do; the Wilcoxon Signed Rank Test converts the scores to ranks and compares them at time 1 and time 2 (Pallant, 2013).

Furthermore, in order to answer the fifth research question pertaining to the impact that the covariate or connectedness to nature may have on the IV/DV relationships measured in research question one to four, the researcher anticipated to run four separate ANCOVAs. However due to the fact that the assumptions were not met as mentioned previously, the researcher would be tasked to run the non-parametric alternative for an ANCOVA. At this point the researcher was faced with an unexpected quandary due to the fact that there is no non-parametric alternative for ANCOVA analysis. At this point the researcher was tasked to find an alternative way in which she could calculate the impact the covariate would have on the relationship between the absence and presence of plants and the employees' psychological well-being, physical well-being, perceptions of their work environment and their work engagement.

After careful consideration, the researcher decided to calculate a difference score between the no plants and plants results for every relationship that was measured in the Wilcoxon Signed Rank Test previously. These results would be regarded as the "difference related to plants" for each of the dependent variables. At this point the researcher correlated concern for the environment (the covariate) with the difference score and this would ultimately indicate whether or not there was a relationship between the presence of plants and the participants concern for the environment. It is important to note that a correlation analysis is regarded as a parametric test, therefore taking into consideration the fact that the sample of the current study was too small, in this instant it is important for the researcher to utilise the nonparametric equivalent, which in this instance is known as Spearman Rho.

Spearman Rank Order Correlation (Rho), according to Pallant (2013) is the nonparametric equivalent to Pearson's Correlation. She goes on to explain that correlations are used in order to assess the strength and direction of a relationship between two variables (Pallant, 2013). Spearman's Correlation is a statistical measure of strength of a monotonic relationship between paired data that is interpreted similarly to Pearson's Correlation (Pallant, 2013). The correlation coefficient effect size varies in order to determine the strength of the relationship between the two variables. The calculations of Spearman's

correlation are not required to be regarded as normal, hence it is a nonparametric statistic (Pallant, 2013).

3.8 Ethical Considerations

The researcher has anticipated a variety of ethical issues that arose during the data collection process; some ethical issues that may arise during data analysis and interpretation have been identified and addressed below.

Due to the quasi-experimental nature of the study, the researcher was unable to inform the participants of the purpose of the study prior to data collection in order to prevent drawing additional attention to the indoor plants being installed and their empirical relevance to the study. Therefore it was the responsibility of the researcher to inform the participants of the true nature of the study after all three assessments were carried out. Nonetheless, the participants still received a participant information sheet (Appendix N) prior to completing all three assessments that informed the participants that the study looked at the perceptions of the work environment and work engagement. Anonymity was not assured in this proposed study due to the fact that the researcher was required to obtain the participants' employee numbers in order to match the three assessment times. These employee numbers were however removed from the final data set and replaced with unidentifiable participant numbers. At no point did the researcher know the names of the respondents and the employee numbers were not given to the organisation. The result assured confidentiality, which were preserved by the fact that only the researcher and research supervisor had access to the data responses and all analyses were conducted at a group level, meaning that responses were acknowledged in relation to all other responses and not specific, individual responses. Additionally, all collected data has been stored in a secure and safe electronic location.

No harm or foreseeable risks were experienced by the individuals who chose to participate in this study. All participation was strictly voluntary in nature. Participants were given the right to withdraw from the study at any point in the study permitted that they had provided the researcher with their employee ID, without penalties or repercussions. Informed consent was obtained by providing participants with a participant information sheet which will inform them about the study.

CHAPTER FOUR: RESULTS

4.1 Introduction

The following chapter presents a comprehensive analysis of the statistical results. The chapter begins with a reflection of the air quality results captured by the four SE controls that were installed in the office area. Additionally, these results are presented graphically in order for the reader to comprehend the change of the office ambient temperatures, humidity and carbon dioxide levels throughout the study. This will be followed by the descriptive statistics that will be reviewed in order to describe the sample. Additionally, internal consistency analyses were performed in order to determine the reliability coefficients of the instruments used in this study. This chapter will also present the normality tests that were carried out by the researcher as well as the types of analyses that these normality tests led the researcher to utilise in order to assist in solving the research questions introduced in Chapter 2.

As previously mentioned in chapter three, there were two main analyses that were run in order to assist in answering the research questions for this research. First and foremost there were four Wilcoxon Sign Rank Tests that were run in SPSS in order to assess how the presence and absence of plants within the work environment impacted the employees' psychological well-being, physical well-being, work engagement and their perceptions of their work environment. Furthermore, four Spearman Correlation's were run in SPSS in order to answer the fifth research question pertaining to how the employees' connectedness to nature (covariate) impacted the relationship between the absence and presence of plants and their psychological well-being, physical well-being, work engagement and their perceptions to their work environment. Therefore this chapter will conclude with the presentation of the results of the six research questions presented in the study.

4.2 Statistical Abbreviations

In order to assist the reader in understanding the statistical analysis that will be presented in this chapter, it is important to assure that all the abbreviations are understood. The researcher has tabulated all the relevant abbreviations below for the reader's convenience.

Table 10: Summary of Abbreviations for Key Variables

APPROPRIATE ABBREVIATIONS FOR STATISTICAL ANALYSIS	
Variable	**Abbreviation**
Psychological Well-being (No Plants)	*PSYCH_WB_NP*
Physical Well-being (No Plants)	*PHYS_WB_NP*
Work Engagement (No Plants)	*WORK_ENG_NP*
Perceptions of the work Environment (No Plants)	*PERCEP_NP*
Psychological Well-being (Plants)	*PSYCH_WB_P*
Physical Well-being (Plants)	*PHYS_WB_P*
Work Engagement (Plants)	*WORK_ENG_P*
Perceptions of the work Environment (Plants)	*PERCEP_P*
Connectedness to Nature	*CNS*

4.3 Descriptive Statistics

According to Stangor (2011), it is common practice for researchers to conduct basic descriptive analysis in order to determine the characteristics of the sample. In order to support this suggested practice, the researcher ran descriptive statistics in SPSS in order to define the representation of the sample of the current study. These statistics included frequencies, percentages, means, standard deviations, minimum scores and maximum scores. These results are presented below. The biographical information that was attained for this study included; age, race and gender. Furthermore, the researcher was interested in determining the participant's tenure as well as the amount of time that they spend at their desks during the day. These results will also be presented in this chapter.

Table 11: Descriptive Statistics for Gender of final 32 participants.

GENDER		
	Frequency	**Percent**
Male	21	65.5
Female	11	34.4
Total	32	100

As depicted in table 11 above, the total sample of 32 participants that were assessed throughout the current study included 21 male employees (65.5%) and 11 female employees (35.4%).

Table 12: Descriptive Statistics for Race of final 32 participants.

RACE		
	Frequency	**Percent**
White	14	43.8
Black	11	34.4
Indian	3	9.4
Coloured	4	12.5
Total	32	100

As depicted in table 12 above, the 32 employees that participated in the current study made up a diverse sample made up of 14 White participants (43.8%), 11 Black participants (34.4%), 3 Indian participants (9.4%) and 4 Coloured participants (12.5%). This diverse sample highlights the acceptance of participants of widespread racial categories.

Table 13: Descriptive Statistics for age of final 32 participants.

AGE						
Valid	**Missing**	**Mean**	**Median**	**Standard Deviation**	**Minimum**	**Maximum**
29	*3*	*31.62*	*31*	*10.825*	*19*	*65*

Table 13 above represents the ages of the participants in the current study. It would appear that the sample age ranges from 19 to 65 years old (M=31.62; SD=10.825). Furthermore, due to the fact that providing age was not a compulsory requirement, it is evident that 3 participants chose to not reveal their age.

Table 14: Descriptive Statistics for Tenure of final 32 participants.

TENURE						
Valid	**Missing**	**Mean**	**Median**	**Standard Deviation**	**Minimum**	**Maximum**
32	*0*	*3.5*	*1.5*	*4.443*	*.00*	*16*

Table 14 above represents the tenure of the participants in the current study. It would appear that the sample tenure ranges from .00 years (in other words employed in 2015) to 16 years (M=1.5; SD=4.443). Furthermore, it's worthwhile mentioning that providing tenure

was not a compulsory requirement, however the 32 participants that were included in the final assessment provided tenure.

Table 15: Descriptive Statistics for Hours at Desk of final 32 participants.

HOURS AT DESK						
Valid	**Missing**	**Mean**	**Median**	**Standard Deviation**	**Minimum**	**Maximum**
32	*0*	*7.89*	*8*	*1.141*	*6*	*12*

Table 15 above represents the amount of hours per day the employees spend sitting at their desks or workstations. It would appear that this period ranges from 6 hours per day to 12 hours per day (M=7.89; SD=1.141). When considering the tenure range provided, one may question how an individual may sit at their desk for 12 hours if they are only working 9 hour shifts from 8:00 am to 17:00 pm. It is important to remember that there is a 24 hour department included within the sample, therefore their shifts are longer than the typical 9 hour shifts. Additionally, when the researcher was observing the employees during the data collection period, it became evident that many of the employees chose to stay in the office for an hour or two after 17:00 pm in the evenings in order to avoid having to sit in traffic while commuting home. Furthermore, it's worthwhile mentioning that providing hours spent at their workstations was not a compulsory requirement; however the 32 participants that were included in the final assessment provided this information.

Upon analysis of the descriptive stats, the researcher was able to identify that there is slightly skewed data evident in all of the characteristics that were captured for the sample. According to Pallant (2013), it is a common occurrence to find variables that are not normally distributed. Additionally there are also instances where the data is distributed or arranged in an irregular shape (Pallant, 2013).

4.4 Ambient Environmental Conditions

Data was recorded from the 4 SE control systems that were installed in different areas of the workspace. The SE controls automatically captured measures of indoor environmental quality (IEQ) such as temperature, humidity and carbon dioxide, every 15 minutes from the time of installation for the duration of the study. This data was then carefully considered

and standardised by looking at the data that was captured every hour, this data reflected interesting results below. It is important to note that the tabulated results that are presented below are the averages of each time that was studied, thus one would comprehend that the minimum and maximum values of each of the three measures would be evident on the line graphs presented as supposed to the tabulated averages below. Note that the measures that were compared were those taken within the first three weeks of the study or when the office area had no plants installed and the during the last three weeks of the study or when the office area had the relevant planters in place.

Hypothesis: The installation of the plants would reduce the carbon dioxide levels within the workspace as well as stabilize the temperature, and stabilize and maintain the humidity levels according to the published accepted range.

Table 16: Unit 1 SE Control averages across the study.

BUSINESS CONNEXION SE CONTROLS – UNIT 1 (AREA 2)			
	Temperature	**Humidity**	**Carbon Dioxide**
Time 1: No Plants	*24.83 ℃*	*33.74%*	*917.96 ppm*
Time 2: No Plants	*24.29 ℃*	*30.31%*	*902.17 ppm*
Time 3: Plants	*23.59 ℃*	*32.23%*	*972.04 ppm*

As seen above, unit 1's initial temperature measure that was recorded when there were no plants evident in the work environment was captured at 24.83 °C, and it becomes evident that there is a decrease the longer the plants remain in the office area, finally dropping and stabilising at 23.59 °C. There is also evidence of the humidity levels dropping from 33.74% down to 30.31% then an obvious jump back up to 32.23%, nonetheless this could be due to that fact that the humidity levels were simply stabilising. However, this will be further explored and discussed in Chapter 5. Reflecting on the Carbon Dioxide levels within the workspace, the initial reading is 917.96 ppm and there is an obvious drop to 902.17 ppm during the second phase of the research, however there is an unusual increase of Carbon Dioxide levels (972.04 ppm) at time 3.

Table 17: Unit 2 SE Control averages across the study.

BUSINESS CONNEXION SE CONTROLS – UNIT 2 (AREA 2)			
	Temperature	**Humidity**	**Carbon Dioxide**
Time 1: No Plants	*24.72°C*	*34.46%*	*1036.15 ppm*
Time 2: No Plants	*24.11°C*	*30.41%*	*850.95 ppm*
Time 3: Plants	*23.86°C*	*31.53%*	*895.75 ppm*

The table above presents the results captured from unit 2 in the office area. It is evident that the initial temperature reading is fairly high at 24.72°C. However it is evident that from the moment the plants were installed into the office area, there was a drop of 0.86°C. With Regards to humidity, we identify that the initial reading was recorded at 34.46%, however there is an evident drop and once again, just as the researcher identified in unit 1, the humidity levels jumped up slightly when recorded at time 3. Upon reflecting on the Carbon Dioxide levels within the office area, the SE Controls captured a reading of 1036.15 ppm, which was the highest recording of CO_2 levels within the whole office area, throughout the whole study. There is an unmistakeable and remarkable drop of 185.20ppm in the CO_2 levels from time 1 to time 2, however we note a slight increase in time 3. Explanations for this increase will be explored in chapter 5 of this research paper.

Table 18: Unit 3 SE Control averages across the study.

BUSINESS CONNEXION SE CONTROLS – UNIT 3 (AREA1)			
	Temperature	**Humidity**	**Carbon Dioxide**
Time 1: No Plants	*24.47℃*	*33.20%*	*774.83 ppm*
Time 2: Plants	*24.19 ℃*	*28.67%*	*783.52 ppm*
Time 3: Plants	*23.81 ℃*	*29.85%*	*750.70 ppm*

Upon reflection on the results presented above for unit 3, it is evident that the initial reading of the temperature levels in this area are slightly high at 24.47°C, however there is evidence of the temperature dropping. When looking at the humidity levels presented in table 17 it is evident that the initial reading at time 1 is recorded at 33.20%, there is an evident drop at time 2 (28.67%), while we also see a slight increase in time 3. This fluctuation will be explored further at a later stage. The CO_2 levels in the area are fairly low

to start off with, there could be many reasons for that, however there is evidence of a further decrease from time 1 to time 3.

Table 19: Unit 4 SE Control averages across the study.

BUSINESS CONNEXION SE CONTROLS – UNIT 4 (AREA 1)			
	Temperature	**Humidity**	**Carbon Dioxide**
Time 1: No Plants	*24.47 ℃*	*33.20%*	*775.17 ppm*
Time 2: Plants	*24.19 ℃*	*28.67%*	*783.52 ppm*
Time 3: Plants	*24.37 ℃*	*29.85%*	*751.93 ppm*

The final SE Controls unit that was placed in the office area recorded the same temperature of 24.47 °C that was recorded from unit 3. Once the plants were installed the initial drop was the same, however the increase in time 3 was less that that reported in unit 3. According to table 18 there was a 4.53% drop in the humidity levels from time 1 to time 2, however once again there is evidence of a slight increase in time 3. The CO_2 levels recorded are also fairly low, although not as low as the CO_2 levels recorded by unit 3. There is an unusual increase from time 1 to time 2, however the recorded CO_2 levels at time 3 drop significantly once again and reflect a lower recording than that presented at time 1.

4.5 Employee Assessments Results

4.5.1 Reliability Tests

The following section will clarify the reliability coefficients of the scales that were utilised in the current study. Huck (2012), notes that according to the theory of reliability, the Cronbach's Alpha is utilised to measure internal consistency or reliability in a versatile manner due to the fact that is able to measure items with three or more possible values. Gravetter and Forzano (2011) expand this explanation by adding that a Cronbach Alpha may range from 0.00 to +1.00, where all values above 0.7 are regarded as acceptable reliability values and all values below 0.4 are regarded as poor or unacceptable reliability values. The table below will reveal the reliability values for the current study, furthermore, the researcher will expand on this by indicating the strengths of the values obtained.

Table 20: Cronbach's Alpha for all the scales utilized in the current study.

CRONBACH'S ALPHA (RELIABILITY)					
	N	**Cronbach's Alpha (α)**	**Mean**	**Variance**	**SD**
Psychological Wellbeing	*15*	*.85*	*44.69*	*57.98*	*7.61*
Physical Wellbeing	*7*	*.73*	*26.06*	*16.96*	*4.11*
Perceptions of Work Environment	*14*	*.81*	*45.14*	*51.68*	*7.18*
Engagement	*9*	*.88*	*38.07*	*79.13*	*8.89*
Connectedness to Nature	*14*	*.76*	*50.13*	*47.84*	*6.91*

As depicted in table 20 the reliability coefficients were all above 0.7 as suggested by Grevetter and Forzano (2011). More specifically, psychological wellbeing (α= 0.85), Physical wellbeing (α= 0.73), perceptions of the work environment (α=0.81), work engagement (α=0.88) and connectedness to nature scale (α=0.76); all indicate good internal consistency due to the fact that they fall within the acceptable range. However Pallant (2013) suggests that although Cronbach Alpha's above 0.7 are acceptable, it is preferred for the value to be above 0.8. Therefore the researcher highlights the strong or high reliability coefficients that are presented by the Warwick-Edinburgh Mental Wellbeing Scale (psychological wellbeing), the Perceptions of Work Scale, and Ultrecht Work Engagement Scale. Thus the reliability coefficients for the sick building syndrome scale (physical wellbeing) and the connectedness to nature scale may be considered as slightly weaker reliability coefficients, however the values are still within the accepted range.

4.5.2 *Test of Normality*

In order to answer the research questions relating to how the absence and presence of plants within the workspace may impact the employees' psychological well-being, physical well-being, perceptions of their work environment and their work engagement; as well as how one's connectedness to nature may have impacted the above relationships, the researcher was tasked to evaluate several characteristics of the sample and the data. This would allow for the researcher to assure what sort of analysis would be carried out for the current study.

Table 21: Tests of Normality.

TESTS OF NORMALITY

	Kolmogorov-Smirnov [a.]			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
PSYCH_WB_NP	*.11*	*32*	*.20**	*.98*	*32*	*.97*
PSYCH_WB_P	*.08*	*32*	*.20**	*.97*	*32*	*.61*
PHYS_WB_NP	*.13*	*32*	*.12*	*.93*	*32*	*.05*
PHYS_WB_P	*.09*	*31*	*.20**	*.96*	*31*	*.37*
PERCEP_NP	*.20*	*32*	*.00*	*.83*	*32*	*.00*
PERCEP_P	*.14*	*32*	*.08*	*.89*	*32*	*.00*
ENGAGE_NP	*.15*	*32*	*.07*	*.94*	*31*	*.12*
ENGAGE_P	*.14*	*32*	*.09*	*.95*	*32*	*.21*

**This is a lower bound of the true significance.*

a. Lilliefors Significance Correlation.

Two tests of normality were run and tabulated above, however the researcher will be utilising the Shapiro-Wilk normality test due to the fact that this study is made up of a small sample. This decision is supported by Razali and Wah (2011) who highlight that the Shapiro-Wilk test of normality is restricted for sample sizes that are less than 50. The null hypothesis in this case is that the variables are normally distributed, if the significance value is smaller than 0.05, the null hypothesis of normality can be rejected indicating that there is enough evidence to suggest non-normality. According to table 21 above, psychological wellbeing in the no plant condition ($W_{(32)} = .98$, $p > 0.05$), psychological wellbeing in the plant condition ($W_{(32)} = .97$, $p > 0.05$), physical wellbeing in the no plant condition ($W_{(32)} = .93$, $p > 0.05$), physical wellbeing in the plant condition ($W_{(31)} = .96$, $p > 0.05$), work engagement in the no plant condition ($W_{(32)} = .94$, $p > 0.05$), work engagement in the plant condition ($W_{(32)} = .95$, $p > 0.05$), and perceptions of the work environment in the plant condition ($W_{(32)} = .89$, $p > 0.05$). These results are statistically non-significant, therefore in these cases the null hypothesis is not rejected and normal distributions are assumed. However, Perceptions of the Work Environment in the No Plant Condition ($W_{(32)} = .83$, $p < 0.05$), reported a statistically significant result, which ultimately rejects the null hypotheses.

Upon completion of testing the assumptions above, the researcher discovered that although several of these assumptions were met, the researcher acknowledges that the sample for the current study was small and thus suspecting that this may compromise the homogeneity of variance. Therefore after careful consideration, it was decided to continue with the statistical analysis utilising a non-parametric equivalent to the anticipated matched-paired t-tests that were going to be run. Therefore it was decided on non-parametric tests as an alternative of the paired samples t-test, the Wilcoxon Sign Rank Test would be utilised in the current study. Additionally, the non-parametric Spearman Rank Order Correlation (Rho) will be used in order to assist in answering the final research question.

4.5.3 Wilcoxon Sign Rank Test

Although nonparametric techniques are believed to have less stringent assumptions, it is important to mention that there are some general assumptions that should be checked prior to running the analysis (Pallant, 2013).

i. Random Samples

Random samples are samples that have been drawn from a population in such a way that every possible individual within the sample had the same chance of being selected (Pallant, 2013).

ii. Independent Observations

This assumption specifies that each participant can only be counted once, in other words they cannot appear in more than one category or group (Pallent, 2013). This assumption is however an exception for the Wilcoxon Signed Rank Test due to the fact that this technique is measuring the same participants on different occasions or in different conditions.

Table 22: Wilcoxon Sign Rank Test Descriptive Statistics.

DESCRIPTIVE STATISTICS

	N	Mean	SD	Min	Max	Median
PSYCH_WB_NP	*32*	*3.64*	*.59*	*2.33*	*5.00*	*3.67*
PSYCH_WB_P	*31*	*3.58*	*.64*	*2.33*	*5.00*	*3.67*
PHYS_WB_NP	*32*	*2.96*	*.52*	*2.20*	*4.00*	*2.92*
PHYS_WB_P	*32*	*2.98*	*.58*	*1.53*	*3.93*	*3.07*
PERCEP_NP	*32*	*3.17*	*.62*	*1.00*	*3.86*	*3.30*
PERCEP_P	*32*	*3.24*	*.54*	*1.36*	*4.00*	*3.36*
ENGAGE_NP	*31*	*4.22*	*1.06*	*2.33*	*5.00*	*4.44*
ENGAGE_P	*32*	*3.70*	*1.16*	*0.78*	*5.78*	*3.78*

Table 22 presented above provides a summary of the descriptives of the variables that are being tested in the current study. These descriptives include the means, standard deviations, minimums and maximums. Furthermore, the results of the Wilcoxon Sign Rank Test are presented in the table below.

Table 23: Wilcoxon Sign Rank Test Ranks.

RANKS

		N	Mean Rank	Sum of Ranks
PSYCH_WB_NP	*Negative Ranks*	*16[a]*	*14.89*	*208.50*
PSYCH_WB_P	*Positive Ranks*	*14[b]*	*16.03*	*256.50*
	Ties	*2[c]*		
	Total	*32*		
PHYS_WB_NP	*Negative Ranks*	*12[d]*	*14.03*	*224.50*
PHYS_WB_P	*Positive Ranks*	*16[e]*	*15.13*	*181.50*
	Ties	*3[f]*		
	Total	*31*		
PERCEP_NP	*Negative Ranks*	*12[g]*	*14.15*	*184.00*
PERCEP_P	*Positive Ranks*	*13[h]*	*11.75*	*141.00*
	Ties	*7[i]*		
	Total	*32*		

ENGAGE_NP	*Negative Ranks*	*25[j]*	*16.75*	*100.50*
ENGAGE_P	*Positive Ranks*	*6[k]*	*15.82*	*395.50*
	Ties	*0[l]*		
	Total	*31*		

a. PSYCH_WB_P < PSYCH_WB_NP
b. PSYCH_WB_P > PSYCH_WB_NP
c. PSYCH_WB_P = PSYCH_WB_NP
d. PHYS_WB_P < PHYS_WB_NP
e. PHYS_WB_P > PHYS_WB_NP
f. PHYS_WB_P = PHYS_WB_NP
g. PERCEP_P < PERCEP_NP
h. PERCEP_P > PERCEP_NP
i. PERCEP_P = PERCEP_NP
j. ENGAGE_P < ENGAGE_NP
k. ENGAGE_P > ENGAGE_NP
l. ENGAGE_P = ENGAGE_NP

The ranks table presents some interesting results on comparisons of the participant's scores in the no plant condition and in the plant condition. The table's legend suggests that 16 employees had a higher psychological wellbeing score in the no plants condition; while 14 employees had a higher psychological wellbeing score in the plants condition. Furthermore, 2 employees saw no change in their scores. When considering the physical wellbeing scale, 12 employees had a higher physical wellbeing score in the no plants condition; while 16 employees had a higher physical wellbeing score in the plants condition. Furthermore, 3 employees saw no change in their scores. When considering the perceptions of the work environment scale, 12 employees had higher perception scores in the no plants condition; while 13 employees had higher perception scores in the plants condition. Furthermore, 7 employees saw no change in their scores. When considering the employee engagement scale, 25 employees had a higher work engagement score in the no plants condition; while 6 employees had a higher work engagement score in the plants condition.

Table 24: Wilcoxon Sign Rank Test, Test Statistics.

TEST STATISTICS

	PSYCH_WB_NP PSYCH_WB_P	**PHYS_WB_NP PHYS_WB_P**	**PERCEP_NP PERCEP_P**	**ENGAGE_NP ENGAGE_P**
Z	*-0.495*	*-0.490*	*-0.580*	*-2.892*
Asymp. Sig. (2-tailed)	*.621*	*.624*	*.562*	*.004*

The tables above depict the results for the Wilcoxon Sign Rank Test that was run in order to assist the researcher in answering the Research Questions mentioned in Chapter 2. According to table 24 psychological wellbeing ($Z_{(32)}$ = -0.495, p > 0.05), Physical Wellbeing ($Z_{(31)}$ = -0.490, p > 0.05), perceptions of the work environment ($Z_{(32)}$ = -0.580, p > 0.05); these results show that there is insufficient evidence to suggest that the presence of the plants impacted the employees psychological wellbeing, physical wellbeing and their perceptions of the work environment. However, as seen in the table above, for work engagement ($Z_{(31)}$ = -2.829, p < 0.05), this significant result proposes that there is sufficient evidence to suggest that the presence of plants changes employees work engagement. This result leads the researcher to investigate whether this change is a positive or negative change. In other words does this significant result reflect that the presence of plants resulted in employee engagement increasing or decreasing among the sample. Upon reflection of table 22, it becomes evident that the recorded mean=4.22 in the no plant condition and the recorded mean=3.70 in the plant condition. This would suggest that there is sufficient evidence to propose that work engagement decreased throughout the study.

Due to the fact that there are 3 non-significant results that have been reported, only the effect size for the significant result can be calculated and reported. The effect size for nonparametric Wilcoxon Sign Rank Test is calculated as follows:

$$Effect\ Size\ (r) = \frac{z}{\sqrt{N}}$$

Therefore, the effect size for Employee Work Engagement is calculated below:

$$Effect\ Size\ (r) = \frac{2.892}{\sqrt{32}}$$

This produces a result of 0.5. According to Cohen (1988), this would be considered as a large effect size when considering his ranges of 0.1 being a small effect size, 0.3 being a medium effect size and 0.5 being a large effect size.

As is evident from the results presented above, the only variable where the presence of plants had a significant impact on the dependent variable was in the case of employee engagement. This result led the researcher to assess and compare the individual items of

each of the scales that were utilised in this study, in order to assess if there are in fact any significant results present at the individual item level. These results will be explored below and discussed in Chapter 5. Furthermore, the researcher was interested to see if there would be different results presented if matched pair t-test were carried out instead; however an identical pattern of results were presented in the t-tests that were conducted.

4.5.4 Wilcoxon Sign Rank Tests for Individual Items in the Scales

The researcher was tasked to unpack the results further by investigating how the individual items that were measured throughout the study were impacted when planters were installed in the work environment. The tables below capture the results of the individual items from the no plant condition as well as the plant condition. The researcher was tasked to identify if there were any significant results present among these individual items. The results are presented below.

Table 25: Wilcoxon Sign Rank Test – Perceptions of the Work Environment Individual Scales

EMPLOYEES PERCEPTIONS OF THE WORK ENVIRONMENT – TEST STATISTIC				
Item		**Mean Score**	**Z**	**Asymp. Sig. (2-tailed)**
1	Temperature too Warm_NP	*2.76*	*-.22*	*.81*
	Temperature too Warm_P	*2.83*		
2	Temperature too Cold_NP	*2.56*	*-.61*	*.53*
	Temperature too Cold_P	*2.65*		
3	Lighting too Dim_NP	*3.54*	*-.77*	*.43*
	Lighting too Dim_P	*3.62*		
4	Lighting too Bright_NP	*3.26*	*-.74*	*.45*
	Lighting too Bright_P	*3.34*		
5	Insufficient Ventilation_NP	*3.22*	*-.31*	*.75*
	Insufficient Ventilation_P	*3.23*		
6	Too Drafty_NP	*3.24*	*-.90*	*.36*
	Too Drafty_P	*3.62*		

7	Too little Air Movement_NP Too little Air Movement_P	*3.09* *3.16*	*.00*	*1.00*
8	Air too Dry_NP Air too Dry_P	*3.00* *3.25*	*-1.03*	*29*
9	Air too Humid_NP Air too Humid_P	*3.64* *3.56*	*-.72*	*.47*
10	Distracting Ambient Noises_NP Distracting Ambient Noises_P	*2.64* *2.78*	*-.88*	*.37*
11	Unpleasant Odour in the Air_NP Unpleasant Odour in the Air_P	*3.25* *3.18*	*-.58*	*.56*
12	Stale Air_NP Stale Air_P	*3.30* *3.250*	*-.45*	*.65*
13	Dusty of Stuffy air_NP Dusty of Stuffy air_P	*3.64* *3.50*	*-1.26*	*.20*
14	Electrostatic Shock_NP Electrostatic Shock_P	*3.71* *3.34*	*-2.76*	*.00*

Table 25 that has been presented above unpacks the results of the individual items within the Perceptions of the Physical Work Conditions Scale (Appendix K) in order to determine whether any individual items presented any significant changes when the plants where installed within the office environment. Out of the 15 individual items measured, it is evident that there is only one significant result present. Table 25 suggests that "electrostatic shock" ($Z=-2.76$; $p<0.05$) reveals there is sufficient evidence to suggest that the presence of plants had an impact on the electrostatic shock within the workplace. When referring to the means presented in table 24 it is apparent that the mean=3.71 in the no plant condition and then it drops to 3.34 in the plant condition, suggesting that the employees were experiencing less electrostatic shocks. The effect size of this significant value is calculated at 0.48, which according to Cohen (1988) is regarded as a large effect size. This result will be discussed in more detail in chapter 5. Furthermore, it is important to mention that there are no additional significant results that can be reported from the Perceptions of the Physical Work Conditions Scale individual items analysis.

Table 26: Wilcoxon Sign Rank Test – Physical Wellbeing Individual Scales

EMPLOYEES PHYSICAL WELLBEING-TEST STATISTIC				
Item			**Z**	**Asymp. Sig. (2-tailed)**
1	Excessive Mental Fatigue_NP	*2.65*	*-1.54*	*.12*
	Excessive Mental Fatigue_P	*2.93*		
2	Headaches_NP	*2.81*	*-.21*	*.83*
	Headaches_P	*2.83*		
3	Dry Eyes_NP	*2.77*	*-1.15*	*.25*
	Dry Eyes_P	*2.93*		
4	Irritated or Sore Eyes_NP	*2.35*	*-1.91*	*.06*
	Irritated or Sore Eyes_P	*2.77*		
5	Tired or Strained Eyes_NP	*2.16*	*-1.75*	*.07*
	Tired or Strained Eyes_P	*2.54*		
6	Nervousness or Irritability_NP	*2.93*	*-1.16*	*.24*
	Nervousness or Irritability_P	*2.74*		
7	Tiredness or Lethargy_NP	*2.60*	*-.22*	*.82*
	Tiredness or Lethargy_P	*2.61*		
8	Stuffy or Congested Nose_NP	*2.58*	*-1.08*	*.27*
	Stuffy or Congested Nose_P	*2.76*		
9	Sore or Irritated Throat_NP	*3.06*	*-.26*	*.79*
	Sore or Irritated Throat_P	*3.12*		
10	Runny Nose_NP	*3.00*	*-.55*	*.57*
	Runny Nose_P	*3.00*		
11	Hoarseness_NP	*3.54*	*-1.38*	*.16*
	Hoarseness_P	*3.35*		
12	Dry Skin_NP	*3.35*	*-1.89*	*.06*
	Dry Skin_P	*3.03*		

13	Dizziness_NP Dizziness_P	*3.50* *3.32*	*-1.69*	*.09*
14	Wheezing of chest or Tightness_NP Wheezing of chest or Tightness_P	*3.50* *3.35*	*-1.40*	*.16*
15	Nausea_NP Nausea_P	*3.50* *3.41*	*-.36*	*.71*

Table 26 that has been presented above unpacks the results of the individual items within the Sick Building Syndrome Scale (Appendix J) in order to determine whether any individual items presented any significant changes when the plants where installed within the office environment. Out of the 15 individual items measured, it is evident that there are no significant results to be reported, therefore suggesting that the plants had no impact on the employees' physical wellbeing throughout the study. Conversely upon analysis of the means presented in the no plant condition and the plant condition, there are several means that do suggest slight improvements in the items; however these slight improvements are not concrete enough to report.

Table 27: Wilcoxon Sign Rank Test – Psychological Wellbeing Individual Scales

EMPLOYEES PSYCHOLOGICAL WELLBEING-TEST STATISTIC				
Item		**Mean Scores**	**Z**	**Asymp. Sig (2-tailed)**
1	Optimistic about my Future_NP Optimistic about my Future_P	*3.84* *3.78*	*-.47*	*.63*
2	Feeling Useful_NP Feeling Useful_P	*4.06* *3.78*	*-1.59*	*.12*
3	Feeling Relaxed_NP Feeling Relaxed_P	*2.18* *2.36*	*-.89*	*.37*
4	Dealing with Problems Well_NP Dealing with Problems Well_P	*3.78* *3.71*	*-.36*	*.71*
5	Thinking Clearly_NP Thinking Clearly_P	*3.78* *3.84*	*-.57*	*.56*

6	Feeling Close to People_NP Feeling Close to People_P	*3.59* *3.40*	*-1.21*	*.22*
7	Make up my Mind about Things_NP Make up my Mind about Things_P	*4.18* *3.96*	*-1.49*	*.13*

Table 27 that has been presented above unpacks the results of the individual items within the Warwick-Edinburgh Mental Wellbeing Scale (Appendix I) in order to determine whether any individual items presented any significant changes when the plants where installed within the office environment. Out of the 7 individual items measured, it is evident that there are no significant results to be reported therefore suggesting that the plants had no impact on the employees' psychological wellbeing throughout the study. Conversely, upon analysis of the means presented in the no plant condition and the plant condition, there are several means that do suggest slight improvements in the items; however these slight improvements are not concrete enough to report.

Table 28: Wilcoxon Sign Rank Test – Employees Work Engagement Individual Scales

EMPLOYEES WORK ENGAGEMENT-TEST STATISTIC				
Item		**Mean Scores**	**Z**	**Asymp. Sig (2-tailed)**
1	While at work I feel that I am bursting with energy_NP While at work I feel that I am bursting with energy_P	*3.35* *3.15*	*-.77*	*.44*
2	At my job I feel strong and vigorous_NP At my job I feel strong and vigorous_P	*4.00* *3.53*	*-1.93*	*.05*
3	I am enthusiastic about my job_NP I am enthusiastic about my job_P	*4.45* *3.77*	*-2.05*	*.04*
4	My job inspires me_NP My job inspires me_P	*4.25* *3.51*	*-1.74*	*.08*

5	When I get up in the morning, I feel like going to work_NP When I get up in the morning, I feel like going to work_P	*4.09* *3.53*	*-1.80*	*.07*
6	I feel happy when I am working intensely_NP I feel happy when I am working intensely _P	*4.45* *3.93*	*-2.12*	*.03*
7	I am proud of the work I do_NP I am proud of the work I do_P	*5.10* *4.34*	*-3.56*	*.00*
8	I am immersed in my work_NP I am immersed in my work_P	*4.20* *3.80*	*-1.55*	*.12*
9	I get carried away when working_NP I get carried away when working_P	*4.10* *3.71*	*-1.53*	*.12*

It is not necessary to assess the individual items of the Utrecht Work Engagement Scale (Appendix L) due to the fact that the researcher was presented with a significant results in the Wilcoxon Sign Rank Test conducted in section 4.3.3 of this chapter. However the researcher deemed in necessary to identify which items of the scale that presented significant results in order to recognise which items the sample was experiencing decreased work engagement. The Utrecht Work Engagement Scale (Appendix L) presented 9 items, of which 3 presented significant results suggesting that there was a change in employee work engagement. These items included; "I am enthusiastic about my job" ($Z=-2.05$; $p<0.05$; mean NP= 4.45 ,mean P= 3.77), "I feel happy when I am working intensely" ($Z=-2.12$; $p<0.05$; mean NP= 4.45 ,mean P= 3.93) and "I am proud of the work I do" ($Z=-3.56$; $p<0.05$; mean NP= 5.10, mean P= 4.34). The means confirm that there was in fact a decrease in work engagement among the employees in the sample once the plants were installed in the office environment. The effect size of the significant values are calculated at 0.36, 0.38, and 0.63 respectively; the first two values according to Cohen (1988) are regarded as medium effect sizes, while the third calculated effect size is regarded as a large effect size. These results will be discussed further in chapter 5 of this research report.

4.5.5 Spearman Rank Order Correlation (Rho)

The final research question was interested in investigating how an individual's concern for the environment or their connectedness to nature impacted the presence of plants within the BCX workspace, in other words, was the participants' level of concern for the environment related to the influence of the presence of plants on the dependent variables. With a view to answering this research question, a difference score was calculated on each of the dependent variables between the score in the presence of plants condition or in the absence of plants condition.

Table 29: Descriptive Statistics for the Difference Scores

DESCRIPTIVE STATISTICS

	N	Mean	SD	Min	Max
PSYCH_DIFF	*32*	*.0213*	*.39811*	*-0.77*	*.80*
PHYS_DIFF	*31*	*-0.0616*	*.52378*	*-1.17*	*1.00*
ENGAGE_DIFF	*31*	*-0.5410*	*1.03173*	*-4.00*	*1.95*
PERCEP_DIFF	*32*	*.0747*	*.50230*	*-0.58*	*2.23*

The difference scores were obtained by subtracting the "No Plant" condition score from the "Plant" condition score. Therefore a positive score would imply that the individual's score for the "Plant" condition was higher than the "No Plant" condition, and a negative score would imply the inverse. Mere inspection of the difference scores demonstrate that these were quite close to 0. The widest spread was found on the engagement sale, while the range of scores were quite small for the remaining scales. These difference scores were subsequently correlated with the concern for the environment. A significant correlation would imply that Concern for the environment does influence the people's scores under the 2 experimental conditions. Due to the small sample size, a non-parametric Spearman's rho correlation was used. Results are reported in the table below.

Table 30: Difference Scores Correlations

NONPARAMETRIC CORRELATIONS		
		Connectedness To Nature Scale
PSYCH_WB_DIFF	***N***	*32*
	Correlation Coefficient (rho	*.053*
	Asymp. Sig. (2-tailed)	*.722*
PHYS_WB_DIFF	***N***	*31*
	Correlation Coefficient (rho	*-0.061*
	Asymp. Sig. (2-tailed)	*.743*
PERCEP_DIFF	***N***	*32*
	Correlation Coefficient (rho	*-0.300*
	Asymp. Sig. (2-tailed)	*.096*
ENGAGE_DIFF	***N***	*31*
	Correlation Coefficient (rho	*-0.116*
	Asymp. Sig. (2-tailed)	*.536*

Table 30 above presents interesting results as the Psychological Wellbeing Difference Score (($T_{(32)}$ = 0.722, p > 0.05), Physical Wellbeing Difference Score ($T_{(31)}$ = -0.061, p > 0.05), Perceptions of the Work Environment Difference Scores ($T_{(32)}$ = -0.300, p > 0.05) and Employee Engagement Difference Score ($T_{(31)}$ = -0.116, p > 0.05) all present a non-significant relationship, thus there is no evidence of correlation between the difference scores and Connectedness to Nature Scale. Therefore, it may be inferred that one's connectedness to nature or concern for the environment would not influence the respondents' scores when they were exposed to plants within the work environment.

Due to the fact that there are no significant relationships provided in the above table, the researcher is unable to determine the direction of the relationship or the strength of the relationship.

CHAPTER FIVE: DISCUSSION

5.1 *Introduction*

The following chapter aims to critically address the results of the study in relation to the conceptual framework that was explored earlier in the report. The core objectives that were explored in this study were the relationships between the absence and presence of plants and air quality, psychological well-being, physical well-being, perceptions of the physical work environment and employee engagement. The following chapter will expand on the results that were presented in chapter 4. Additionally, in order to assist the reader to understand how these results are relevant in the work environment and in assuring well-being and ultimately a productive organisation; the researcher will support her findings with research that has been conducted previously and presented results that preserve the findings of the current study. Furthermore, this chapter will address the strengths and limitations of the current study, as well as future recommendations. Finally, this chapter will be concluded by reflecting on the theoretical and practical implications of the current study.

5.2 The Absence and Presence of Plants and the Air Quality

According to the tabulated results presented in Chapter 4, the researcher was able to identify that across all four SE Control units the average room temperatures were all recorded to be above 24°C. Units one through to four captured initial thermal recordings of 24.83 °C, 24.72°C, 24.47°C and 24.47 °C respectively. These results are believed to be slightly above the regulation temperature levels that have been suggested by Fernandez-Canero, Urrestatazu, and Salas (2012). According to regulations in office buildings, indoor air quality is only believed to be good in an indoor environment once temperatures are maintained within the range of 20°C - 24°C (Fernandez-Canero, Urrestatazu, Salas, 2012). However it becomes evident that once the plants are installed in the office areas, there is an evident drop in temperatures, which reflects that the temperature levels are beginning to adjust to an appropriate temperature suited for the office area, the amount of employees situated there as well as the amount of plants that were installed in the areas. At Time 2 the SE Controls reordered temperatures of 24.29 °C, 24.11°C, 24.19 °C and 24.19 °C across all the units respectively. Although these temperature drops are not extreme, one would be urged to take into account that the measures were taken only three weeks after the plants were

installed in office area 1. One may question why the temperatures were dropping in office area 2 seeing as there were no plants installed within the area at the time, thus it is important to note that there was no physical separator that divided the two areas, thus the impact of the plants could have been due to the installation of the plants in area 1. Previous research within this spectrum had time frames of approximately 1-2 years in order to gather the results that have been reported in Chapter 2 (Evensen, Raanaas, & Patil, 2013; Fernandez-Canero, Urrestarazu, & Salas; Raanaas, Patil, & Hartig, 2001). Upon reflection of the temperature recordings that were captured in time three the researcher notes that there was a further drop evident from unit 1, unit 2 and unit 3 with temperatures of 23.59 °C, 23.86°C, 23.81 °C respectively. These results show that they have dropped a sufficient amount to be regarded as temperatures within the maintained accepted range of 20°C - 24°C as suggested by Fernandez-Canero, Urrestatazu, and Salas (2012). Furthermore, at time 3, unit four recorded a temperature of 24.37°C, which illustrated that there was a slight increase in the temperature levels in that area of the office. Although this is not an ideal result, the researcher explains that during the data collection process, it was noted by the researcher that the employees were climbing onto their desks on various occasions and fiddling with the air conditioner systems as well as the temperatures. Therefore it is believed that the fiddling of the air conditioner system may have impacted the result recorded from unit 4. The decrease in temperatures recorded since the installation of the plants are supported by research presented by a study conducted in Spain that concluded that the introduction of an active living wall within the work environment dropped temperature levels between 0.8°C and 4.8°C, depending on where the measure was being recorded (Perez-Urrestatazu, Fernandez-Canero Franco & Egea, 2015).

There is evidence of a 3 % reduction of ambient temperature in the office space, as well as stabilization of ambient temperature. There is further evidence of the employees most likely manually adjusting the air conditioner system, this was evident in the recordings in the beginning of the study as the temperatures all varied across the workspace, however once the plants were installed, they served as a temperature stabilising mechanism throughout the whole wok space. Research conducted in California supports the fact that plants serve as a temperature reduction mechanism within small environments. Kurniawan (2004) conducted a study in order to conclude whether or not plants would affect temperature

levels within small sealed boxes. Kurnianwan (2004) created two identical atmospheres within two sealed boxes, however one box had an Aralia plant placed inside, while the other box contained no plant. These boxes were monitored over time and temperature recordings were averaged out on a weekly basis (Kurnianwan, 2004). Upon completion of this experiment, the researcher concluded that that box that contained the plant presented a lower temperature of 19.38°C, while the box that never had a plant recorded a temperature of 20.2°C (Kurnianwan, 2004). Although these temperatures are both within the accepted indoor temperature, it is evident that the box that contained the plant was able to reach a lower ambient temperature.

According to the tabulated results presented in Chapter 4, the researcher was able to identify that across all four SE Control units the average humidity levels were all recorded to be above 33%. Units one through to four captured initial humidity recordings of 33.74%, 34.46%, 33.20% and 33.20% respectively. According to recent research it is evident that these levels of humidity are acceptable in order to assume a healthy indoor air quality as long as they are maintained within the range 30% - 60% (Fernandez-Canero, Urrestatazu, Salas, 2012). At time two, the SE Controls recorded humidity levels across all four units of 30.31%, 30.41%, 28.67%, 28.67% respectively. Evidently, units three and four recorded humidity levels that fall below the accepted range as suggested by Fernandez-Canero, Urrestatazu, and Salas (2012). It is relevant to highlight that the indoor plants were not installed in area two where units three and four were located, thus this drop in the humidity could have just been as a result from the dry and cold winter conditions that were experienced at the time of the study. Upon reflection of the humidity recordings that were captured in time three the researcher notes that there was a slight increase evident from the recorded humidity levels in time two, however they still remained significantly lower than the readings in time one. The workplace health, safety and welfare regulations code of practise (2006) highlights that if humidity gets too low the air may feel too dry, thus suggesting the installation of plants within the area in order to stabilise the humidity levels of the area to an appropriate reading. However, as previously reported, the humidity levels at time 3 (plants condition at all four units) were recorded at 32.23%, 31.53%, 29.85%, and 29.85% in all four units respectively. These recordings show that although recordings from units one and two remain within the accepted range suggested; recordings from units three

and four are slightly lower than the 30% accepted or “healthy” range. This could suggest that the humidity levels were not stabalised appropriately and ultimately it could mean that employees may feel as though the air maybe too dry in their workspace, as suggested by the workplace health, safety and welfare regulations code of practise (2006).

The research is able to conclude that there is evidence of an 8% decrease in the humidity levels and the humidity levels still remain within the accepted level for the indoor environment. The slight drop in the humidity levels is notable for researchers, as it is suggested that although the high humidity levels may not be a direct serious problem on people physically, it is evident that increased humidity levels may lead to individuals becoming hot and sweaty, which would result in feeling uncomfortable within their work environment (Jacarta, 2011). Importantly, it needs to be highlighted that the current study was conducted during the dry winter season in South Africa, therefore, naturally humidity would decrease as the winter season progressed, which is the data collection timeframe of the current study.

Upon analysing the results presented in Chapter 4 the researcher was able to identify that the average CO_2 recordings from all the SE Control units were logged as follows 917.96 ppm, 1036.15 ppm, 774.83 ppm and 775.17 ppm respectively. Although the readings from units three and four were relatively low, it is evident that the readings from units one and most importantly unit two are quite high and would possibly reflect that these levels of CO_2 may be affecting the employees negatively. Some reported symptoms of increased levels of Carbon Dioxide include but are not limited to dizziness, disorientation, suffocation, headaches and increased heartrate with shortness of breath (Behzadi & Fadeyi, 2012). At time two, the SE Controls recorded the average CO_2 parts per million (ppm) for each of the units, as 902.17 ppm, 850.95 ppm, 783.52 ppm and 783.52 ppm respectively. At time three the SE Controls recorded CO_2 levels as 972.04 ppm, 895.75 ppm, 750.70 ppm and 751.93 ppm for each of the units respectively. There is evidence of an unusual increased in Carbon Dioxide levels at several points, however once the researcher explored the possibilities, she discovered that there were more people within the office area during certain periods, as they were receiving training from the senior staff that were stationed within the department. This increase in people would naturally result in the increase of breathing, which would ultimately contribute to the Carbon Dioxide build up during that time.

However these slight increases are not concerning due to the fact that the overall readings from the SE controls indicated that there was a remarkable 21% decrease in Carbon Dioxide levels. This decreased result is larger than what previous studies have reported (Burchett et al., 2013). This result reveals that it is highly likely that the original CO_2 levels within this area prior to the study were much too high and as a result the plants were thriving on the copious amounts of CO_2 available. The Green Plants for Green Buildings Association (2016) suggest that employee concentration and productivity are impacted negatively when elevated levels of CO_2 are present in the work environment. This result highlights the importance of CO_2 reduction in the workplace. A recent study conducted by Harvard's Centre for Health and the Global Environment (2015) suggested that individuals who work in environments with below average recordings of Carbon Dioxide, among others are believed to have a significantly higher cognitive functioning in areas such as problem solving and developing a strategy (Behzadi and Fadeyi, 2012)

Research has been conducted in air-conditioned areas as well as areas that do not have air conditioners in the work space; results indicated that office areas that have air conditioners reported an average of a 10% decrease in CO2 levels, whereas office areas that did not have air conditioner systems reported an average of a 25% decrease of CO2 levels. This study that has taken into account the air conditioner system has reported a 21% CO2 decrease, this reveals the poor air quality that is available within this office area regardless of the air conditioner system (Burchett et al., 2013).

5.3 The Absence and Presence of Plants and Their Impact On Employee Wellbeing

The aim of the current research was to determine whether or not the presence of plants impacted a range of variables that included employee psychological wellbeing, employee physical wellbeing, and perceptions of the work environment and employee work engagement. These variables were measured using various existing scales that were tested to have reliability coefficients between α=0.734 and α=0.878 as the highest and lowest Cronbach's Alpha range. These reliability coefficient are understood to be acceptable measures of internal reliability according to standards suggested by Wells and Wollack (2003). These researchers go on to highlight the importance of one's concern with tests of reliability; first and foremost these reliability coefficients provide a "measure of the extent

to which an examinee's scores reflect random measurement of error" (Wells & Wollack, pg. 2, 2013).

Upon closer analysis of the results that were presented in the previous chapter, it is evident that there was only one significant result outcome. This result highlighted the impact that the presence of plants had on employee engagement. Even though there were no more statistically significant results that were presented, the researcher unpacked the scales further by investigating if there were any significant results among the individual items These results will be discussed in the subsections below.

Prior to unpacking and discussing the results, there are several critical issues that need to be highlighted in order to allow the reader to understand the context upfront. Once the researcher had completed the data collection process, a meeting was arranged management and superiors in order to discuss the process going forward. During this meeting, it was discovered that there were two large occurrences that had taken place during the weeks that the current study was being conducted. It was clarified that the first occurrence involved a large significant incident with management that involved many negative occurrences that took place in the area of the study at the time of the study. The second large occurrence that was evident within the organisation at the time of the study was the company merger and introduction of new management from the other leading organisation that would now be partners with Business Connexion. Additionally, it needs to be made clear that the call centre employees were believed to be outsourced call centre workers who were not stationed at the sample work station throughout the study, as implied earlier in this research paper.

An additional critical issue that is important for the researcher to mention is that the current study was conducted during the dry winter season in South Africa. This leads to the researcher to further examine the possibility of Seasonal Affective Disorder (SAD). According to Saeed and Bruce (1998), SAD is regarded as a pattern of depressive episodes that may occur during seasonal changes. The most recognised form of SAD is known as "winter depression,that is believed to begin during the early stages of autumn right through the winter months (Saeed & Bruce, 1998).

5.3.1 The Absence and Presence of Plants on Psychological Well-Being

Reflecting on the results presented in chapter four, the Wilcoxon Sign Rank Test results revealed a non- significant relationship between the presence of the indoor planters and the employees' psychological wellbeing. The researcher then unpacked the scale further and ran Wilcoxon Sign Rank tests on each individual scale that measured psychological wellbeing. However, out of the 7 items that were measured and tested individually, there were no significant results that reported the plants had an impact on the employees' psychological wellbeing.

It became clear to the researcher that there may have been something going on with the organisation itself that may have hindered the psychological wellbeing of the employees while there were plants present in the work environment. As mentioned previously, there was a significant incident with management that involved many negative occurrences that took place in the area of the study at the time of the study. Research has shown that the work environment is made up of several relationships, among these relationships is that between employees and management (Mason, 2007). Thus naturally, if there was an occurrence taking place in the work environment that could mean that the employees' line manager or department manager were to be dismissed, it would result in several negative feelings of psychological wellbeing that may be experienced by the employees.

The second large occurrence that was evident within the organisation at the time of the study was the company merger and introduction of new management from the other leading organisation that would now be partners with Business Connexion. According to Catwright and Cooper (1993) the human aspects of mergers and the impact of such a major change event has great impact on employee wellbeing, however this relationship has received very little research attention. Organisational mergers typically involve large scale organisational change which may be a significant source of anxiety to employees within the organisation as they may question their future within the organisation (Seo & Hill, 2005). This anxiety and lack of optimism about one's future may have impacted the employees' psychological wellbeing in the current study. Furthermore, anxiety theory suggests that one's fear about their future may lead to several predicted outcomes, some of which

include low productivity, lack of motivation and mental and physical illness (Marks & Mirvis, 1985; Rentsch & Schneider, 1991).

Additionally, it is important to mention that an individual's psychological wellbeing may be influenced depending on the season. In other words, research on seasonal affective disorders suggests that studies carried out during the winter season, such as the current study, may impact health and wellbeing and result in symptoms regarding neuropsychological effects (Kuller & Lindsten, 1992). It is believed that individuals that suffer from seasonal affective disorder tend to become increasingly depressed during the winter months; however these individuals are longer depressed at the first sight of spring.

5.3.2 The Absence and Presence of Plants on Physical Well-Being

Reflecting on the results presented in chapter four, the Wilcoxon Sign Rank Test results revealed a non- significant relationship between the presence of the indoor planters and the employees' physical wellbeing. The researcher then unpacked the scale further and ran Wilcoxon Sign Rank tests on each individual scale that measured physical wellbeing. However, out of the 15 items that were measured and tested individually, there were no significant results that reported the plants had an impact on the employees' physical wellbeing.

Previous research concluded that the presence of the indoor planters within the work environment resulted in an overall increase in employee physical wellbeing (Fjeld, 2000). More specifically, Fjeld (2000) identified the indoor planters positively impacting factors such as fatigue, feeling heavy headed and headaches, itching or irritated eyes, runny or stuffy nose and sore throat among others. However this research was conducted over a two year period, where the researcher was able to carefully impact the seasons had on the employees. Due to the fact that this study was completed in 12 weeks during the winter season, these variables are most likely to have been influenced by the dry and cold weather experienced at the time. As the researcher mentioned in chapter two, sick building syndrome is a feeling of ill health (Hedge, 1996; Smith & Pitt, 2011). It is important to highlight that the following study was conducted during the winter months in South Africa, therefore there may be a possibility that the employees may have in actual fact been sick

due to the cold weather conditions, as supposed to experiencing there ill health symptoms that are related to sick building syndrome. It is evident that the 12 week time frame of the study starts in the beginning of winter, where there may not be many cases of individuals feeling “flu like” symptoms, however as the study went on, it became colder as the winter season ripened. Therefore it is highly likely that many of the employees may have been experiencing sick like symptoms that may have been a result of the cold weather and the natural understanding of people getting sick during these winter conditions. To the researchers’ knowledge, there is no research or evidence suggesting that the presence of plants may cure an individual’s flu that is as a result of a viral or bacterial infection. Therefore we would see no improvements in several of the employees’ physical wellbeing characteristics with the presence of plants. Thus it is believed that these conditions may explain the results that the researcher acquired from the presence of the plants within the work environment.

5.3.3 The Absence and Presence of Plants on Perceptions of the Physical Work Environment

Reflecting on the results presented in chapter four, the Wilcoxon Sign Rank Test results revealed a non- significant relationship between the presence of the indoor planters and the employees’ physical wellbeing. The researcher then unpacked the scale further and ran Wilcoxon Sign Rank tests on each individual scale that measured physical wellbeing. However, out of the 14 items that were measured and tested individually, there was only one statistically significant result that reported the plants had an impact on the employees’ perceptions of the work environment. This result highlighted the positive impact that the plants had on electrostatic shock experienced by the employees. Research suggests that if there isn’t sufficient humidity in the air, or if the air is too dry then there may be a build-up of static electricity leading to electrostatic shocks (Workplace Health, Safety and Welfare Regulations, Approved Code of Practise, 2006). Therefore, it is suggested that in this current study, despite the fact that there were dry winter conditions, the plants may have produced enough humidity to result in a decrease of static electricity, resulting in the statistically significant result that was found in chapter four.

5.3.4 The Absence and Presence of Plants on Employee Engagement

According to the results presented in Chapter 4, the relationship among the absence and presence of plants and employee engagement was the only relationship that produced statistically significant results. This result suggested that the presence of plants within the work environment aided a change in employee engagement. The work engagement items that were measured in the current study included; bursts of energy while at work, feelings of strength and vigour while at work, enthusiasm and intensity towards work, pride in ones work and the feeling of being immersed and getting carried away while working. This relationship presented a large effect size; this indicates the strength of the plants impacting employee engagement within the work environment. This statistically significant result, however, is not a positive one. Upon reflection of the means in the plant and no plant conditions, the researcher concluded that since the installation of the plants, employee work engagement decreased.

The researcher investigated which items of the scale reported these significant results through individual Wilcoxon Sign Rank Tests, the outcome suggested that three items reported statistically significant results, these include; “I am enthusiastic about my job”, “I feel happy when I am working intensely”, and “I am proud of the work that I do”. There could be several reasons for these results that should be noted. Firstly, we are aware of the management issue as well as the merge that were taking place at the time of the study; these significant event have most likely impacted the wellbeing of the employees which in turn would impact their engagement. Naturally, if an individual was aware of a merger that was taking place in there organisation, there would be a sense of uncertainty of their job security, which in turn would result in the employees not being able to effectively engage in their work. .

There have been several studies that have been carried out internationally that have produced significant results regarding the positive impact that the planters have had on all the dependent variables measured in the current study. Several studies showed that employee morale and in turn employee productivity improved when indoor plants are present in the work space (Conklin, 1972, 1978; Jaeger, 1969; Marchant, 1982; Rogers, 1968; Scrivens, 1980; Snyder, 1995; Tresch, 1971; Zandardelli, 1969). Furthermore, research suggests that as employee engagement increased, this would result in an increase in productivity (Fjeld, et al., 1998). Therefore the researcher was tasked to investigate why she

did not find significant results. Upon further investigation, the researcher found that typically, research of this kind is carried out over significantly longer periods of time. Research conducted by Tove Fjeld (2000) was carried out over 2 years, while there are also additional studies that have conducted the same research over one year (Evensen, Raanaas, & Patil, 2013; Fernandez-Canero, Urrestarazu, & Salas; Raanaas, Patil, & Hartig, 2001). It is understood that these longer periods would not be sensitive to external factors that could impact the wellbeing, engagement and perceptions of the employees. The researchers would have been able to monitor things like the different seasons and how they may have impacted wellbeing, engagement and productivity. Additionally, this type of research would be more appropriate if it were conducted over a longer period of time as the researcher would be able to monitor external factors such as the merger and management issue that was experienced in the current study.

5.3.5 The Impact of the Participants' Connectedness to Nature

The final research question was interested in investigating how an individual's concern for the environment or their connectedness to nature may or may not impact the presence of the indoor planters in the work environment, in other words, was the participants' level of concern related to the influence the plants may have on the employees. The nonparametric Spearman Rank Order Correlation revealed that there were no significant interaction effects evident. Therefore, this result suggests that the covariate never strengthened or weakened the relationship among the presence of plants and employee wellbeing, engagement and their perceptions of their work environment. Therefore, suggesting that instead of one's concern for the environment serving as a moderator variable in predicting the outcomes, the current study had proven that there is rather a direct interaction between the independent variable and the dependent variable.

Restall and Conrad (2014) suggest that understanding an individual's relationship with nature is important in order to determine how it may influence their personal values and attitudes as well as how this relation may influence their behavioural implications. In the case of the current study it is relevant to note that the employees that occupied the working area at the time of the study had no significant impact from their connectedness to nature toward the upward trends that were presented. This result is similar to the non-significant

result presented in It is important to mention that upon completion of the study, the researcher discovered that this scale was not as appropriate as she would have liked for it to be due to the fact that it was not solely focused on plants. There were several questions that were related to nature in terms of animals and other living organisms. The researcher recommends further careful consideration of the scale used to assess an individual's concern for the environment. When considering the scale used in the present study, the researcher acknowledges that it is not plant specific and includes the testee's concern for animals, which may impact the results in terms of concern for plants. Therefore it would be beneficial to utilize a scale that is more plant specific when measuring one's concern for the environment. Furthermore, a suggestion would be to assess the participant's perceptions of their office or workspace aesthetics before and after plants are installed in order to measure if the planters impact their perceptions.

5.4 Limitations, Recommendations and Future Research

There are several factors that need to be considered when looking at the above mentioned results. First and foremost, it was discovered that several employees were not permanently stationed in the same areas throughout the study; therefore the researcher was unable to match all the questionnaires to each employee at time one, time two and time three and make individual comparisons. This led to the researcher gathering the holistic results from the stage where there were no plants in the office area and comparing there results to the stage, where there were plants installed in the office area. This meant that the researcher was tasked to select questionnaires that matched with these significant stages in order to obtain the appropriate results. This resulted in the overall sample of the study decreasing significantly. Furthermore, this study suffered from a high rate of the work area population who were not willing to partake in the study, thus resulting in a reduced sample. This small sample is believed to raise questions regarding the representability of the sample. Furthermore, the small sample weakened the statistical validity of the results

An important aspect that needs to be acknowledged is that this study was done over a very short period of time, more specifically over 10 to 12 weeks; this could be a valid justification as to why the researcher was unable to acquire statistically significant results that reflected the positive upward trend. Previous similar research conducted a similar study over 2 years

and this study had an outcome of statistically significant positive upward trends. Therefore a recommendation for future research would be to conduct this study over a longer period of time in order to have visible results as well as statistically significant results. Importantly, it has been emphasised that call centers are considered to be highly psychologically toxic work environments (Campbell, 2006), therefore the fact that this research has reported an upward trend in the results is a positive as it shows that the employees are not getting worse within this toxic work environment. An additional limitation of the study relates to the fact that non-parametric tests are believed to have several disadvantages that need to be considered in this chapter. The most relevant disadvantage in this context suggests that these alternatives are less sensitive than their more powerful parametric alternatives, therefore there is a change that they may fail to detect differences within groups that may actually exist (Pallant, 2013).

Finally, in terms of the air quality measures, it would be beneficial for future researchers to include the measure of VOC's in order to assess how the installation of the planters improve the workspace air quality. Vertical greening systems may be an interesting green technology to look into for future research. These living walls hold a high quantity of plants that may be beneficial for organizations that may not have the sufficient floor space to foster the correct amount planters in order to satisfy that plant to employee ratio.

This study is a first in South Africa, thus it is significant to acknowledge that this was a learning process for all the parties involved. This project allowed us to clarify what we would do differently in the future as well as the importance of considering the specifics of each organisation of department when conducting this study as well as when determining on the length of the study in order to assure the best possible result for all the involved parties.

5.5 ***Theoretical and Practical Implications***

The results achieved in this study have both theoretical and practical implications. Importantly, these results have implications for those who are ambitious enough to replicate the study or those who would like to further the sphere of research and knowledge of the impacts of adopting plants within organisations. It is important to note that if organisations better understand the relationship between their workspace, the employees

and their performance or productivity; it becomes easier for horticulturalists to encourage management to improve the work environment in which their employees spend most of their time in. In other words, a better understanding of how buildings impact people should drive improvement within the workspace, this may be one of the most important decisions to be made.

Through this type of research and evidence of the impact that plants have in the work environment and more specifically on the employees, there is a clear opportunity for organisations to begin to think differently and use their “healthy” workplace as a competitive gain in the market. Practically, should an organisation improve the working conditions in which their employees work it is likely that they would have a maximised return on investment as well as improved productivity. More specifically, creating a “healthy” or “green” work environment is bound to have multiple positive outcome such as reduced employment costs per employee, increased staff retention, increased engagement resulting in deadlines being met effectively and timeously as well as sales being made.

CHAPTER SIX: CONCLUSION

Plants play a big role in large cities where there has been a widespread development that may be causing problems such us pollution, unstable temperatures and lack of green spaces. This research has highlighted the value that plants have within any indoor space, through the support of the various studies that were introduced throughout the research report. Although there is a large amount of research that suggests that plants within the workplace offer more than just aesthetic value. The current study failed to provide positive statistically significant results. The possible reasons for these results were explored further by the researcher. This result should not be regarded as a final say regarding the impact that plants may have on employees in the workplace within a South African context. It is important to remember that the call centre environment, in which this research was carried out, is naturally regarded as being a "toxic" work environment. Thus, suggesting that these unique working conditions would not be the "norm" among different departments within an organisation.

In addition to the "toxic" work environment, it came to the researcher's attention that there were several significant occurrences that took place during the short time frame in which this study was conducted. It is believed that these occurrences played a role in the overall morale and wellbeing of the employees, therefore suggesting that future research of this nature be carried out over a longer period of time in order to account for any influential occurrences, as well as seasonal circumstances that may impact the results of the study in any way. There is great opportunity for researchers within the ergonomics field to uncover the impact that plants may have in on the wellbeing on individuals in organisations within a South African context.

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APPENDIX A

BLUE PRINT PLANS OF BUSINESS CONNEXION OFFICE AREA


Business Connexion
SCREEN PLANTERS x 25
40CM GREY SQUARE x 8
FIRST FLOOR
scale 1:100
FOR INFORMATION
Area 2
Area 1

APPENDIX B

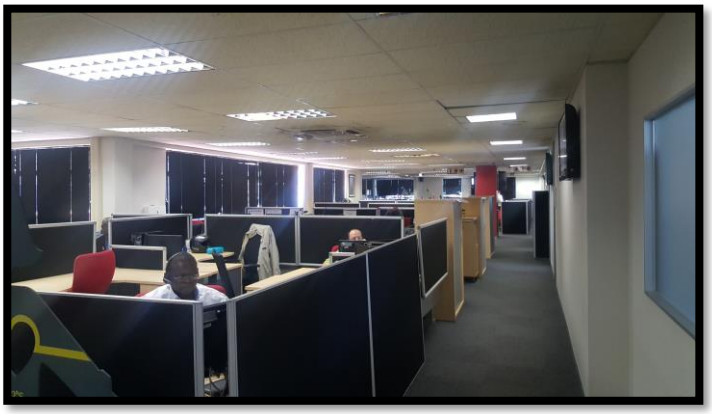
PICTURES OF URUBI PLANTERS

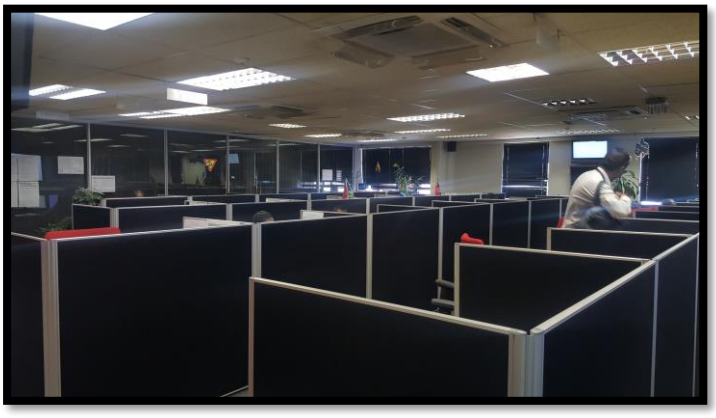
APPENDIX C

PICTURES OF SCREEN PLANTERS

APPENDIX D

PICTURES OF OFFICE AREAS DURING NO PLANT CONDITIONS





APPENDIX E

ETHICAL CLEARANCE

APPENDIX F

PERMISSION TO ENTER THE ORGANISATION

THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT
(SHCD)

Private Bag 3, Wits, 2050 • Tel: 011 717 4524 • Fax: 011 717 4556 • E-mail: umthombo.SHCD@wits.ac.za

Dear Sir/Madam

My name is Anastasia Kalantzis; I am an Organisational Psychology Masters student at the University of the Witwatersrand. In order to fulfil the requirements for my Masters degree, a research project needs to be conducted and completed. My study aims Assessing how the presence of indoor plants impacts employee wellbeing within the selected office space.

In order to examine this relationship, I am required to collect data, in this case through a collection of three assessments among the additions of trial planters within the office area. Due to the fact that the employees within your organisation are the sample that I would like to study; I would like to ask permission if you could grant me access to your employees to invite them to participate in the study by completing these assessments. The assessments will take approximately 15 - 20 minutes to complete and will be set up at a time most appropriate for you. Participation in this study is voluntary and participants may withdraw before the completion of the assessment (as completion of the assessments is considered consent). Employees will remain anonymous as I will not disclose any information that could single out any participants. Pseudonyms will be used in the final write up of the research report to guarantee participants confidentiality. The data will be analysed at group level so as that no individual will be identified. Your organisation will receive the results of the study in the form of a summary. Additionally, the results will be made available for six months prior to the completion of the study should any employees wish to enquire about the outcome of the study.

Once the study is complete, the raw data will be destroyed. The assessments will only be viewed by me and my research supervisor. If you have any further questions, please don't hesitate to contact either me or my supervisor.

Kind Regards

Anastasia Kalantzis

anastasia888@live.com

Professor Andrew Thatcher

andrew.thatcher@wits.ac.za

APPENDIX G

SIGNED NON-DISCLOSURE AGREEMENT

APPENDIX H

DEMOGRAPHICS QUESTIONS

BIOGRAPHICAL DETAILS

Employee Number: _____

Gender: Male ☐ Female ☐

Race: White ☐ Black ☐ Indian ☐ Asian ☐ Other ☐

Date of Birth: _____

When did you start working at Business Connexion? _____

Organisation Level: _____

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 come in to work?

_____

APPENDIX I

THE WARWICK-EDINBURGH MENTAL WELLBEING SCALE

PSYCHOLOGICAL WELLBEING QUESTIONS

Please answer the following questions in relation to how you have been feeling at work in the last three weeks. (The Warwick- Edinburgh Mental Well-being Scale)

	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 cheerful					

APPENDIX J

SICK BUILDING SYNDROME QUESTIONS

PHYSICAL WELLBEING QUESTIONS

In the last month how often have you experienced the following symptoms while at work? (Sick building Syndrome Questions)

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

APPENDIX K

PERCEPTIONS OF PHYSICAL WORK CONDITIONS

PERCEPTIONS OF THE PHYSICAL WORK ENVIRONMENT QUESTIONS

Please rate how often you have experienced the following conditions while at your work station or in your office in the last three weeks (Perceptions of Physical Work Conditions).

	Never	1-3 times a month	1-3 times a week	Every day
Temperature too warm				
Temperature too cold				
Lighting too dim				
Lighting too 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 L

UTRECHT WORK ENGAGEMENT SCALE

WORK ENGAGEMENT QUESTIONS

Please rate the extent to which you agree with each statement, using the scale from 0 to 6 as shown below. (Utrecht Work Engagement Survey)

0 – Never
1 – Almost never *(a few times a year or less)*
2 – Rarely *(once a month or less)*
3 – Sometimes *(a few times a month)*
4 – Often *(once a week)*
5 – Very often *(a few times a week)*
6 – Always *(every day)*

	0	1	2	3	4	5	6
While at work, I feel that I am bursting with energy.							
I find the work that I do full of meaning and purpose.							
Time flies when I'm working.							
At my job I feel strong and vigorous.							
I am enthusiastic about my job.							
When I am working, I forget everything else around me.							
My job inspires me.							
When I get up in the morning, I feel like going to work.							

APPENDIX M

CONNECTEDNESS TO NATURE SCALE

CONCERN FOR THE ENVIRONMENT QUESTIONS

Please rate the extent to which you agree with each statement, using the scale from 1 to 5 as shown below. Please respond as you really feel, rather than how you think “most people” feel. (Connectedness to Nature Scale)

	1 Strongly disagree	2 Disagree a little	3 Neutral	4 Agree a little	5 Strongly agree
I often feel a sense of oneness with the natural world around me.					
I think of the natural world as a community to which I belong.					
I recognize and appreciate the intelligence of other living organisms.					
I often feel disconnected from nature.					
When I think of my life, I imagine myself to be part of a larger cyclical process of living.					
I often feel a kinship with animals and plants.					
I feel as though I belong to the Earth as equally as it belongs to me.					
I have a deep understanding of how my actions affect the natural world.					
I often feel part of the web of life.					
I feel that all inhabitants of Earth, human, and nonhuman, share a common ‘life force’.					
Like a tree can be part of a forest, I feel embedded within the broader natural world.					
When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature.					
I often feel like I am only a small part of the natural world around					

me, and that I am no more important than the grass on the ground or the birds in the trees.					
My personal welfare is independent of the welfare of the natural world.					

APPENDIX N

PARTICIPANT INFORMATION SHEET

THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT
(SHCD)

Private Bag 3, Wits, 2050 • Tel: 011 717 4524 • Fax: 011 717 4556 • E-mail: umthombo.SHCD@wits.ac.za

Dear Sir / Madam

Good day, my name is Anastasia Kalantzis and I am currently completing my Organisational Psychology Masters degree at the University of the Witwatersrand. I am conducting research for the purpose of obtaining this degree which involves exploring the perceptions of your work environment and how you engage in your work. Part of this research kindly requests your participation in three self-report assessment surveys, which should take approximately 15-20 minutes for each assessment (conducted several weeks apart) to complete. I understand that this is a substantial investment of your time; however, your response is valuable as it will contribute towards a broader understanding of your work environment perceptions and work engagement. I therefore would like to invite you to participate in this research.

Participation is voluntary, and you will not be advantaged or disadvantaged in any way for choosing to go through with the assessment survey. Your responses will remain confidential however anonymity is not guaranteed due the request of obtaining your employee numbers in order to assist me in matching your three assessments. At no time will anyone other than my supervisor and I know who you are, as in the research write up no personal information will be reported. Although I know who you are, confidentiality will be maintained by not disclosing any information that is of a personal nature in the report. I will assign a pseudonym to your information in the report if necessary, for example, Participant A or Respondent B. You have the right to withdraw from the study at any time. You also have the right to refrain from answering any question should you wish to do so. Informed consent will be assumed after reading this participant information sheet and your choice to complete and submit of the questionnaires.

You may email me or my research supervisor approximately 6 months after completion of the assessments should you require general feedback or debriefing on the results of this study.

If you have any further questions or require feedback on the progress of the research, please feel free to contact either myself or my supervisor on the details provided below.

Thank you for considering taking part in the research project. Please detach and keep this sheet for future reference.

Kind Regards

Anastasia Kalantzis (Researcher)

082 7022 433

anastasia888@live.com

Professor Andrew Thatcher (Supervisor)

011 717 45 33

andrew.thatcher@wits.ac.za