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Mobile mindfulness; a comparative study of mindfulness and relaxation apps, and the impact on employee wellbeing in the workplace.

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Abstract

Organisations are looking for effective interventions to improve employee wellbeing in order to counteract high work demands. Mindfulness has recently gained in popularity as a readily available tool that can be utilised for a variety of self-improvement and wellbeing effects. Technological advances in the mobile health space have placed mindfulness interventions onto smartphone devices allowing anyone, anywhere, to access such tools. However, there remains a number of limitations on current research. This investigation explored the effectiveness of a mindfulness app within the workplace and its impact on employee wellbeing using both an active and waitlist control. A randomised semi-blind control trial was conducted with a diverse self-selecting sample, randomly assigned to one of three groups: mindfulness intervention, relaxation app active control, or passive waitlist control. Apps were used for three to five days per week over a four week period. Participants completed a baseline questionnaire (n = 95) measuring personality, mindfulness, and a range of wellbeing measures. Questionnaire was repeated at the end of the four week intervention (n = 67), and again four weeks post intervention (n = 52). The study explored impact of mindfulness on employee wellbeing, sustained benefits four weeks post intervention, effect of expectancy on intervention, impact on longer usage of intervention app, and impact of personality type in continuing the study and effect of the intervention. Results of repeated measure ANOVAs showed no significant effect of mindfulness on employee wellbeing, therefore no analysis was conducted of sustained results. Expectancy of the effectiveness of the trial positively correlated with self-rated perceived positive impact of the mindfulness intervention, but not for either control group. Length of time the app was used was not significant. There was a positive correlation between the intervention and the Positive subscale of Positive and Negative Affects Scale and negative correlations with the Autonomy and Self-Actualisation subscales of Ryff's Wellbeing Scales for the mindfulness intervention group, this differed to the active control group. There were no statistically significant changes in the waitlist passive control condition. Findings do not support the viability of smartphone-based mindfulness interventions to significantly improve employee wellbeing.

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Ethical consent was provided by the Massey University Human Ethics Committee [Southern B, Application 18/31]. Full informed online consent was received from all participants before being able to partake in the study.

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Abbreviations

ACT = Acceptance Commitment Therapy

FFM = Five-Factor Model

MAAS = Mindfulness Attention Awareness Scale

MBCT = Mindfulness Based Cognitive Therapy

MBSR = Mindfulness-based Stress Reduction

mHealth = Mobile Health

PANAS_Neg = Negative subscale of Positive and Negative Affect Schedule

PANAS_Pos = Positive subscale of Positive and Negative Affect Schedule

PSI = Physical Stress Index

PWB = Psychological Wellbeing

RWBS_A = Ryff's Wellbeing Scale, Autonomy

RWBS_EM = Ryff's Wellbeing Scale, Environmental Mastery

RWBS_PG = Ryff's Wellbeing Scale, Personal Growth

RWBS_PL = Ryff's Wellbeing Scale, Purpose in Life

RWBS_PR = Ryff's Wellbeing Scale, Positive Relations with Others

RWBS_SA = Ryff's Wellbeing Scale, Self-Acceptance

RWBS_Tot = Ryff's Wellbeing Scale, Total

SWB = Subjective Wellbeing

SWLS = Satisfaction with Life Scale

WRRS_AR = Work Related Rumination Scale, Affective Rumination

WRRS_D = Work Related Rumination Scale, Detachment

WRRS_PSP = Work Related Rumination Scale, Problem Solving Pondering.

Introduction

It is not a new concept that job demands can be stressful. Perhaps more than ever the pressure on workers to deliver and evolve is paramount. Employees are expected to be more creative, innovative, productive, engaged, and happier while often working in an ambiguous and changing landscape. While shifts in mind sets and practices towards more flexible working arrangements have in many ways made the balancing act of work and home life easier, it has also blurred the lines between being 'at work' and 'off the clock'. Technological advances mean workers are increasingly expected to be accessible at all hours, removing the downtime required to recover from job demands. Technology has also led the charge on a rapidly changing work environment and for some that means retraining or job loss.

Rising housing prices, steadily increasing cost of living, changed family group dynamics and events such as the Global Financial Crisis have forced retirees and second income earners back into the workplace, creating pressure on the number of roles available. There are more women in the workplace, more men working part-time and more roles are now considered high skilled, often requiring entry-level workers to have university degrees (Australian Institute of Health and Welfare, 2017). While benefits such as greater equality and more stringent safety requirements are positive progressive steps (Skills Australia, 2012; WGEA, 2016), there is also evidence to suggest that the quality of some roles is decreasing, requiring anti-social or excessive hours, and a lack of job security (Green, Kler, & Leeves, 2010; Kullberg, 2011).

There has been an increase in part time and casual roles in both New Zealand and Australia, helpful for those looking for flexibility however also increasing the number of underemployed, which currently sits around 8.5% in Australia (Scutt, 2018). This often results in individuals holding multiple jobs, paying higher secondary tax rates and precariously balancing multiple responsibilities often around family obligations. This strains not only the budget but limits quality down time and can create distress for those unable to get enough paid hours to meet their financial obligations. Those in casual roles have reported poorer mental health than permanent employees although it is hard

to determine whether there is causation between the two (Australian Institute of Health and Welfare, 2017). Employees are not the only ones facing challenges; organisations are more often in constant transformation to ensure they remain relevant, profitable, and ultimately sustainable. To meet these demands employers require employees to have the mental resilience and agility to adapt to new role requirements, changed conditions, and to be able to work comfortably with uncertainty. This requires a well performing, healthy and highly engaged workforce (Merrill et al., 2013).

Change is not only prevalent within the workforce; on a global scale we are dealing with widespread and rapid transformation. In the news there are daily messages about climate change, severe weather events such as drought (Kachor, 2019), political unrest, new threats including domestic terrorism (Palin, 2017), online bullying (Cooper, 2019), increased drug use (Carroll, 2016) rising crime rates (Clarke & Chamberlin, 2017) and higher rates of homelessness than ever before (Tilley, 2016). With so much happening around us, it is perhaps not surprising that mental health issues are also increasing (ABS, 2013). The increase in mental health issues affects all of society and within the work place, it can manifest in high rates of absenteeism costing employers billions of dollars each year. Those same employers are also battling rising costs and increasingly competitive markets, no longer competing only domestically but often on an international scale (Merrill et al., 2013). Businesses are progressively faced with the necessity to deliver more with less and that pressure flows through to employees who are tasked with elevating performance and continually pursuing improved ways of working. This may result in higher stress levels; however, stress in itself is not necessarily negative.

Lazarus's Transactional Model identifies a difference in the way people appraise similar challenges based on individual differences, the outcomes of which may either be eustress or distress (Di Fabio, Peiro, Rodriguez, & Kozusznik, 2018; Lazarus, 2006). Eustress is a term accredited to Hans Selye (1976) who argued that stress had a non-specific physiological response in the body that could result from both positive and negative precursors (Nelson & Simmons, 2003). Eustress, which occurs when someone is challenged or stretched and has the coping mechanisms to see this as an opportunity, can result in positive outcomes for both employer and employee such as improved performance and job satisfaction, optimal flow conditions, personal growth, broader

opportunities, and a high sense of achievement. However, if the pressure becomes overwhelming whether due to individual differences, simple overloading, or other demands, this produces distress and the employee may be unable to cope (Di Fabio et al., 2018; Lazarus, 1991; Lazarus, 2006; McGowan, Gardener, & Fletcher, 2006; Nelson & Simmons, 2003).

When the inability to cope with the imbalance between job demands and resources is prolonged, it can have serious health effects such as psychosomatic difficulties, cardiovascular complaints and musculoskeletal disorders (Heckenberg, Eddy, Kent, & Wright, 2018; Lazarus, 2006; McGowan et al., 2006). Studies have shown that males in particular are more susceptible to health complications arising from a distressful work environment, which may include minor ailments such as head and back ache, through to serious health complications such as heart attack and stroke (Gerdi, Torhild, Sonja Carl, & Nancy, 1997).

With studies showing that both physical and mental health of employees are significant indicators of job performance, organisations are increasingly looking to new and innovative ways to ensure they are providing safe work environments where employees are able to achieve their best (Parker, Wilson, Vandenberg, DeJoy, & Orpinas, 2009). Mindfulness has become a mainstream tool encouraged in societal franchises including schools and the workplace as a solution to calm and centre individuals so that they can better cope with stressors (Wells, 2015). With the rapid rise of technology, online tools are providing inexpensive options for businesses to consider as alternative delivery methods over face-to-face training and mindfulness apps are now being utilised to improve wellbeing (Quinn, 2011). However, how useful are these tools really?

With a large commercial incentive and little regulation there are many apps on the market that have been largely untested to deliver the results they proclaim. Those apps tested in scientific studies often lack rigorous scientific design (Lomas, Ivtzan, Hart, Eiroa-Orosa, Medina, & Rupprecht, 2017). Common shortcomings are suitable control conditions and possible bias through the relationship between the tester and financial beneficiary. Understanding impact of mindfulness apps on wellbeing is further challenged by the multiple definitions of both mindfulness and wellbeing.

Literature review

Wellbeing at work

The work environment can be a place for some to thrive; enhancing mental health and wellbeing through the provision of social connections, positive sense of identity and purpose (Lazarus, 2006). For others it can be diminishing; endangering wellbeing due to the aforementioned high job-demand pressure, poor workplace relationships, and anxiety producing stimuli overtaxing the individual, potentially leading to poor health outcomes and long-term absenteeism (Muschalla, Heldmann, & Fay, 2013). Lazarus's Transactional Model shows that distress at work will transfer into the home environment, effecting not only health outcomes but familial and community relationships and can even influence spousal health (Nelson & Simmons, 2003). It is not surprising that a distressful work environment has such an impact on the home considering the large amount of time many people spent at work.

In Australia, the average working adult spends 1,676 hours a year at work, in New Zealand it is higher averaging 1,753 hours per year (OECD, 2019). In Australia, the accountability of organisations to protect their workers from psychological harm and to provide a safe working environment is a legislative requirement under the Work Health and Safety Act (2011). New Zealand introduced similar laws in the Health and Safety at Work Act (2015). If these legislations are breached it can result in hefty fines and even prison sentences. Beyond the legislative requirements, psychological safety and employee wellbeing is paramount if employers want to ensure high engagement and effectiveness, and a constructive culture to maximise productivity and therefore profitability (Merrill et al., 2013).

Employers have additional financial pressure to provide a safe environment not only in terms of absenteeism and turnover, but also in potential workplace claims. The average psychological injury claim in Australia cost \$24,500 in 2014-15, with a total cost of over \$480 million per annum in mental health related worker's compensation (Safe Work Australia, 2018). Additionally there is an ethical responsibility to ensure that employers provide an environment which supports and develops long term sustainable work practices, beneficial not only for employees but for business brand and reputation

as the competition to attract and retain top talent and ensure high productivity increases. Despite these pressures there are very few context specific measures such as questionnaires designed to look at psychological wellbeing specifically within the work environment (Dagenais-Desmarais & Savoie, 2012) and even less that are applicable to indigenous populations (Sandilya & Shahnawaz, 2018). It is perhaps unexpected given the cost impact of poor wellbeing at work to the individual, business, and society.

Mental illness is the leading cause of long-term absence from work for Australian workers (Petrie et al., 2018) with one in five Australians having trouble with their mental health each year (Australia Institute Health and Welfare, 2018). Perceived stress has risen by 22% across all business sizes, caused in order of impact by workload, family relationships, pressure to meet targets, management styles and long hours (Wellness in the Workplace, 2017). In New Zealand, 24% of adults report some form of medium to high-level psychological stress, and four in five adults experience mental distress, either themselves or through someone they know (Kvalsvig, 2018). The impact on the individual can mean loss of income, fear and anxiety, and inability to provide for their family. For businesses, supporting workers with high-volume or long-term absenteeism is costly not only to the budget but also to employee engagement and customer experience as remaining employees need to take on additional duties to cover the work (Merrill et al., 2013). Despite the high rates of mental health experienced by employees, there is little evidence-based guidance for employers on how to support a healthy work environment.

Many employees fear mental health stigma whether that takes the form of ignorance or misinformation, negative attitudes and behaviors, or more serious discrimination (Thornicroft, Wyllie, Thornicroft, & Mehta, 2014). While in Australia the Fair Work Act (2009) and in New Zealand the Human Rights Act (1993), both prevent discrimination in the workplace due to mental illness, the reality is this may be difficult for individuals to challenge, especially if their psychological resources are already reduced through job strain. Mental health charity SANE Australia's research (2014) showed 48% of respondents were concerned about disclosing a diagnosis of depression to their employer, fearing it would put their jobs in jeopardy. Similarly in New Zealand, one third of respondents in the report 'Wellbeing and mental distress in Aotearoa New Zealand: snapshot 2016' had either experienced discrimination due to

mental illness or had modified their behavior to prevent others finding out they had a mental illness, and only 20% would be willing to tell their employer if diagnosed (Kvalsvig (2018). This leads to high rates of unreported illness and a hidden danger for employers and employees alike when navigating mental illness at work. The most common form of support provided by businesses for reduction of stress and anxiety is Employee Assistant Programs and flexible work hours, but if employees are reluctant to notify their employer they may also fear stigma of using these programs despite their confidential nature (Pitsilis, 2015). It also means the problem may be larger than organisations are able to see and therefore counteract, which has the potential to exacerbate the problem, creating further stress and tension.

In 2016, New Zealand lost 6.6 million working days to absenteeism, a cost of approximately \$1.5 billion (Wellness in the Workplace, 2017). In Australia, the annual estimated cost of absenteeism is \$33.06 billion per annum (DHS, 2017) in addition to mandatory worker's compensation insurance costing a combined \$10 million per annum (HRD, 2018). Absenteeism has been labeled a global epidemic with estimates it will cost the global economy \$23 trillion AUD by 2030 (HRD, 2018). With growing pressure to extract greater productivity from employees while balancing the provision of a safe work environment, more organisations are looking for ways to provide an optimal environment that enhances the employee experience and improves employee wellbeing. Some even believe that with the hours spent at work it may be the ideal place to identify and prevent or treat disorders (Mykletun & Harvey, 2012). Mindfulness is one of the more recent developments in recommended activities and programs for workplaces to reduce stress (HRD, 2018; Hyland, Andrew Lee, & Mills, 2015).

Mindfulness

Mindfulness originated 25 centuries ago in the Buddhist Dharma - teachings based on spiritual traditions and meditative practice designed to sustain humankind in its search for happiness and spiritual fulfilment, removing suffering, and putting one on the path to nirvana (Bodhi, 2011). A key focus was on obtaining embodied awareness, clarity, and emotional balance through which positive qualities such as compassion; wisdom and equanimity are improved (Baer, Smith, Hopkins, Krietemeyer & Toney, 2006; Bodhi, 2011; Fennell & Segal, 2011; Kabat-Zinn, 2011; Williams & Kabat-Zinn, 2011).

Buddhist theory indicates that regular meditative practice develops mindfulness, indicating that mindfulness contains a set of skills that can be learned, and applied (Sauer et al., 2013; Shapiro, Oman, Thoresen, Plante, & Flinders, 2008).

In the last 40 years, mindfulness practice has grown increasingly more popular with those in the secular space seeking to increase happiness and improve wellbeing. More recently mindfulness has been utilised and incorporated into mental health applications including clinical interventions such as mindfulness-based stress reduction (MBSR), mindfulness based cognitive therapy (MBCT) and acceptance commitment therapy (ACT) (Baer et al., 2006; Baer, 2011; Fennell & Segal, 2011; Kabat-Zinn, 2011; Williams & Kabat-Zinn, 2011).

Credited to the convergence of two seemingly different epistemologies; western empirical science and the eastern world of contemplative practice, Kabat-Zinn's 1979 development of the MBSR programme led the way for a more integrative approach of mindfulness into mainstream medicine (Bodhi, 2011; Williams & Kabat-Zinn, 2011). Central to mindfulness-based programmes is aiding individuals to break the pattern of recurrent behaviour such as avoidance or negative rumination by recognising indicators of mood change and applying mindfulness practice to create alternative schemas and responses (Fennell & Segal, 2011). MBSR is described as changing modern medicine's perspective of the ability to overcome human vulnerabilities through regulation and control (Bodhi, 2011). Mindfulness based interventions and study are now widely funded and implemented by medical facilities, universities and large government bodies such as the National Institute of Health (US) and are more widely accepted for treatment for a wide range of health challenges including substance abuse, depression and anxiety (Baer et al., 2006; Baer, 2011; Williams & Kabat-Zinn, 2011).

Despite the growing popularity, determining an exact agreed definition of mindfulness within psychology is difficult and *'psychologists have noted that the meaning of mindfulness is subtle and elusive and that defining it in precise terms is difficult'* (Baer, 2011, p. 245). Commonly used definitions of mindfulness in psychology literature today generally consist of being aware or bringing attention to experiences in the current moment in a non-judging, accepting manner (Baer et al., 2006; Brown & Ryan, 2003; Dane, 2011; Economides, Martman, Bell, & Sanderson, 2018; Kabat-Zinn, 2011;

Williams & Kabat-Zinn, 2011). The belief is that by observing thoughts and feelings as perception rather than truths about the self, an individual can retrain negative thought patterns and reduce reactive responses resulting in calmness and increased wellbeing (Economides et al., 2018). The most prominent definition of mindfulness within psychology still comes from Kabat-Zinn (2003): *‘The awareness that arises through pausing attention on purpose in the present moment and non-judgementally to the unfolding of the experience, moment by moment’* (p. 145).

Kabat-Zinn’s definition differs from the diverse pluralist Buddhist teachings which traditionally encouraged the balance between suspending evaluation and judgment, and the purposeful evaluation of mental qualities to ensure the removal of destructive attributes preventing purposeful action that could lead to the path of nirvana (Dreyfus, 2011; Dunne, 2011). Mindfulness in the traditional sense can be similar to the western approach, directed or guided, or alternatively undirected and open in order to evoke insight (Bodhi, 2011). This differential between eastern origins and western adaptations is one of the critiques of modern scientific application.

Challenges of applying mindfulness in psychology

The sudden rise of mindfulness as an intervention and the enthusiasm by which the general population has embraced it is potentially problematic as practice is implemented with limited true understanding of what mindfulness means (Bodhi, 2011; Dunne, 2011; Kabat-Zinn, 2011; Williams & Kabat-Zinn, 2011). The purity of the practice has the potential to be undermined and weakened by unqualified practitioners and inconsistent application of theory (Grossman, 2008). In recent times, the label of mindfulness has been applied to everything from adult colouring books to fidget spinners with little linkage to the definition of developing non-judgment and acceptance. The seemingly high speed by which mindfulness has gained momentum in the health and wellbeing arena has created a financial incentive for incorporating the terminology into commercial applications without oversight by a governing body to ensure that it is aligned, consistent, and credible.

Western psychologists are largely untrained in the eastern philosophies of Buddhist practice. This leads to inevitable inconsistency between the detail and subtlety of the

Buddhist teachings taught in the original texts and a modern western translation and application in the secular field of psychology (Bodhi, 2011; Grossman, 2008; Grossman, 2011; Fennell & Segal, 2011). There is critique in the way mindfulness interventions, developed for a psychological context, are interpreting and using mindfulness as missing the fundamental underpinnings of the Buddhist origins (Baer, 2011; Bodhi, 2011; Dreyfus, 2011; Dunne, 2011; Fennell & Segal, 2011; Grossman, 2008; Grossman, 2011). In order to withstand the test of scientific methodology, interventions must be repeatable, and have both validity and reliability. This predictive requirement reduces some of the ability for participants to develop mindfulness at their own pace, within their own growing self-awareness and the opportunity therefore for enlightenment diminishes. While many Buddhists welcome the application of mindfulness methods in a broader context, others are unhappy that this desire for pragmatic outcomes reduces the boarder philosophies to homogeneous treatment rather than a true search for enlightenment, and therefore misses the point (Bodhi, 2011).

Kabat-Zinn (2011) acknowledges that he intentionally designed MBSR in a manner that would not be seen as ‘too Buddhist’ in order for it to be accepted. Fringe activities in the 1970’s such as yoga, meditation and mindfulness are now heavily commercialised and widely accepted in mainstream society, indicating some of those pre-existing challenges Kabat-Zinn faced with introducing alternative therapies have now changed. Broader integration into multiple arenas provides an opportunity to unabashedly reconnect to the original underpinnings of the dharma perspective. *‘We can observe an accelerating confluence of dharma with mainstream medicine, healthcare, cognitive science, affective neuroscience, neuroeconomics, business, leadership, primary and secondary education, higher education, the law, indeed, in society as a whole, in this now very rapidly changing world’* (Kabat-Zinn, 2011, p. 284). This mainstream acceptance of mindfulness may become even more common providing an opportunity to return to the original teachings in a more integrated approach.

Researchers encourage the continued exploration of mindfulness application within psychology but also encourage approaching it with compassion and gratitude. Recognition that work in this field is drawing from an ancient wisdom should not be disregarded (Bodhi, 2011; Fennell & Segal, 2011; Kabat-Zinn, 2011). For every sacrifice made to move the theological to the scientifically practical there is concern

some of the essence of the practice is given up and the meaning behind it potentially lost (Fennell & Segal, 2011; Grossman, 2008; Grossman, 2011). Traditional mindfulness with a focus on sustained attention is described as much more of a cognitive process than current practice would indicate (Dreyfus, 2011). Attention should be paid to how this then shifts the purpose of mindfulness and whether the mainstream mindfulness is still creditable to the underlying philosophy. Having said this, it is apparent that some interventions such as mindfulness based cognitive behaviour therapy requires systematic self-observation and focused cognition to change what are often deeply held thought patterns (Fennell & Segal, 2011). In these circumstances, the space between traditional and modernist application may not seem too distant.

When measuring mindfulness, clear indication of what definition is being used needs to be considered as variation between the meanings can lead to misinterpretation of data and misapplication of tools. Some researchers have found definitions of mindfulness as somewhat ‘poetic and abstract’ (Chiesa, Calati, & Serretti, 2011), vague (Bodhi, 2011) and without serious reference to its origins (Dreyfus, 2011). Baer (2011) also warns consideration should be paid to ensure that what is being measured is not being manipulated to fit a certain definition. Grossman (2008; 2011) highlights multiple challenges in the attempt to measure mindfulness ranging from inconsistency between definitions, and the inexperience of Buddhist teachings of those designing scales through to the subjective nature of self-assessment on which most scales rely.

For the purposes of this study the psychology definition of mindfulness; being aware or bringing attention to experiences in the current moment in a non-judging, accepting manner will be used, however, acknowledgment is paid to the argument of traditional practitioners that this is a singular scholastic and sometimes narrow version of a multifaceted and complex tradition (Dreyfus, 2011).

Mindfulness application in the workplace

Mindfulness research has indicated numerous applications within a work environment and there is growing interest from organisations in the use application of mindfulness for employees (Hyland et al., 2015). Studies investigating mindfulness at work have

shown to reduce negative thoughts (Kiken & Shook, 2014), improve critical thinking performance (Noone, Bunting, & Hogan, 2016), enhance cognitive function including working memory capacity, executive functioning (Chiesa et al., 2011), and cognitive functioning and attention (Moore & Malinowski, 2009), reduce sunk cost bias, and attenuate negative affect (Hafenbrack, Kinias, & Barsade, 2014). Mindfulness has also been linked to lower turnover and improved performance (Dane, 2011; Dane & Brummel, 2014), and is linked to psychological flexibility, facilitating better mental health (Bond, Lloyd, & Guenole 2013).

While there are documented benefits, the application for organisations to utilise this research in a pragmatic way is a less clear and considerably more complex to navigate. Do organisations need to hire a qualified practitioner? Can they run their own mindfulness activities? Is there a tool Human Resources teams can use to spread the benefits of mindfulness application in a cost effective, high impactful way? The reality is that tools and practices are challenging to embed within organisations especially those navigating perceived barriers such as limited time and resources, high demand to deliver outcomes, varied hours and global spread of employees, and the desire to deliver consistent reliable training. With the foundations of mindfulness being spiritual, there can be a reluctance to take on a practice potentially perceived as counter cultural or theological.

While delivery of MBSR and other mindfulness interventions have traditionally been face to face, there is a growing popularity in shorter, more accessible options, including internet-based delivery (Hyland et al., 2015). Where traditional face to face delivery can be expensive and largely rely on the skill of the teacher, digital mediums may have a broader reach providing greater accessibility for remote workers, are often more affordable to deliver, and allow for self-paced learning. Online training however does not provide the same opportunities for discussion and group interaction, which helps embed learning (Reavley et al., 2018; Spikerman, Pots, & Bohlmeijer, 2016). In the interest of accessible delivery, content can also be minimised to the point where the key messages are no longer as impactful (Hyland et al., 2015). Despite these limitations, not only are online courses continuing to gain popularity, smartphone apps are now presented as an effective delivery medium for mindfulness training where individuals can practice anytime, anywhere (Economides et al., 2018). These apps come with their

own challenges not least how user technology aptitude plays a part, and how users practice if completing during work time and not in a dedicated space without distraction or appropriate settings.

Mobile health technology and apps in the health arena

In 2017, there were over 5 billion mobile phone users with projections predicting this will reach 5.9 billion by 2025, equivalent to 71% of the world's population (GSMA Intelligence, 2018). Globally, more people will have access to a phone than will have access to electricity (Cheng, 2016). Most (77%) of these will be smart phone users with the number of mobile internet subscriptions reaching 5 billion. This is putting information that was once unavailable in the hands of users instantaneously and on a global level. In areas such as health care, this has had the benefit of removing previous restrictions related to access, quality and cost for those in areas where it is untenable to be able to see a medical practitioner face to face (Lupton, 2017). Digital health is viewed as one of the key business opportunities for innovation in the tech sector where there are now over 6 million apps available worldwide (Statista, 2017). Globally \$1.2 trillion has been invested in tech start-ups related to health in the past five years (GSMA Intelligence, 2018).

Other smart devices such as wearable trackers are on the increase and the proliferation of technology in this space designed specifically to monitor, record or provide information regarding health has spawned the term 'mHealth', defined by the World Health Organization (2011), as '*medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices*' (p. 6). There are three significant components in mHealth; mobile devices, software platforms, and mHealth applications (apps) (Rebolj & Menzel, 2004). These technological advances have significant potential to increase universal health coverage, ensuring access to quality health services. In 2018, the World Health Organization identified a number of key areas where digital health is able to improve and increase the effective and timely provision of health data through:

- 1) *Increasing access to quality health services and improving the ability to gather, analyse, manage, deliver and exchange information in all areas of health.*

- 2) *Increasing access to sexual and reproductive health services; reducing maternal, child, and neonatal mortality.*
- 3) *Reducing premature mortality from non-communicable diseases and non-communicable disease comorbidities, improving awareness to bring about change on the key non-communicable diseases risk factors improving disease diagnosis and tracking, as well as self-care and home care and overall management of chronic conditions.*
- 4) *Increasing global health security through obtaining information directly from the public to support disease surveillance of both communicable and non-communicable diseases.*
- 5) *Increasing the safety and quality of care by providing secure access to the information needed by the attending physicians in the event of disasters, emergencies and other unplanned events or when patients seek care outside of their normal care settings.*
- 6) *Increasing family and community engagement through being more responsive to people's needs with digital self-care* (Summarised from World Health Organization, 28 March 2018, pp. 3-4).

While the potential benefits may be far ranging so are the concerns, especially regarding health apps. There has been significant increase in the rise of readily available apps. In early 2018 there were over 325,000 health, fitness and medical apps in the market with 78,000 added to app stores in 2017 alone (Research2Guidance, 2018). Despite the number of new apps coming onto the market every day there are no standards which they need to comply with, meaning comparably few are tested, and little have clearly reported clinical or science advisors (Freudenberg, 2017). Those studies that do occur are often poorly executed.

Byambasuren, Sanders, Belle, and Glasziou (2018), highlight a number of issues with existing studies in this space including high potential for bias where the researcher or test participants are consciously or unconsciously influenced regarding the study. Blind studies where individuals do not know what app they are using so the outcome is not influenced which counteracts potential bias are rarely used. There is also often failure to provide between-group comparisons to understand how individuals using the app compare to non-users, few using comparative controls over a baseline change and

control group contamination (Byambasuren et al., 2018). Control group contamination is when the control group are made aware of the fact they are in the control and the expected outcome. This potentially influences the results of post use testing and means the usual neutrality of a control group is lost. Sometimes contamination also occurs when the control group are able to casually use the intervention, thereby diluting their role as a control.

The financial relationship between investors, developers, and clinical advisors are currently largely unreported with clinical advisors sometimes holding multiple, often financially rewarding roles within a study. Freudenberg (2017) argues this has led to misinformation and reporting. Experimenter bias is a common challenge within studies where the experimenter may influence the outcome, certainly when there is considerable financial gain to be had this potential intensifies. This high profitability potential of an industry with little to no regulatory control can push deceptive health benefits through managed marketing, placing the consumer at risk.

With challenges surrounding the reliability of the research, trusting consumer ratings is not necessarily the answer either. A study by Singh et al., (2016) found that consumer ratings had little similarity with clinical utility or consumer usability and that most apps failed to provide a sufficient response when potentially dangerous information was entered. There are also numerous concerns regarding the security of data stored on apps where the power usually sits with large corporations with high potential of data exploitation (Lupton, 2017). Security concerns include limited availability of privacy information, risky data collection and storage, low safety scores, and high sharing of information with third parties, advertisers and marketers (Lupton, 2017; Sampat & Prabhakar, 2017).

Government organisations such as Health Navigator (www.healthnavigator.org.nz) have introduced programs to clinically test and review health apps with the findings published for users online, however this takes considerable resources and at last count, there were only 161 app reviews available on this site. The enormity of the gap between what is available to the public and what has been tested for relevance and effectiveness is concerning. Despite this, the market continues to grow. Greater collaboration between the industry and academia is required to ensure more rigorous

testing and that products are sufficiently researched and proven to deliver the expected outcomes prior to being put into commercial production (Arigo et al., 2019).

Mindfulness and relaxation apps

Mindfulness-based smartphone apps ranging from guided meditation through to reminder and tracking apps have become widely available to the general public (Plaza, Demarzo, Herrera-Mercadal, & García-Campayo, 2013). A meta-analysis of online mindfulness-based intervention completed by Spijkerman, Pots, and Bohlmeijer (2016) indicated significant beneficial impact on stress, anxiety, depression, and wellbeing. A study by van Emmerik, Berings, and Lancee (2017) indicated that smartphone delivered mindfulness training could improve quality of life. Other research indicates benefits such as improved wellbeing (Creswell, Pacilio, Lindsay, & Brown, 2014; Howells, Ivztan, & Eiroa-Orosa, 2014), and an effective means to decrease perceived stress in medical students (Yang, Schamber, Rika, Meyer, & Gold, 2018). One of the most popular mindfulness apps on the market is Headspace.

Headspace

Launched in 2010, Headspace is an online tool that provides guided meditation and education on mindfulness, is available in over 190 countries, has millions of followers, and has been downloaded more than 20 million times (Economides et al., 2018). A systematic review of mindfulness-based iPhone mobile apps by Mani, Kavanagh, Hides, and Stoyanov (2016), which evaluated quality of apps using the Mobile Application Rating Scale (MARS) that takes into consideration functionality, visual aesthetics, information quality and subjective quality subscales, rated Headspace the highest. According to Headspace founder and meditation narrator Andy Puddicombe's TedSalon talk, just ten minutes per day of mindful meditation can give you focus, calm, and clarity in your life (Puddicombe, 2012). Users can choose to partake in a free foundation course of ten minutes per day for ten days or purchase a subscription gaining access to a suite of programs of varying length focused on specific topics such as 'patience', 'without fear', 'happiness within,' and 'sleep'.

Headspace themselves sponsor large amounts of research regarding the use of their product. The studies published on their site indicate the use of Headspace has

significant positive impact on irritability, affect, and stress resulting from external pressure. Published outcomes state that only 10 minutes per day for ten days can reduce stress by 14% and irritability by 27% (Economides et al., 2018), improve self-compassion (Wylde, Mahrer, Meyer, & Gold, 2017) and increase positivity and wellbeing (Howells et al., 2014). Three weeks of Headspace use increased compassion by 23%, (Lim, Condon, & DeSteno, 2015) and reduced aggression by 57% (DeSteno, Lim, Duong, & Condon, 2017). Studies also found that the use of Headspace improved individuals' ability to focus (Bennike, Wieghorst, & Kirk, 2017), reduced stress (Wylde et al., 2017) and job strain (Bostock, Crosswell, Prather, & Steptoe, 2019) and improved job satisfaction (Wylde et al., 2017).

Of note is that some of these results are only marginally significant and often tested on a single work group profession such as contact center workers or nurses. The funding and support Headspace provides for the research undertaken and published on their site creates a conflict of interest. This conflict of interest is a reoccurring theme in health and wellbeing app research and highlights some of the challenges that make it difficult for consumers to ensure what they are purchasing has undertaken rigorous testing and will perform as stated. Of note is that while these studies acknowledge the relationship with Headspace, no conflict is indicated.

Limitations of existing research on mindfulness apps

The limitations on research regarding mindfulness apps mimic those found in the broader literature. Critique of the current research on apps includes; solely measuring for mindfulness rather than other effect on the end user, for example health impact (Plaza García et al., 2017), using no control or only a waitlist rather than an active control groups that used a different app (Byambasuren et al., 2018; Economides et al., 2018), not keeping the study blind, and in some case contaminating the study by providing information which could lead to bias (Byambasuren et al., 2018).

Additionally, it is unclear how many of the apps branded as mindfulness are actually delivering mindfulness activities. Mani et al., (2016) found when searching for mindfulness apps, out of 606 results, in reality only 23 provided mindfulness training

based on criteria including meeting a definition of mindfulness and containing a mindfulness intervention over a relaxation activity or reminder alert.

While there are many studies that indicate a significant relationship between mindfulness, and health and wellbeing outcomes, other studies have found the impact of mindfulness apps on wellbeing and stress non-significant. Wahbeh and Oken (2016) tested the effectiveness of a daily hour-long internet mindfulness intervention used for six weeks and found that while the participants increased in their mindfulness practice, there were no significant differences to health outcomes. Chiesa et al., (2011) undertook a systematic review on mindfulness impact on cognitive ability and found that while many articles indicated improved cognitive functioning such as sustained attentive abilities and attention, there were a number of methodological limitations. Some limitations included ensuring the mindfulness interventions was actually mindfulness (not only a component of mindfulness or an alternative practice), and not defining what the cognition outcome was. They also noted lack of control measures and an overreliance on waitlist without an active control. In other studies, Chiesa et al., (2011) found negative reported outcomes.

Kreplin, Farias, and Brazil (2018) conducted a meta-analysis on the pro-social benefits of mindfulness. In addition to their main finding that the effects of mindfulness on pro-sociality was limited, they also highlighted common major flaws across the studies. These flaws included the lack of active control groups to test alternative interventions, not randomising assignment of individuals to intervention or control group to ensure a fair and equal distribution, and not assessing covariate factors such as expectation effect. The meta-analysis by Kreplin et al., (2018) also noted that compassion was more likely to increase when the mindfulness trainer was also the researcher which raises questions about influence and conflict of interest. As previously mentioned, conflict of interest can result in experimenter bias where the experimenter consciously or unconsciously seeks a certain outcome to support the hypothesis, may be overly enthusiastic evoking a greater response, or in confirmation bias where the experimenter evaluates supporting data more favourably. The result of such biases may eventuate through influenced outcomes or data manipulation.

Lomas and colleagues' (2017) systemic review of empirical literature also stated that there was inconsistent quality within much of the available research and more high quality randomized control studies were required with clear definitions of wellbeing. Another challenge of the existing research is the preoccupation of the research to focus on health professions or other single closed groups such as university students, or within call centers, making it challenging to know whether the outcomes can be replicated across a broader group of professionals within a multifaceted organisation.

In order to ensure credible reliability and validity of the research all of these limitations must be addressed in future research, particularly where research is funded by the company producing the app. With such large potential financial gain at stake and growing popularity within the consumer market, more than ever there is a need for high quality trials protect users and ensure marketing of what the app delivers and validated outcomes align.

Defining wellbeing

In order to complete a study on wellbeing it is imperative to have a clear understanding of what wellbeing is. The terms wellbeing and happiness are used interchangeably in much of the current research and trying to gain a clear definition is challenging. The study of psychological wellbeing has an interesting history influenced by war, politics and emerging practices such as positive psychology. A 2012 empirical review study by Dagenais-Desmarais and Savoie (2012), revealed 23 theories and 42 distinct dimensions of psychological wellbeing. There seems to be two competing views of how psychology refers to health, one as the absence of dysfunction and the other of enhancing human factors to provide optimal functioning.

During World War II psychology practice, potentially driven by financial incentives for 'curing' post war patients, had emphasis on a pathological base concentrating on helping people under adversity, treating illness, and addressing individual suffering (Seligman & Csikszentmihalyi, 2000). While psychological practice had become heavily focused on removing dysfunction, the official definition did not align. In 1948, the World Health Organization redefined health as '*physical, mental and social wellbeing, and not merely the absence of disease and infirmity*' (p. 459, as cited

McDowell, 2010), yet much of the psychological practice remained centered on curing disease.

The opposing view had its foundations in the early 1920-1930's, where practitioners like Terman and Jung were focusing on areas designed to improve humankind such as giftedness, and the meaning of life. While this to some extent disappeared with the preoccupation of post war practice, in the 1990's psychologists such as Mihaly Csikszentmihalyi and Martin Seligman, who had grown frustrated with the continued focus on dysfunction, reinvigorated these early concepts and looked for opportunities to enhance the human psyche by focusing on optimising human factors (Waterman, 2013). At a subjective level, this new philosophy, collectively termed positive psychology, formed around the concepts of wellbeing, contentment and satisfaction, hope and optimism, and flow and happiness (Seligman & Csikszentmihalyi, 2000).

Today psychological wellbeing signifies far more than an absence of dysfunction and the field has opened up to encompass a broad range of initiatives. However, critics point out that there still appears to be a difference between the espoused views and much of the research, which still focuses on reducing clinical conditions (Nelson & Simmons, 2003). Despite decades of research and the term 'wellbeing' being used in multiple contexts, a review of the literature and the multiple definitions indicates there is still no clear agreed description of what it actually means. Wellbeing has been described as an abstract and unstable term, complex in its nature with multiple possible understandings and measurements (Atkinson, 2013). McDowell (2010) agrees that wellbeing is complex and suggests it should cover multiple domains such as the physical, emotional, social, and spiritual. The sum of these domains is one's quality of life. Indeed the literature in this area is vast and at times confusing in its competing views.

Dagenais-Desmarais and Savoie (2012), outline three mainstream schools of thought around wellbeing. The first is the hedonic approach, which is essentially pleasure in the here and now. This is evaluated by having low negative affect, high positive affect and high satisfaction with life (Diener, Emmons, Larsen, & Griffin, 1985; Gruber, Mauss, & Tamir, 2011; Pavot & Denier, 1993). The second is the eudaimonic approach sometimes referred to as psychological wellbeing (PWB) which is described as having a

meaningful life (Dagenais-Desmarais & Savoie, 2012; Huta & Ryan, 2010; Huta, Ryan, & Deci, 2008; Keyes, Shmotkin, & Ryff, 2002; Waterman, 1993; Waterman, 2013). One of the most common tools used to measure this is Ryff's Wellbeing Scale (Kállay & Rus, 2014; Ryff and Keyes 1995). The third school of thought is the integrated approach which contains various models including what Testoni, Mansfield and Dolan (2018) called subjective wellbeing (SWB) and Frisch, Cornell, Villanvera, and Retslaff's (1992) quality of life, all of which are outlined below.

Hedonic approach

The hedonistic approach to wellbeing can be traced back to early Greek and Roman philosophers whose Epicurean theories of 'hedonia' upheld the goal of life as to maximise pleasure and reduce pain, thereby producing happiness and enjoyment (Homel, 2010). The modern hedonistic approach is based on the attainment of a balance of positive emotion (commonly described as positive affect, pleasantness or pleasure) combined with reduced or absent negative emotion (negative affect or displeasure), and life satisfaction (Dagenais-Desmarais & Savoie, 2012; Diener, Emmons, Larsen, & Griffin, 1985; Gruber, et al., 2011; Keyes et al., 2002; Ryan, Huta, & Deci, 2008; Ryff, 1995; Waterman, 1993).

Although not strictly interchangeable terms, positive and negative emotions are often measured using positive and negative affect scales and, like happiness and wellbeing, the terms are regularly used to describe each other within the literature (Cohen & Pressman, 2006). Bradburn (1969) is the forefather of modern positive and negative affect research, which is used to measure hedonic wellbeing (Watson, Clark, & Tellegen, 1988). Affective response refers to feelings, inspired by everyday experiences, where the perception of the experience is cognitively processed and compared against the expectation one had of that experience (McDowell, 2010). A stronger positive affect has been related to better levels of happiness and life meaning (Bhutoria & Hooja, 2018). Rather than a single scale, positive and negative affect are distinctive dimensions, which though negatively correlated, are in fact independent measures (Ryff, 1995).

Life satisfaction is a cognitive component that requires subjective judgment and evaluation by the individual to compare their existing thoughts on their current life state

against their expectations of what their life should be like (Pavot & Denier, 1993). These judgment thoughts on life state will adjust over time with changing expectations as people age, experience more, and therefore desire different things (Diener et al., 1985). While there are some universal components to life satisfaction such as good health, individuals will assign weighting based on what is most important subjectively to them at that point in time, and what one person considers a marker of success or satisfaction may be very different for another. Happiness or wellbeing therefore becomes an interpretation by the individual of how they think and feel about their life. As this involves a broad range of emotions and thoughts, rather than focusing on each component of the domain, the global judgment of life satisfaction becomes more important (Diener et al., 1985; Gruber et al., 2011; Pavot & Diener, 1993).

There are some limitations to the hedonic approach to wellbeing; while greater positive affect has many benefits including greater pro-social outcomes, cognitive flexibility and improved happiness it needs to remain balanced. Overly heightened positive affect may lead to risky behaviors or mania, reducing any possible health benefits and, in extreme form, can be an indication of psychopathology (Gruber et al., 2011). There is evidence of trait positive and negative affect being hereditary (Ryff, 1995) however, affective response is largely state based and reliant on subjective experience. Therefore, it is considered short term and a snapshot in time not necessarily predicting long-term happiness or wellbeing, which then raises questions whether this is a valid measurement for wellbeing if it is only fleeting (Grimes, 2015).

Eudaimonic approach

If the hedonistic approach is described as the pursuit of ‘feeling good’ (Ryan et al., 2008), the eudaimonic approach is considered the pursuit of ‘living well’ and is tied to optimal function, meaning in life, virtue and excellence (Dagenais-Desmarais & Savoie, 2012). With initial thought leadership coming from Aristotle who claimed the hedonistic search for happiness to be shallow and vulgar, eudaimonic wellbeing is derived from the word ‘daimon’ which means true nature and refers to the desire to understand the ‘true self’ and find meaning and purpose in life (Schlegel, Hicks, & Christy, 2016). Based on self-determination theory, the eudaimonic approach necessitates a perception of being able to engage and overcome existential life challenges (Keyes et al., 2002). It requires a longer-term cognitive appraisal integrating

past, present, and future experiences with self-actualization and generosity toward others (Hernandez et al., 2018).

The eudaimonic approach has four key concepts; the pursuit of intrinsic goals (setting and obtaining goals which are self-driven), being autonomous (having control of one's destiny), being mindful and aware, and behaving in a manner that satisfies the human need for competence, relatedness and autonomy (Ryan et al., 2008). Huta and Ryan (2010) found interventions focused on eudaimonic wellbeing were more likely to have long-term mental health benefits than those that focused on hedonic pursuits, perhaps because of the notion that pleasure can be fleeting but self-development is long lasting. Some research has also shown eudaimonic wellbeing as resulting in superior psychological functioning than hedonistic (Steger, Kashdan, & Oishi, 2008, as cited in Hernandez et al., 2018).

Eudaimonic practitioners critique the hedonistic focus on pleasure as too narrow, self-indulgent, greedy, and lacking depth and meaning and argue that mankind is striving for more than the simple pleasure championed by the hedonists (Waterman, 1993; Waterman, 2013; Diener, 1984; Ryan et al., 2008). However, despite their differences there are similarities between the two terms, which challenges a single definition stance for research and makes choosing a suitable battery of test for measuring wellbeing difficult.

Integrated approach including subjective wellbeing and quality of life

Oles and Janowski, (2017) call out a mutual underlying focus on positive orientation between the hedonistic and eudaimonic approaches '*a tendency to formulate positive judgments concerning the self, one's personal life, and the future*' (p. 105). They theorise that the cognitive variables of self-esteem and satisfaction with life are interconnected and, in most situations, inherited. Keyes et al., (2002) also indicate that although hedonic and eudaimonic wellbeing are empirically distinct, combinations of them are related, especially when personality is taken into consideration with sociodemographics. Both are likely to increase to more highly desired wellbeing as age, education, extroversion and conscientiousness increase and neuroticism decrease. Openness to experience is also a factor in obtaining higher wellbeing scores.

Subjective Wellbeing (SWB) is a relatively new term and places emphasis on an individual's feelings and mental state as subjectively experienced so that an outcome in terms of wellbeing is positive if it makes an individual feel good for a sustained period of time (Testoni et al., 2018). While this sounds similar to hedonic wellbeing, advocates describe it as a hybrid model taking aspects of both hedonic (pleasure) and eudaimonic (purpose) and asking individuals to make an appraisal on their feelings of an experience (Dolan & Kudrna, 2016). SWB can be influenced based on the environment, for example, what is considered a positive life in one country may differ in another, and even within particular communities as people subjectively compare to what they experience and have around them (Tay & Diener, 2011). While a lack of needs will not produce a greater negative affect, fulfillment of needs can reduce negative affect but will not be enough to ensure a high SWB (Tay & Diener, 2011).

Frisch and colleagues (1992) use a definition called quality of life, which they state encompasses both hedonic, and eudaimonic definitions. It has parallels with SWB and life satisfaction and the terms are often used interchangeably within the literature. Quality of life is based upon 16 domains, which are weighted in line with assumptions that an individual's satisfaction with an area of their life is slanted according to its importance or value. For example, relationships may have a higher weighting than money (Frisch, 2003). The total is then calculated to provide an overall life satisfaction score. The associated coaching intervention approach to this teaches individuals strategies to identify and then improve their most valued areas (Firsch, 2011). Felce & Perry (1995) describe quality of life as an integration of objective and subjective indicators giving thought to life domains and taking into consideration an individual's own values.

Recognising this blend between the definitions, Boehm and Kubzansky (2012) argue that some constructs are harder to define as distinctly hedonic or eudaimonic and found optimism, vitality and hope to be shared sub-definitions that sit under both categories. What these more emerging fields show is that there is not as distinct a division between the definitions as first described. With multiple perspectives, nuanced approaches and often cross over there is still no definitive agreed definition of psychological wellbeing (Hernandez et al., 2018) and therefore it is best to take a collective view when conducting research such as this.

Physical Wellbeing

Physical wellbeing or the way the body functions is an important part of wellbeing that sometimes appears overlooked when considering impact within the workplace.

Physical wellbeing has been shown to be interrelated to psychological wellbeing and may therefore be seen as an integral part to wellbeing overall. Poor physical wellbeing such as obesity and chronic illness has been shown to manifest psychological symptoms such as depression and anxiety (Hernandez et al., 2018). Similarly, poor psychological wellbeing including anxiety, stress, or depression can manifest in somatic or physical symptoms such as hypertension, diabetes, cardiovascular heart disease, back pain, stomach issues, and headaches (Rajgopal, 2010).

Additionally positive affect has been shown to slow down or reduce impact of chronic illness (Hernandez et al., 2018) and individuals with positive affect have less stroke symptoms and lower cardiovascular risk (Cho, Martin, Margrett, Macdonald, & Poon, 2011). Perceived benefits of exercise have also shown to have a positive impact on life satisfaction (Dolan, Kavetsos, & Vlaev, 2014).

Wellbeing used in the current research

To summarise, a holistic view of wellbeing may therefore encompass mental, physical health and social wellbeing (Kállay & Rus, 2014). The intention of this study is not to judge the elements of wellbeing in terms of one theory over another. Wellbeing is a concept encompassing multiple theories; therefore, a wide battery of tests was used in this research to ensure that most if not all aspects were covered.

Introduction of the current research

The current research is a randomised semi-blind control trial on the impact of mindfulness on employee wellbeing within a complex organisation in comparison to an active and inactive control group.

Five hypotheses were tested:

Hypothesis One (H1): A mindfulness app will have a greater positive impact on employee wellbeing over a relaxation app or waitlist control group.

Hypothesis Two (H2): Benefits will be sustained four weeks post intervention.

Hypothesis Three (H3): The amount of time spent using the app will positively affect mindfulness and wellbeing.

Hypothesis Four (H4): Expectations in the benefits of the intervention will affect wellbeing.

Hypothesis Five (H5): Personality type indicated in the Ten Item Personality Inventory questionnaire will influence impact; those with higher conscientiousness will be more likely to continue the study (H5a). Those with higher agreeableness will have greater effect of the intervention of mindfulness (H5b).

When designing the study attention was paid to previous critique in the literature and the Quality Assessment Tool for Quantitative Studies (QATQS, National Collaborating Centre for Methods and Tools, 2008, as cited Lomas et al., 2017) to negate flaws in previous research designs. The QATQS assesses methodological rigour in six areas:

- 1) Selection bias (ensuring proper randomisation is achieved so that the sample obtained is representative of the group being tested)
- 2) Design (does the research measure what it sets out to do)
- 3) Confounders (were any confounding variables present)
- 4) Blinding (was the experimenter blind to the data group)
- 5) Data collection (how data is collected and stored)
- 6) Withdrawals and drop outs (ensuring withdrawals and drop outs are recorded and reported appropriately).

We took a number of steps to ensure a rigorous research design. In ensuring selection bias did not occur, parameters were set regarding the criteria (outlined in the methodology below), and all individuals who enrolled and met the criteria were sent the information sheet and questionnaire. Individuals were then randomly assigned to the mindfulness intervention or the active or passive control groups. All of the measurements used related to the variables to be tested. Where subscales have been used as a measurement this has been identified clearly to not imply an overall significant result. All individuals were asked if at the post intervention data collection points if there was anything else occurring in their lives (confounding variables) that may have influenced the results.

Due to the nature of the research and the resources available, it was not possible in this case to completely blind participants. Therefore, to minimise unintentional bias of the data, researcher two (university supervisor) allocated participants to their condition and gave each condition a unique code (e.g. Condition 66 instead of waitlist control).

Researcher one (master's student) was blind to which participants had continued with the study and which condition the data was describing (intervention, active or passive control) until analysis was completed. In other words, the data analysis was blinded.

All data was stored securely on the Qualtrics database, and when exported, password protected on Massey University systems. Researcher two was not provided with any identifying data and all identifying data will be destroyed post submission of the thesis. Withdrawals and drop outs were identified in the research data. Additionally the study was pre-registered using 'as predicted' <https://aspredicted.org/> (Appendix A).

Method

Research design

To test the hypotheses participants were recruited to take part in an eight-week study. The study involved a pre-test questionnaire, which benchmarked the big five personality styles, mindfulness, and wellbeing based on a battery of tests. Participants then completed four weeks of either a mindfulness intervention or one of two control variables; a relaxation app active control or passive waitlist control. The questionnaire was administered again at the end of the four-week intervention and once more four weeks post practice.

Recruitment

To take part in the study, participants had to be 18 years or over and be currently employed in some capacity (temporary, part time or full time). Participants were recruited through researcher one's place of employment, an Australian statutory body distributor-retailer of water and provider of sewerage services with a mix of white-collar office and blue-collar field employees. The recruitment campaign consisted of posters displayed in common areas within the workplace for a one-week period. The posters showed a drawing of the brain and stated 'research volunteers needed for a master's

thesis studying impact of mindfulness on employee wellbeing' (Appendix B). The same posters were displayed on the workplace social media forum 'Yammer' and interested parties were able to ask questions regarding the study in either the public or a private forum. Participants were able to forward the information to external parties who could register if they personally requested to do so over email and met the criteria. The study was also mentioned in three leadership team meetings.

To take part participants wrote their name on a sign-up list or emailed researcher one and were sent an email thanking them for registering and an initial participant information sheet providing further information regarding the nature of the study and advising next steps if they would like to continue (Appendix C). Their contact details were then forwarded to researcher two who registered participants into the Qualtrics system and controlled all further communication regarding the study to ensure that data was kept confidential and blind to researcher one. Participants were provided with a unique identifier that was used to track their results throughout the study in Qualtrics. All procedures were approved by the Massey University Human Ethics Committee [Southern B, Application 18/31]. Full informed consent was provided online from all participants before being able to partake in the study.

Participants

One hundred and four (104) participants registered to take part, of which 95 completed the baseline questionnaire (T1) and were then randomly assigned to a group. Following the intervention, 72 participants completed the questionnaire again (T2), providing a completion rate of 76%, however five were excluded due to low app use or not completing at least 90% of the questionnaire, providing a sample group $n = 67$ for T2. All 67 were sent the third questionnaire, $n=52$ completed the post questionnaire (T3). Demographics are based on T2 completions, as this was the core data group used.

Of the 67 participants at T2, 63% identified as female, 37% as male. The mean age was 43 years with a range in age of 18-64 years. On average participants had been at their existing organisation for six years or more although the range varied from less than one year to more than 15 years. The majority of participants (84%) identified as full time workers, 3% as part time, 10% as temporary, and 3% declined to answer. Office based

workers made up 91% of the participants, 7% identified as field or site based and 2% as contact centre. Over half of the participants (58%) identified as individual contributors meaning they do not lead teams, 34% identified as leaders, 7% as senior leaders, which at the dominant organisation refers to executives, or individuals that directly report to an executive.

Procedure

Once registered, all participants were sent a link to the baseline questionnaire by researcher two. Participants were required to initially read an online participant information sheet regarding the procedure, confidentiality, participant's rights and further information including researcher one and two's contact details and organisations that could assist in the unlikely event that the self-reflection required in the study caused some unwanted emotion or anxiety. An online consent form was included and participants had to tick a box at the end of the information sheet allowing them to move to the next screen.

Once participants had provided consent through the online form, they were taken to an online questionnaire containing wellbeing and mindfulness measures. Participants were given until close of business the following Friday (five days) to complete the survey. Reminder emails were sent on day two, four and five reminding them of the purpose of the study, the requirement to complete the questionnaire, and thanking them for taking part (Appendix D).

The app 'Headspace' was used to provide the mindfulness intervention and two controls were utilised; an online relaxation app 'Zen Koi' formed the active control condition and a waitlist control group acted as passive control group. 'Soar Tree of Life' was originally registered with 'As Predicted' as the active control app, however due to technical difficulties this was replaced by Zen Koi.

Participants who completed the questionnaire (T1, n = 95) were then randomly assigned by the second researcher to one of three groups:

1. Mindfulness app 'Headspace' intervention (n = 32)
2. Relaxation app 'Zen Koi' active control (n = 32)

3. Waitlist passive control (n =31)

Participants assigned an app were asked to complete 10 minutes per day on the app for the period of five days per week, for four weeks. All participants including those assigned in the waitlist control group were asked not to take up any new form of mindfulness or relaxation activity (other than that assigned) for the duration of the study but to continue their normal routine as much as possible.

At the end of the four-week period participants were asked to complete the questionnaire again to measure any change in response (T2), the questionnaire was open until close of business the following Friday (five days). Reminder emails were sent on days two, four, and five. All participants were reminded not to take up any new forms of mindfulness or relaxation activity that might interfere with the study. Those participants assigned an app were asked to cease all use for the following four-week period. Sixty-seven participants completed the second questionnaire (T2).

A final questionnaire was issued four weeks later (T3) to those who had completed the second questionnaire (n = 67) to measure any sustained impact over time post intervention. Due to a public holiday the email with the questionnaire went out on a Tuesday instead of a Monday but still ended at close of business the following Friday (four days). Daily reminder emails were sent until the questionnaire closed. Fifty-two (n = 52) participants completed the final survey.

Intervention and controls

Headspace mindfulness intervention

As outlined previously Headspace is an online tool where users are led through guided meditation and education on mindfulness. Users can choose to utilise free sessions or to purchase a subscription which provides access to a range of mindfulness practices focusing on topics such as sleep, focus, stress etc. For the purpose of this study all participants assigned this app were provided with a full subscription and were free to choose any topic of interest. The cost of using Headspace was paid by researcher one's employer.

Zen Koi active control

Zen Koi is a free relaxation app featuring constantly flowing Koi fish swimming in a Zen garden pool and with imagery featuring waterfalls and blue skies. Developers advise it is designed to bring an inner calm, tranquillity and peacefulness to users as they manoeuvre colourful Koi fish through the water to the sounds of nature. The intent is to help users switch off from what the developers call the noise and sound pollution of modern life. Studies have shown playing video games can make participants more relaxed, decrease physical stress and improve mood (Russoniello, O'Brien, & Parks, 2009). Playing games can also decrease worry and negative affect, and increase positive affect (Rupp, Sweetman, Sosa, Smither, & McConnell, 2017).

Waitlist passive control

Those that were assigned a waitlist passive control were asked to continue their normal routine and not to partake in any new mindfulness or relaxation techniques. Positive reinforcement was sent via email thanking them for their continued support and to keep 'being themselves'.

Post intervention all participants were provided with the links to both online apps and invited to trial any that they had not yet used. The procedure and numbers at each stage are outlined in Figure 1.

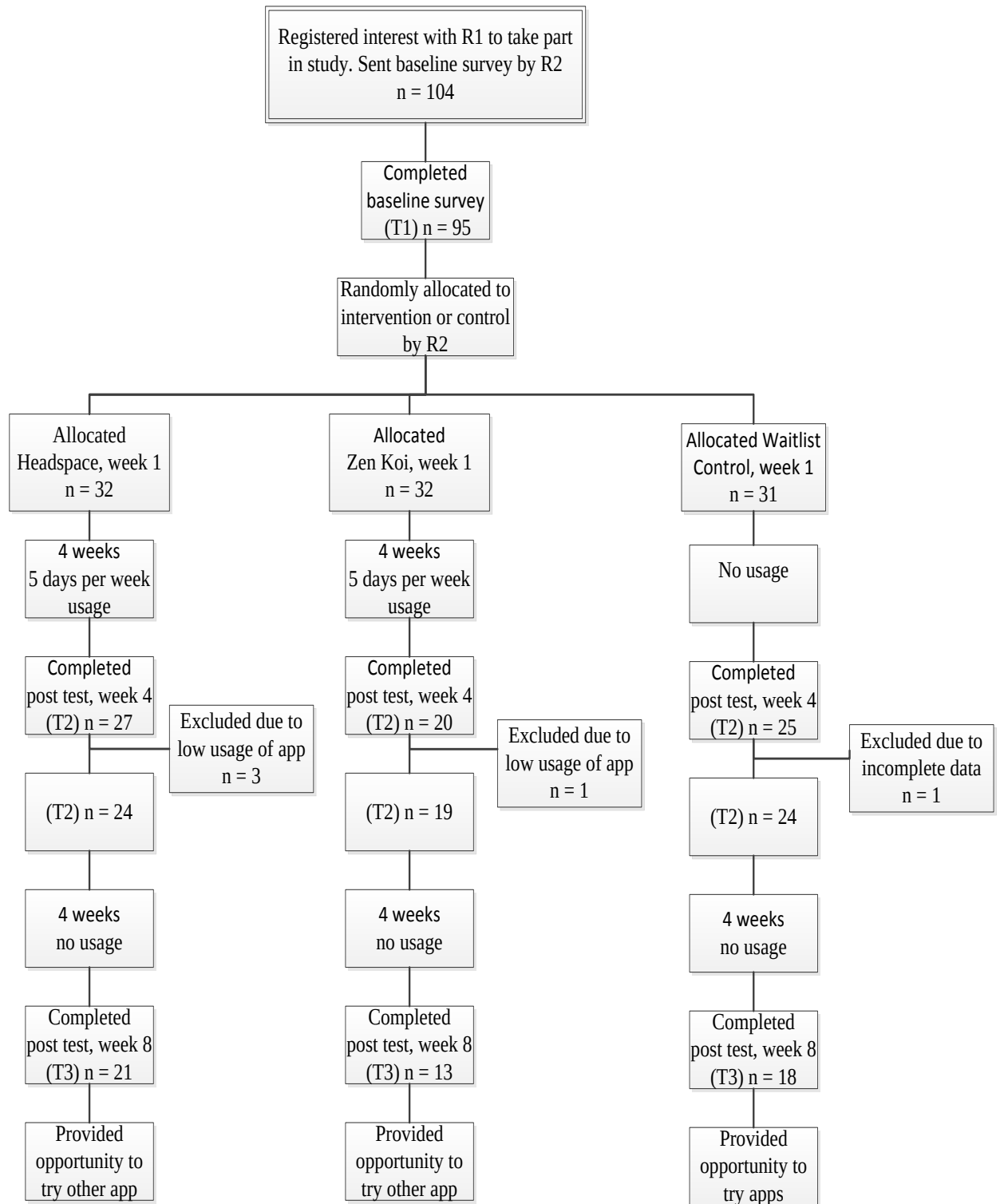


Figure 1. Flowchart of procedure

Questionnaire measures

The questionnaire participants completed was a culmination of a battery of tests used to establish five facet personality, mindfulness, and wellbeing. The scales used were the Ten Item Personality Inventory (TIPI), the Mindful Attention Awareness Scale (MAAS), the Work Related Rumination Scale (WRRS), Positive Negative Affect Schedule (PANAS), Physical Stress Index (PSI), Life Satisfaction, and Ryff's Wellbeing Scale (RWBS). The battery of tests remained the same at all time points; however, additional questions were included at various stages.

The initial questionnaire (T1) included demographic questions regarding gender, tenure, employment status, position type, and level. Two additional questions: *'What experience do you have with mindfulness?'*, and *'How much do you think this intervention will help you?'* were also included to understand any impact previous user experience may have on the outcome, and to measure expectancy of the outcome relevant to hypothesis four (H4). As discussed in Kreplin et al., (2018) it is important to account for any pre-existing expectations in an intervention especially if a double blind design is not available to reduce any unintentional bias.

The second (T2) and third (T3) questionnaires sent included the additional questions; *'Is there something else that may have been a major contributing factor to any changes in your results?'* This question was included was to understand if there were any confounding variables we were not aware of that may have impacted on the results. *'How much do you think this intervention has helped you?'* and *'Please comment on any changes either positive and/or negative you believe you have had as a result of this intervention,'* were included to understand how much participants felt the app had helped particular to hypothesis four (H4).

Specific to T2, two additional questions were added: *'Did you feel any adverse effects from completing the questionnaire the first time?'* This was asked to ensure the questionnaires did not cause any adverse effect on participants. *'On average, how often did you use the app per week during the four week period?'* This was specific to ensuring that participants used the app enough times to remain included in the study as the exclusion usage level was two times per week or less and was also

relevant to hypothesis three (H3). Finally, we asked '*If you decided not to use or stopped using the app please comment on the reason why*'. We included this to gain understanding of why participants may have dropped out.

Specific to T3, a question regarding on-going use of mindfulness was asked to understand any potential impact that this may have had over sustained benefits over time relevant to hypothesis two (H2). Noted is the fact that participants were asked to stop all use at the end of the four week intervention, however some continued casual usage.

At the end of the questionnaire, participants were reminded that all identifying data would be made anonymous and kept confidential from the researcher one. As the questionnaire required some self-reflection, participants were again advised that in the unlikely event that this caused some unwanted emotion or anxiety they were encouraged to contact the free and confidential Employee Assistance Program provided through the organisation, their GP or to access a service through Living Well <https://www.livingwell.org.au/get-support/other-services-2/general-counselling-services-in-queensland/>.

Ten Item Personality Inventory (TIPI)

The Ten Item Personality Inventory (TIPI) was developed by Gosling, Rentfrow, & Swann, (2003a; 2003b), to measure the big five personality dimensions which are openness, conscientiousness, agreeableness, and neuroticism. In the TIPI, neuroticism is replaced by emotional stability. The inventory consists of ten items, each using two descriptors, separated by a comma, with the common stem, "I see myself as:" and a 7-point scale ranging from 1 (disagree strongly) to 7 (agree strongly). Each item measures one of the poles of the five-factor model (FFM) dimensions (Appendix E).

The inventory was used to determine if there were any links between increased mindfulness and personality as well as impact on wellbeing. It may be expected that someone higher on the agreeableness scale may have a more positive affect in comparison to another individual with a higher rating on neuroticism which may have a higher negative affect. This in turn may influence general wellbeing.

Additionally those higher on the conscientious scale would seem more inclined to complete the study than those with lower scores.

The big five: openness, conscientiousness, extroversion, agreeableness, and neuroticism have links to possible outcomes of mindfulness practice. Similarly, personality has been shown to impact on health and wellbeing. Research indicates that there is an association between dispositional mindfulness and the five factor personality model with a positive correlation between self-awareness and openness. Nagy and Bear (2017) identify increased openness as a possible outcome of mindfulness practice. Additionally, self-regulation gained through mindfulness has a positive correlation with conscientiousness and a negative correlation with neuroticism. Mindfulness has also been shown to temper some personality traits (Hanley, 2016; Rau & Williams, 2016; Tucker et al., 2014).

Mindful Attention Awareness Scale (MAAS)

The MAAS measures open and receptive attention and awareness of what is occurring in the present or everyday life. Research has shown that the MAAS is predictive of self-regulation and wellbeing constructs (Brown & Ryan, 2003). The MAAS consists of 15 items with a 6-point scale which indicates how frequently or infrequently the user currently has each experience, ranging from 1 (almost always) to 6 (almost never), for questions such as '*I find it difficult to stay focused on what's happening in the present*' (Appendix F).

This scale was used to measure any changes in mindfulness throughout the study. A higher mean score indicates higher levels of mindfulness. It is anticipated that this score should increase over time for those assigned to the mindfulness intervention compared to those assigned the Zen Koi active control or waitlist passive control groups.

Work Related Rumination Scale (WRRS)

Work related rumination involves the spilling over of pervasive thoughts about work into home or leisure time and has been shown to have both positive and negative impact on wellbeing. While pondering problems can lead to insight and problem solving it can also have long-term health and wellbeing consequences due to

sustained preventive recovery from work demands (Cropley, Zijlstra, Querstret, & Beck, 2016). The inability to unwind or shut off from work has been linked to various stress related disorders including higher rates of cardiovascular disease, heightened blood pressure after work, increased physical symptoms such as head and back aches, and depression (Cropley & Purvis, 2003). In essence, the persistent inability to disconnect from work influences the resilience system, which in turn affects wellbeing due to the hypothalamic-pituitary-adrenal and cardiovascular systems over activation. Symptoms of this over activation include sleep disorders, fatigue, and exhaustion (Kinnunen et al., 2017; Querstret & Cropley, 2012).

Kinnunen et al., (2017) outline three key facets of rumination. Affective rumination is the repetitive reflection on negative emotional responses to an issue. Problem solving pondering involves an emotionally detached mulling over of an issue with the intent to solve it. Even if the problem remains unsolved, often a plan of action is created through the reflective behaviour; therefore, this is generally considered a positive aspect of rumination. The third aspect is psychological detachment where an individual can completely detach from thinking about work regardless of the experience being positive or negative.

The WRRS measures the three distinct factors of affective rumination, problem solving pondering, and detachment relative to the participant's time after work (Querstret & Cropley, 2012; Vahle-Hinz, Mauno, de Bloom, & Kinnunen, 2017). The WRRS contains 15 statements (five for each of the three factors) such as '*In my free time I find myself re-evaluating something I have done at work*' and '*I find solutions to work-related problems in my free time*'. Participants were asked to rate each question with a 5-point scale ranging from 1 (very seldom / never) to 5 (very often / always) (Appendix G).

The mean of each factor (affective rumination, problem solving pondering, or detachment) is taken as the total with a higher total indicating a higher prevalence of that factor. It is predicted that affective rumination and detachment, which are negative responses, may decrease, and problem solving pondering, a positive response, may increase through the mindfulness intervention.

Cropley's Work Related Rumination Scale (WRRS) was selected for this study over scales such as the Rumination Response Scale Short Version (Erdur-Baker & Bugay, 2010) due to the specificity of relevance to the workplace environment.

Positive and Negative Affect Schedule (PANAS)

Developed by Watson, Clark, and Tellegen (1988), the PANAS consists of a number of words that describe different emotions that are distinctive in positive or negative affect such as 'interested', 'distressed', 'excited', 'upset'. The schedule consists of two 10-item scales. Participants were asked to indicate '*the extent they have felt this way over the past few weeks*' on a 5-point scale from 1 (very slightly or not at all) to 5 (extremely). Total scores can range from 10 – 50, with higher scores on either scale demonstrating greater levels of positive or negative affect respectively (Appendix H).

Positive and negative affect are considered distinct dimensions of wellbeing (Ryff, 1989). A high positive affect score indicates high energy and the ability to concentrate at full capacity, with pleasurable engagement (Cohen & Pressman, 2006). A low positive affect may display as lethargy and sadness. Negative affect relates to subjective distress and non-pleasurable engagement. A high negative score indicates an aversive mood ranging from anger through to guilt and nervousness. A low score would indicate calmness. High scores on the negative scale have also been linked to poor coping, higher levels of health complaints and higher self-related stress (Watson, Clark, & Tellegen, 1988). Both state and trait positive and negative affect are reported to be stable over the period of two months. This would indicate any changes measured in this research can be attributed to the mindfulness intervention.

Ryff's Wellbeing Scale 42 item (RWBS)

Carol Ryff's Wellbeing Scale draws upon wide ranging research including Erikson's psychosocial development, Allport's mature personality, Rogers' functioning individual, and Maslow's need for self-actualization (Kállay & Rus, 2014). The result is a multidimensional scale which defines six distinct constructs of wellness designed to measure a scale of positive psychological functioning; Autonomy, Environmental Mastery, Personal Growth, Positive Relations with Others, Purpose in

Life, and Self-Acceptance (Ryff & Keyes, 1995). Ryff's Wellbeing Scale has been described as one of the most influential approaches to eudaimonic wellbeing (Kállay & Rus, 2014).

Ryff has produced various scale lengths; the chosen version is the medium length 42-item multidimensional model questionnaire with six dimensions as listed above (Appendix I). Participants are asked to rate how true they find the statements ranging from 1 (strongly disagree) to 6 (strongly agree) on questions such as '*I think it is important to have new experiences that challenge how you think about yourself and the world*', and '*I am not afraid to voice my opinions, even when they are in opposition to the opinions of most people*'.

Despite some critique regarding validity over measurement of the six full constructs (Henn, Hill, & Jorgensen, 2016; Kafta & Kozma, 2002), this medium item questionnaire has been proven to have factorial validity (Akin, 2008; Kállay & Rus, 2014), especially in middle range score distribution (Abbott, Ploubidis, Huppert, Kuh, Wadsworth, & Croudace, 2010) and is considered one of the most widely used tools to measure positive wellbeing (Abbott, Ploubidis, Huppert, Wadsworth, & Croudace, 2006). It is expected that positive scored wellbeing should increase as a result of the mindfulness intervention.

Physical Stress Index (PSI)

Created by Spector and Jex (1997), the 12 question PSI indicates physical symptoms of stress such as feeling nausea, headache, dizziness, fatigue, eyestrain etc.

Participants rate how often they have experienced each of the symptoms over the past month, using a 5-point rating scale of 1 (not at all), to 5 (every day). The scores are summed for a total score between between 12 and 60 with higher scores indicating a higher level of physical stress or somatic behaviour (Appendix J).

Physical stress can be a sign of psychological ill health, which may manifest in somatic symptoms; additionally individuals with higher levels of stress often have relative physical disorders such as digestion issues and headaches. It is predicted that PSI should decrease through use of the mindfulness intervention.

Satisfaction with Life Scale (SWLS)

One of the more widely used subjective wellbeing scales (Diener et al., 1985), the SWLS provides a one-dimensional measure of global life satisfaction and is shown to have temporal stability with validity across multiple age groups (Diener et al., 1985; Kafka & Kozma, 2002; Pavot & Diener, 1993; Pavot, Diener, Colvin, & Sandvik, 1991). The SWLS refers to an individual's construct of what they see as a suitable standard and then the judgment of their life against that standard.

The SWLS is a 5-item scale with participants asked to rate how much they agree using a 7-point scale that ranges from 7 (strongly agree) to 1 (strongly disagree) on statements such as *'In most ways my life is close to my ideal'*. A score of over 21 indicates some level of satisfaction with scores of 31-35 indicating extreme satisfaction (Appendix K). A score of 19 or below indicates some level of dissatisfaction (Diener et al., 1985; Pavot & Diener, 1993). It is predicted that life satisfaction should increase as participants become more accepting of their situation and apply less negative judgmental appraisal.

In summary, the questionnaire consists of eight specific measures (Table 1).

Table 1

Showing measurement and prediction of change through mindfulness intervention.

<u>Tool</u>	<u>Measurement</u>	<u>Prediction</u>
Ten Item Personality Inventory (TIPI)	Big five personality dimensions; openness, conscientiousness, extroversion, agreeableness, and emotional stability (neuroticism).	Higher scorers of agreeableness will have higher positive affect than individuals with high neuroticism influencing general wellbeing. Higher scorers of conscientiousness will more likely complete the study therefore having greater benefit of the

mindfulness intervention.

**Mindful Attention
Awareness Scale (MAAS)**

Open and receptive
attention and awareness of
what is occurring in the
present or everyday life.

Mindfulness will increase
through the mindfulness
intervention more so than
either the active or passive
control

**Work Related
Rumination Scale
(WRRS)**

Three distinct factors
relative to the participant's
time after work:

- Affective
rumination
(WRRS_AR),
- Problem solving
pondering
(WRRS_PSP),
- Detachment
(WRRS_D).

Affective rumination and
detachment will decrease
and problem-solving
pondering will increase
through the mindfulness
intervention.

**Positive and Negative
Affect Schedule (PANAS)**

Emotions with distinctive
positive and negative affect.

Positive affect will increase;
negative affect will
decrease in the mindfulness
intervention more so than
either control condition.

**Physical Stress Index
(PSI)**

Physical stress symptoms
such as upset stomach or
nausea, trouble sleeping,
headache, etc.

PSI will decrease through
the mindfulness
intervention more so than
either control condition.

**Satisfaction with Life
Scale (SWLS)**

Global life satisfaction.

Satisfaction with life will
increase through the
mindfulness intervention

more so than either control condition.

Ryff's Wellbeing Scale (42 item)

Six distinct dimensions of eudaimonic wellbeing;

- Autonomy (RWBS_A),
- Environmental Mastery (RWBS_EM),
- Personal Growth (RWBS_PG),
- Positive Relations with Others (RWBS_PR),
- Purpose in Life (RWBS_PL), and
- Self-Acceptance (RWBS_SA).

Wellbeing will increase through the mindfulness intervention more so than either control condition.

Exclusions

If participants did not complete a questionnaire they were not sent the next one. Participants who used their allocated app two times or less per week were excluded from the study. Participants had to complete 90% of the questionnaire to be included. Five participants were excluded post T2 (three from the Headspace app and one from Zen Koi) for not using the app two or more times per week, an additional participant from the waitlist control was excluded for an incomplete questionnaire data set (see Figure 1). Data of participants who completed the first (T1) questionnaire and second questionnaire (T2) were used for all statistical analysis.

Data Analysis

The analysis was preregistered as follows with aspredicted.org

A mixed model analysis of variance (ANOVA) with a three (group) x three (time) design for each of the wellbeing measures to assess the impact of the mindfulness condition compared to the two control conditions. Follow up t-tests were planned to assess where potential group differences exist. The ANOVA was designed to test H1 and H2. Due to low completion rate at T3, a mixed model ANOVA with a three (group) x two (time) design was used for the initial analysis. Greenhouse Geisser correction was applied where necessary.

Correlation and regression analysis was used to assess whether the amount of time spent using the app positively affected mindfulness and wellbeing (H3) and whether expectations in the benefits of the intervention affected wellbeing (H4). A correlation and regression analysis was also used to understand whether personality had an impact (H5), in particular whether those with higher conscientiousness had a higher completion rate of the full study (H5a) and whether those with higher agreeableness had greater wellbeing outcomes indicating a larger effect of the mindfulness intervention (H5b).

Power Analysis

Statistical power calculations (GPOWER Software; Faul & Erndinger, 1992) indicated a total a sample size of 105 participants (assuming an equal distribution between groups) would be required for an effect size of 0.5, an alpha of 0.05, and 80 % power.

Results

Hypothesis one

To test the hypothesis that a mindfulness app (Headspace) will have a greater positive impact on employee wellbeing over an active control relaxation app (Zen Koi) or waitlist passive control group, a mixed model ANOVA with a three (group) x two (time) design was used for each wellbeing scale. The data yielded no significant results (see Table 2).

Table 2

Showing baseline (T1) and follow up (T2) questionnaire wellbeing scores by group, and results of repeated measures analyses of variance.

	Headspace (n = 24)				Zen Koi (n = 19)				Waitlist Control (n = 24)				Significance	Effect size (η^2_p)	Power
	T1		T2		T1		T2		T1		T2				
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD			
MAAS	3.76	0.64	3.91	0.70	3.83	0.71	3.94	0.62	3.74	0.79	3.64	0.90	$F_{2,64} = 2.05, p = .14$	0.060	0.408
WRRS_AR	13.83	3.25	12.92	3.84	13.84	4.51	13.37	4.86	14.63	4.55	15.08	4.12	$F_{2,64} = 1.19, p = .31$	0.036	0.251
WRRS_PSP	15.67	2.78	15.08	3.19	14.37	3.92	14.26	3.68	15.71	3.36	15.21	3.49	$F_{2,64} = .25, p = .78$	0.008	0.087
WRRS_D	16.50	2.27	16.75	2.27	15.16	3.22	15.68	3.28	15.67	2.32	15.83	2.28	$F_{2,64} = 0.11, p = .90$	0.003	0.066
PANAS_Neg	17.13	5.99	16.67	6.74	16.74	6.43	16.47	5.57	21.08	6.97	20.96	8.13	$F_{2,64} = .02, p = .93$	0.001	0.052
PANAS_Pos	30.50	7.47	30.54	7.67	30.11	7.29	30.63	8.53	30.92	6.46	31.38	7.64	$F_{2,64} = .06, p = .94$	0.002	0.059
RWBS_A	29.71	5.10	30.38	5.21	31.37	5.21	31.05	5.36	28.50	6.05	27.92	6.55	$F_{2,64} = .83, p = .44$	0.025	0.186
RWBS_EM	28.13	4.27	29.08	4.12	28.05	4.08	28.42	3.81	27.21	3.83	27.29	4.76	$F_{2,64} = .61, p = .55$	0.019	0.271
RWBS_PG	33.67	4.57	33.50	4.98	32.11	5.62	32.11	6.52	34.21	4.85	34.13	4.69	$F_{2,64} = .01, p = .99$	0.000	0.054
RWBS_PR	33.96	4.03	33.04	4.55	33.11	5.89	32.21	6.49	32.00	6.09	31.79	6.24	$F_{2,64} = .27, p = .76$	0.008	0.091
RWBS_PL	30.29	5.79	31.42	5.82	30.68	6.17	30.37	6.31	32.88	5.72	32.63	5.48	$F_{2,64} = 1.40, p = .25$	0.042	0.291
RWBS_SA	28.13	6.49	29.50	7.02	28.79	7.79	29.37	7.30	30.29	6.06	29.83	6.25	$F_{2,64} = 1.31, p = .28$	0.039	0.274
RWBS_Tot	184.92	23.02	185.16	28.94	185.16	28.94	184.58	31.03	187.33	25.16	185.04	28.31	$F_{2,64} = .49, p = .62$	0.015	0.126
PSI	21.88	6.42	21.00	6.52	20.68	5.84	19.89	4.68	23.29	7.07	23.00	7.87	$F_{2,64} = .09, p = .91$	0.003	0.064
SWLS	17.08	7.57	16.42	6.14	15.68	7.98	16.16	8.46	13.92	5.65	14.46	6.85	$F_{2,64} = .67, p = .51$	0.021	0.159

Note: MAAS = Mindfulness Attention Awareness Scale; WRRS_AR = Work Related Rumination Scale, Affective Rumination; WRRS_PSP = Work Related Rumination Scale, Problem Solving Pondering; WRRS_D = Work Related Rumination Scale, Detachment; PANAS_Neg = Positive and Negative Affect Schedule, Negative; PANAS_Pos = Positive and Negative Affect Schedule, Positive; RWBS_A = Ryff's Wellbeing Scale, Autonomy; RWBS_EM = Ryff's Wellbeing Scale, Environmental Mastery; RWBS_PG = Ryff's Wellbeing Scale Personal Growth; RWBS_PR = Ryff's Wellbeing Scale Positive Relations with Others; RWBS_PL = Ryff's Wellbeing Scale Purpose in Life; RWBS_SA = Ryff's Wellbeing Scale Self-Acceptance; RWBS_Tot = Ryff's Wellbeing Scale Total; PSI = Physical Stress Index; SWLS = Satisfaction with Life Scale.

Hypothesis two

Due to low completion rates of the questionnaire and no significant results at T2, no data analyses was run to understand sustained wellbeing over time as there was no significant indication that any effect had occurred due to the intervention (H2).

Hypothesis three

Correlation analysis was used to understand the relationship between the amount of time the mindfulness intervention app was used, and all wellbeing measures at T2 (H3). To assess changes in wellbeing, a change score was computed for all wellbeing measures (T2 – T1). We did not find a significant relationship between the amount of time the Headspace app was used and the changes on the wellbeing measures (all $p < 0.05$) for the mindfulness group. The control groups were not included as the hypothesis was based on the time spent using the intervention (Table 3).

Table 3

Showing correlation between time spent using the mindfulness intervention and the mindfulness and wellbeing outcomes at T2.

Measures	Impact of time using app
MAAS	$r = -0.13$, $df = 23$, $p = 0.55$
WRRS_AR	$r = 0.09$, $df = 23$, $p = 0.09$
WRRS_PSP	$r = 0.06$, $df = 23$, $p = 0.79$
WRRS_D	$r = -0.16$, $df = 23$, $p = 0.47$
PANAS_Neg	$r = -0.14$, $df = 23$, $p = 0.51$
PANAS_Pos	$r = -0.20$, $df = 23$, $p = 0.35$
RWBS_A	$r = 0.35$, $df = 23$, $p = 0.10$
RWBS_EM	$r = -0.33$, $df = 23$, $p = 0.12$
RWBS_PG	$r = -0.13$, $df = 23$, $p = 0.54$
RWBS_PR	$r = 0.08$, $df = 23$, $p = 0.70$
RWBS_PL	$r = 0.14$, $df = 23$, $p = 0.50$
RWBS_SA	$r = 0.07$, $df = 23$, $p = 0.75$
RWBS_Tot	$r = 0.12$, $df = 23$, $p = 0.58$
PSI	$r = -0.23$, $df = 23$, $p = 0.55$
SWLS	$r = -0.02$, $df = 23$, $p = 0.94$

Note: MAAS = Mindfulness Attention Awareness Scale; WRRS_AR = Work Related Rumination Scale, Affective Rumination; WRRS_PSP = Work Related Rumination Scale, Problem Solving Pondering; WRRS_D = Work Related Rumination Scale, Detachment; PANAS_Neg = Positive and Negative Affect Schedule, Negative; PANAS_Pos = Positive and Negative Affect Schedule, Positive; RWBS_A = Ryff's Wellbeing Scale, Autonomy; RWBS_EM = Ryff's Wellbeing Scale, Environmental Mastery; RWBS_PG = Ryff's Wellbeing Scale Personal Growth; RWBS_PR = Ryff's Wellbeing Scale Positive Relations with Others; RWBS_PL = Ryff's Wellbeing Scale Purpose in Life; RWBS_SA = Ryff's Wellbeing Scale Self-Acceptance; RWBS_Tot = Ryff's Wellbeing Scale Total; PSI = Physical Stress Index; SWLS = Satisfaction with Life Scale.

Hypothesis four

Correlation analysis was used to understand the relationship between the expectation of the benefits of the intervention, all wellbeing measures and the perception of how much the app helped at T2 (H4). The change score of the wellbeing measures (T2 – T1) was used to assess the predicted benefits of the app on wellbeing. The data yielded a significant negative correlation between expectations in the benefits of the intervention and the Wellbeing Scale_ Autonomy (WBS_A) ($r = -0.29$, $DF = 65$, $p = 0.01$) (Figure 2) and a negative correlation with Wellbeing Scale_ Positive Relation with Others (WBS_PR) ($r = -0.28$, $DF = 65$, $p = 0.02$) (Figure 3) for the whole sample. See Table 4 for full results.

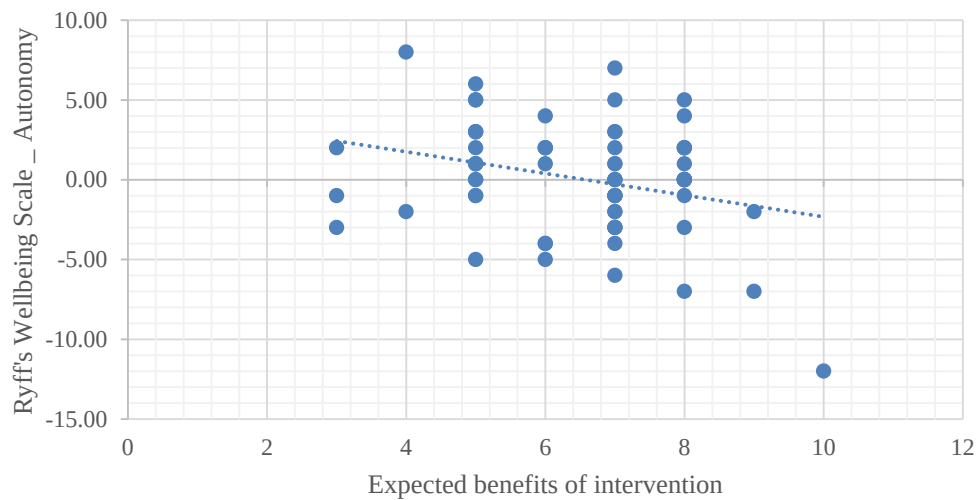


Figure 2. Showing the negative relationship between the expected benefits of the intervention and the Autonomy subscale of Ryff's Wellbeing Scale for whole sample.

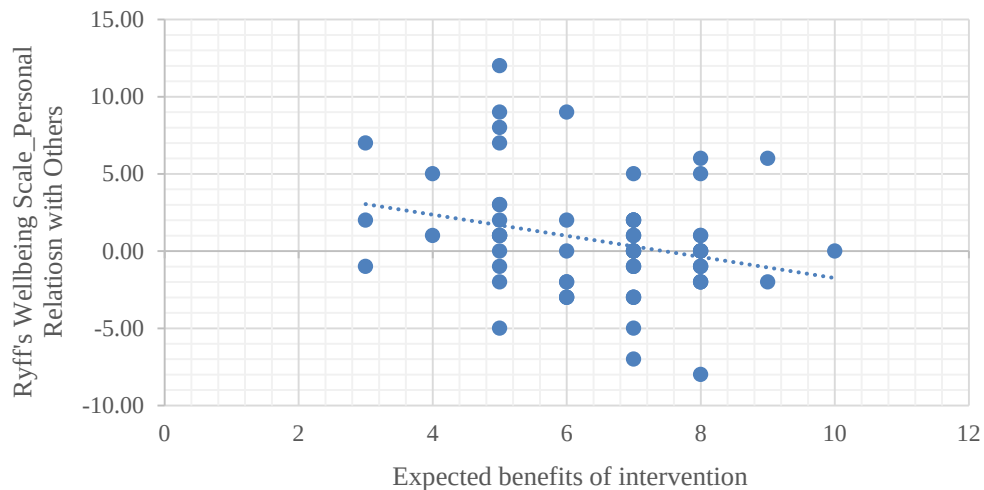


Figure 3. Showing the negative relationship between the expected benefits of the intervention and the Positive Relations with Others subscale of Ryff's Wellbeing Scale for whole sample.

To gain an understanding of the impact expectations in the benefits of the intervention had on each group, we repeated the correlation analysis for each group separately.

Group one, Headspace mindfulness intervention

The data yielded a positive correlation with expectation in the benefits of the intervention and the subjective report of how much the intervention helped ($r = 0.51$, $DF = 22$, $p = 0.01$) (Figure 4). There was a negative correlation with both the Wellbeing Scale_Autonomy (WBS_A) ($r = -0.51$, $DF = 22$, $p = 0.01$) (Figure 5) and the Wellbeing Scale_Self-Acceptance (WBS_SA) ($r = -0.44$, $DF = 22$, $p = 0.03$) (Figure 6). Finally, a positive correlation with PANAS_Positive (PANAS_Pos) ($r = 0.471$, $DF = 22$, $p = 0.02$) (Figure 7) was shown. See Table 4 for full results.

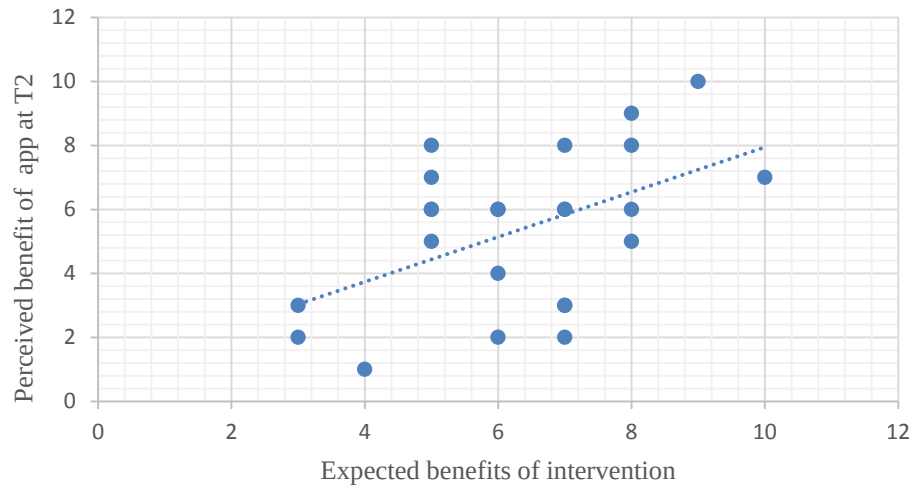


Figure 4. Showing the positive relationship between the expected benefits of the intervention and the perceived amount it helped for group one, mindfulness intervention.

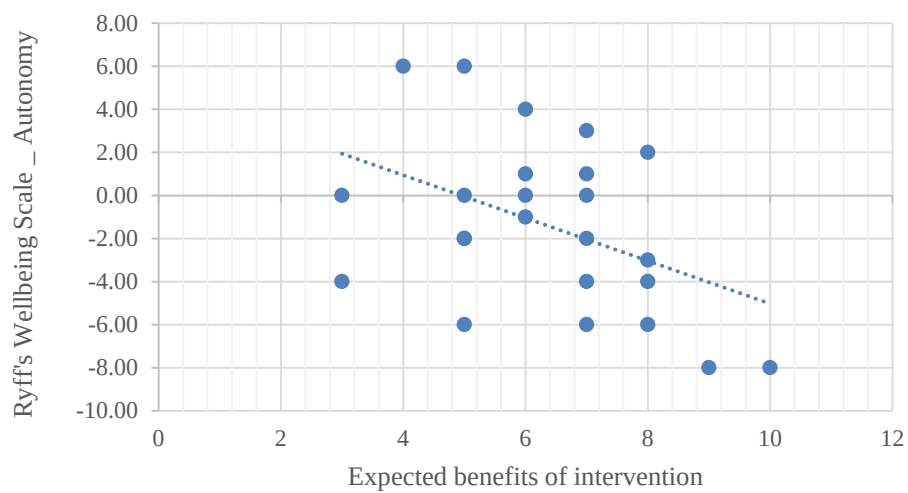


Figure 5. Showing the negative relationship between the expected benefits of the intervention and the Autonomy subscale of Ryff's Wellbeing Scale for group one, mindfulness intervention.

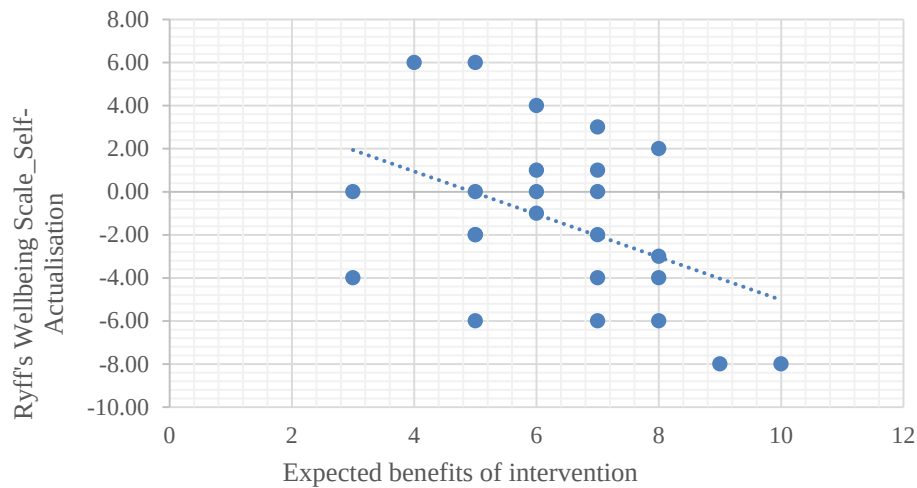


Figure 6. Showing the negative relationship between the expected benefits of the intervention and the Self-Acceptance subscale of Ryff's Wellbeing Scale for group one, mindfulness intervention.

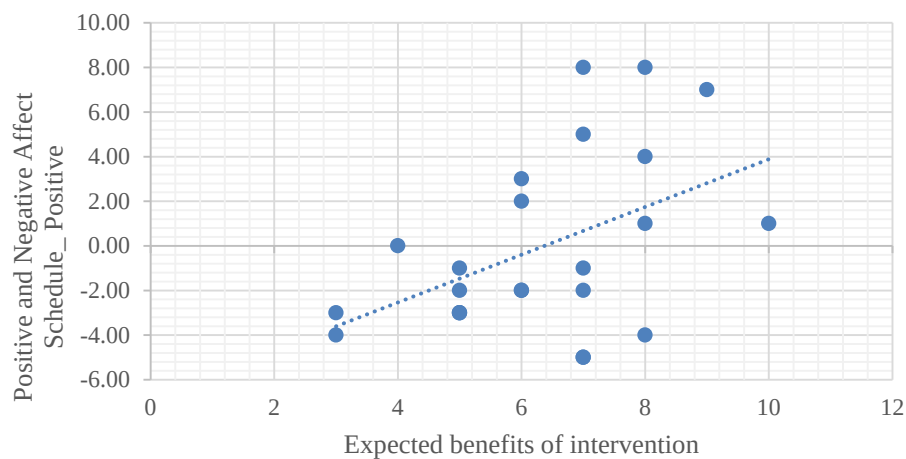


Figure 7. Showing the positive relationship between the expected benefits in the intervention and the positive affect subscale of the Positive and Negative Affect Schedule.

Group two, Zen Koi active control:

There was a negative correlation with expectation in the benefits of the intervention and the subjective report of how much the intervention helped ($r = -0.48$, $DF = 17$, $p = 0.04$) (Figure 8). There was a negative correlation with Wellbeing Scale_ Positive Relation with Others ($r = -0.48$, $DF = 17$, $p = 0.04$) (Figure 9). The data yielded a positive

correlation with Work Related Rumination Scale_Affective Rumination ($r = 0.61$, $DF = 17$, $p = 0.01$) (Figure 10). See table 4 for full results.

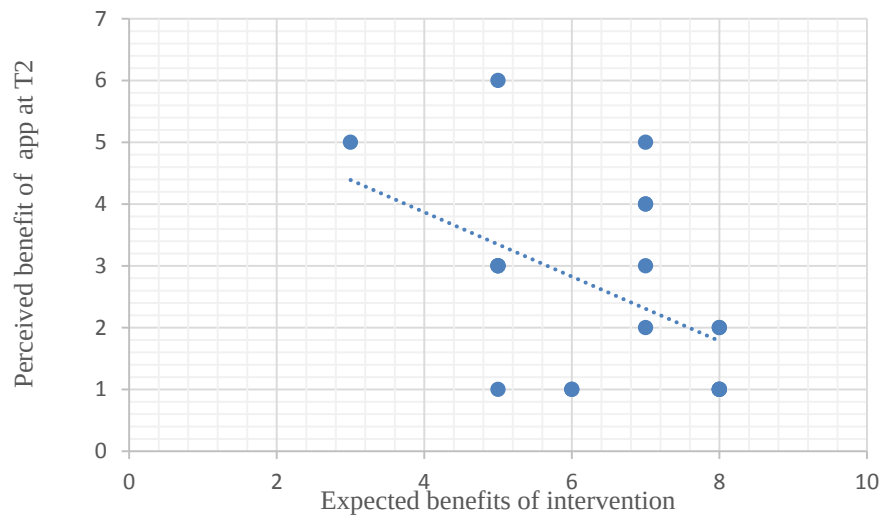


Figure 8: showing the negative relationship between the expected benefits of the intervention and the perceived amount it helped for group two, active control.

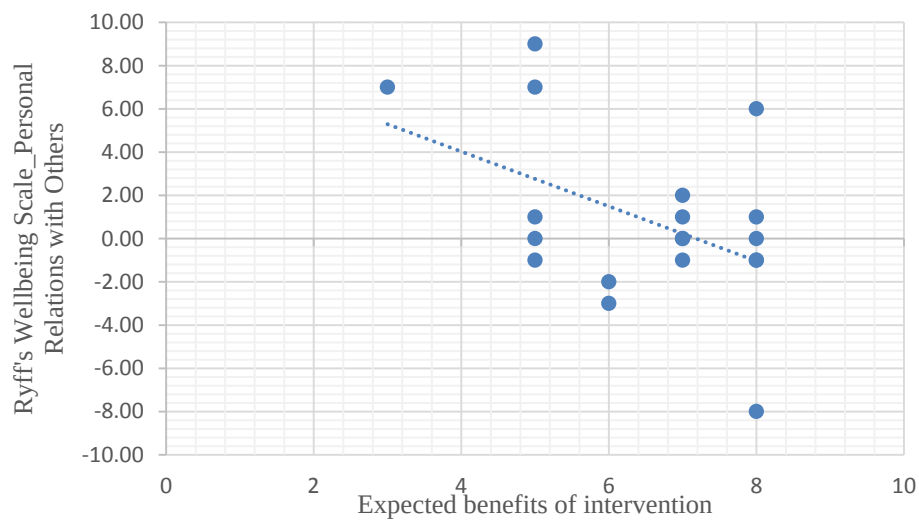


Figure 9: showing the negative relationship between the expected benefits of the intervention and the Positive Relation with Others subscale of Ryff's Wellbeing Scale for group two, active control.

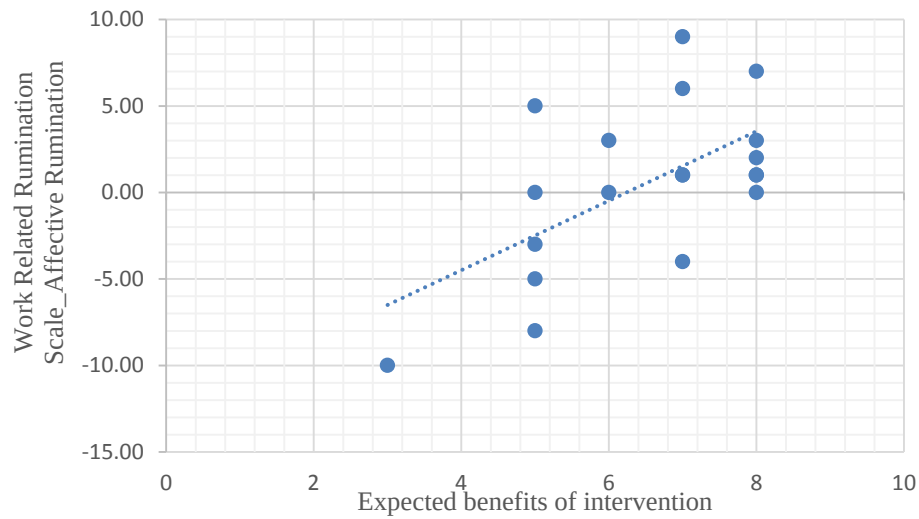


Figure 10: showing the positive relationship between the expected benefits of the intervention and the Affective Rumination subscale of the Work Related Rumination Scale for group two, active control.

Group three, waitlist control:

There were no significant correlations for the waitlist control group (Table 4).

Table 4

Showing correlations between the expected benefits of the intervention T1, and the mindfulness and wellbeing outcomes at T2.

Measures	Whole sample	Group one, Headspace mindfulness intervention	Group two, Zen Koi active control	Group three, waitlist passive control group
MAAS	(r = -0.07, df = 65, p = 0.59)	(r = -0.28, df = 22, p = 0.18)	(r = -0.15, df = 17, p = 0.55)	(r = 0.16, df = 22, p = 0.45)
WRRS_AR	(r = 0.19, df = 65, p = 0.12)	(r = -0.17, df = 22, p = 0.44)	(r = 0.61**, df = 17, p = 0.01)	(r = 0.04, df = 22, p = 0.86)
WRRS_PSP	(r = 0.09, df = 65, p = 0.46)	(r = 0.12, df = 22, p = 0.57)	(r = 0.41, df = 17, p = 0.08)	(r = 0.08, df = 22, p = 0.72)
WRRS_D	(r = 0.12, df = 65, p = 0.33)	(r = -0.14, df = 22, p = 0.53)	(r = -0.17, df = 17, p = 0.49)	(r = 0.05, df = 22, p = 0.82)
PANAS_Neg	(r = 0.14, df = 65, p = 0.26)	(r = 0.18, df = 22, p = 0.41)	(r = 0.24, df = 17, p = 0.31)	(r = 0.01, df = 22, p = 0.96)
PANAS_Pos	(r = 0.12, df = 65, p = 0.35)	(r = 0.47*, df = 22, p = 0.02)	(r = -0.18, df = 17, p = 0.47)	(r = 0.04, df = 22, p = 0.87)
RWBS_A	(r = -0.29*, df = 65, p = 0.02)	(r = -0.06, df = 22, p = 0.06)	(r = -0.15, df = 17, p = 0.53)	(r = 0.06, df = 22, p = 0.46)
RWBS_EM	(r = 0.07, df = 65, p = 0.57)	(r = -0.51*, df = 22, p = 0.01)	(r = -0.27, df = 17, p = 0.26)	(r = 0.19, df = 22, p = 0.77)
RWBS_PG	(r = -0.03, df = 65, p = 0.80)	(r = -0.15, df = 22, p = 0.47)	(r = -0.22, df = 17, p = 0.36)	(r = 0.34, df = 22, p = 0.10)
RWBS_PR	(r = -0.28*, df = 65, p = 0.02)	(r = -0.38, df = 22, p = 0.07)	(r = -0.47*, df = 17, p = 0.05)	(r = 0.10, df = 22, p = 0.64)
RWBS_PL	(r = 0.01, df = 65, p = 0.91)	(r = -0.03, df = 22, p = 0.88)	(r = -0.17, df = 17, p = 0.48)	(r = 0.24, df = 22, p = 0.26)
WBS_SA	(r = 0.22, df = 65, p = 0.07)	(r = -0.44*, df = 22, p = 0.03)	(r = -0.34, df = 17, p = 0.16)	(r = 0.08, df = 22, p = 0.71)
WBS_TOT	(r = 0.22, df = 65, p = 0.07)	(r = -0.37, df = 22, p = 0.07)	(r = -0.42, df = 17, p = 0.07)	(r = 0.24, df = 22, p = 0.27)
PSI	(r = 0.06, df = 65, p = 0.66)	(r = -0.06, df = 22, p = 0.06)	(r = 0.22, df = 17, p = 0.36)	(r = 0.14, df = 22, p = 0.53)
SWLS	(r = 0.18, df = 65, p = 0.16)	(r = -0.28, df = 22, p = 0.18)	(r = 0.37, df = 17, p = 0.12)	(r = 0.13, df = 22, p = 0.56)

Note: MAAS = Mindfulness Attention Awareness Scale; WRRS_AR = Work Related Rumination Scale, Affective Rumination; WRRS_PSP = Work Related Rumination Scale, Problem Solving Pondering; WRRS_D = Work Related Rumination Scale, Detachment; PANAS_Neg = Positive and Negative Affect Schedule, Negative; PANAS_Pos = Positive and Negative Affect Schedule, Positive; RWBS_A = Ryff's Wellbeing Scale, Autonomy; RWBS_EM = Ryff's Wellbeing Scale, Environmental Mastery; RWBS_PG = Ryff's Wellbeing Scale Personal Growth; RWBS_PR = Ryff's Wellbeing Scale Positive Relations with Others; RWBS_PL = Ryff's Wellbeing Scale Purpose in Life; RWBS_SA = Ryff's Wellbeing Scale Self-Acceptance; RWBS_Tot = Ryff's Wellbeing Scale Total; PSI = Physical Stress Index; SWLS = Satisfaction with Life Scale.

* Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed)

Hypothesis five

Our fifth hypothesis related to personality and the influence personality type as measured by the Ten Item Personality Index would have on completing the study and mindfulness outcomes. First, we wanted to know if those with higher conscientiousness would be more likely to continue the study (H5a).

To test H5a, a regression analysis was run with the number of sessions completed as predictor and the TIPI as variables. The regression analysis was not significant, $F_{5, 94} = 0.28$, $p=0.92$.

Finally, we assessed if those with higher agreeableness and neuroticism would be more susceptible to the mindfulness intervention and therefore would have more significant wellbeing outcomes (H5b). A correlation analysis was run between Ten Item Personality Index and the wellbeing measures. There was a negative correlation with TIPI_Agreeableness and PANAS_Negative subscale but no correlation with PANAS_Positive. There was a positive correlation with TIPI_Emotiona Stability and the positive subscale of the PANAS and negative correlation with the negative subscale of the PANAS (Table 5).

Table 5

Showing relationship between Positive and Negative subscales of the Positive and Negative Affect Schedule, and Agreeableness and Emotional Stability personality traits.

	DF	PANAS_Pos T1	PANAS_Neg T1
TIPI_Ag T1	65	$r = 0.14$, $p = 0.27$	$r = -0.25$, $p = 0.04^*$
TIPI_ES T1	65	$r = 0.51$, $p = 0.00^*$	$r = -0.54$, $p = 0.00^*$

Note: PANAS_Neg = Positive and Negative Affect Schedule, Negative; PANAS_Pos = Positive and Negative Affect Schedule, Positive; TIPI_Ag T1= Ten Item Personality Index, Agreeableness at Time 1; TIPI_ES T1= Ten Item Personality Index, Emotional Stability at Time 1.

* Correlation is significant at the 0.05 level (2-tailed)

Despite the significant correlations between the TIPI_Ag and TIPI_ES with the PANAS, the data yielded no significant correlations between TIPI_Ag and TIPI_ES and the wellbeing measures (Table 6).

Table 6

Showing relationship between Agreeableness and Emotional Stability subscales of Ten Item Personality Index and mindfulness and wellbeing measures.

Measures	DF	TIPI_Ag T1	TIPI_ES T1
MAAS	65	$r = 0.27, p = 0.20$	$r = -0.19, p = 0.12$
WRRS_AR	65	$r = -0.14, p = 0.27$	$r = -0.08, p = 0.55$
WRRS_PSP	65	$r = -0.22, p = 0.08$	$r = -0.17, p = 0.17$
WRRS_D	65	$r = 0.20, p = 0.11$	$r = 0.03, p = 0.83$
RWBS_A	65	$r = -0.14, p = 0.25$	$r = -0.14, p = 0.25$
RWBS_EM	65	$r = 0.06, p = 0.63$	$r = 0.11, p = 0.38$
RWBS_PG	65	$r = -0.16, p = 0.20$	$r = 0.04, p = 0.75$
RWBS_PR	65	$r = 0.23, p = 0.07$	$r = 0.19, p = 0.13$
RWBS_PL	65	$r = 0.01, p = 0.93$	$r = -0.13, p = 0.31$
RWBS_SA	65	$r = 0.13, p = 0.73$	$r = 0.01, p = 0.97$
RWBS_Tot	65	$r = 0.04, p = 0.73$	$r = 0.03, p = 0.79$
PSI	65	$r = 0.26, p = 0.84$	$r = 0.05, p = 0.71$
SWLS	65	$r = 0.07, p = 0.60$	$r = 0.09, p = 0.46$

Note: MAAS = Mindfulness Attention Awareness Scale; WRRS_AR = Work Related Rumination Scale, Affective Rumination; WRRS_PSP = Work Related Rumination Scale, Problem Solving Pondering; WRRS_D = Work Related Rumination Scale, Detachment; RWBS_A = Ryff's Wellbeing Scale, Autonomy; RWBS_EM = Ryff's Wellbeing Scale, Environmental Mastery; RWBS_PG = Ryff's Wellbeing Scale Personal Growth; RWBS_PR = Ryff's Wellbeing Scale Positive Relations with Others; RWBS_PL = Ryff's Wellbeing Scale Purpose in Life; RWBS_SA = Ryff's Wellbeing Scale Self-Acceptance; RWBS_Tot = Ryff's Wellbeing Scale Total PSI = Physical Stress Index; SWLS = Satisfaction with Life Scale.

Discussion

The data did not support the hypothesis that mindfulness increased wellbeing (H1). Because there was no increase at T2, no change in wellbeing could be assessed at T3, as there were no significant wellbeing results to sustain (H2). Correlation analysis showed that there was no relationship between the amount of time spent using the app and the wellbeing measures (H3) for either the mindfulness intervention or the Zen Koi active control.

The relationship between the expectancy of the benefits of the intervention and the wellbeing measures were investigated using correlation analysis (H4). High expectancy in the benefits of the intervention measured prior to being assigned a condition at T1, showed a decrease in the Autonomy and Positive Relationships with Others subscales of Ryff's Wellbeing Scale for the whole sample measured at T2. When the sample was divided by group, we found that those in the mindfulness intervention showed a positive relationship with their subjective experience of how much the app had helped them following the four week intervention (T2). We also found an increase in positive emotion measured by the Positive and Negative Affect Schedule and a decrease on the Autonomy and Self-Acceptance subscales of Ryff's Wellbeing Scale.

The active control group using Zen Koi on the other hand showed a negative relationship with their subjective experience of how much the app had helped them following the four-week intervention. They also showed a decrease on the Positive Relationships with Others subscale of Ryff's Wellbeing Scale and an increase on the Affective Rumination subscale of the Work Related Rumination Scale. There were no significant correlations for the passive wait-list control group.

A regression analysis showed that personality did not impact drop out (H5a). However, there was a relationship between personality and affect although this did not translate into the wellbeing measures (H5b).

Mindfulness as an effective tool to improve employee wellbeing (H1 and H2)

Our results did not support previous research findings that state that mindfulness is an effective intervention to improve wellbeing (Bond et al., 2013; Hafenbrack et al., 2014; Spikerman et al., 2016; van Emmerik et al., 2017; Yang et al., 2018). Our findings are therefore contradictory to previous research that indicated significant reductions in stress (Economides et al., 2018; Wylde et al., 2017), job strain (Bostock et al., 2019), and irritability, and increases in positivity and wellbeing (Howells et al., 2014). These studies, most of which were supported financially by Headspace, indicated that the benefits can be achieved with short smartphone mindfulness interventions for periods of four weeks or less.

Empirical studies such as Grossman, Niemann, Schmidt, & Walach, (2004) indicate mindfulness should reduce negative affect and improve mental and physical health across a range of measures. We expected to see a reduction in the negative emotion subscale of the Positive and Negative Affect Schedule in those who completed the mindfulness intervention. This did not occur; however, as there was no significant change in mindfulness as measured by the Mindfulness Attention and Awareness Scale, this is perhaps unsurprising.

It is interesting that most of the research seems to focus on the reduction of negative affect as the dominant wellbeing measure which in this case remained stable. Despite extensive progression forward in the studies being undertaken this approach seems to harken back to that of the early 1900's where reduction of illness was the key focus of psychological interventions. Grossman and colleagues' (2004) empirical research noted that the majority of the studies they reviewed were of clinical patients or stressed non-clinical groups. Lomas et al (2017) also note in their empirical study that much of the research tends to focus on reducing negative effect in clinical groups rather than improving existing positive outcomes in a general population which raises some questions about whether such a mindfulness intervention is as effective to the average user. In our research no evidence could be found to support a reduction of negative affect. The lack of significant impact on wellbeing in this study indicates that

mindfulness apps may not be as effective on a randomised subject group as initially suggested.

While much of the research literature supports mindfulness as a wellbeing intervention, there is also a growing amount of research that disputes this claim. A recent meta-analysis by Lomas et al., (2017) sheds doubt on the robustness of mindfulness findings, identifying mixed results in wellbeing outcomes in a range of mindfulness intervention studies. Their study suggests the impact of mindfulness on overall health benefits remains uncertain. Our research supports that statement. Lomas et al., (2017) note that while eight studies using a mindfulness intervention showed an improvement in anxiety, two had no effect. Additionally, for the eight studies that showed an improvement in reported stress levels, two studies again had no effect and one worsened. Depression studies had even lower results with four studies showing improvement, three showing no improvement and one worsening. Similarly, Wabeh, and Oken's (2016) study on online mindfulness interventions resulted in no significant health change. These mixed results supported by our own study shows that the existing research is not conclusive and therefore it cannot be categorically supported that mindfulness interventions improve wellbeing.

Some of the inconsistencies found in the studies reviewed by Lomas et al (2017) may have been due to a lack of methodological rigour. In our literature review, we have highlighted a number of concerns raised in the existing research that indicate a range of quality issues. These limitations include not being clear on what is being measured; only measuring components or facets of mindfulness not mindfulness as a full construct, a lack of control measures and an overreliance on waitlist control groups for comparison (Chiesa et al., 2011). Additionally, there is often failure to provide intergroup correlations (Byambasuren et al., 2018), not controlling for expectancy effects, and not using randomised sample or blinding (Byambasuren et al., 2018; Kreplin et al., 2018). From this, we can stipulate that one of the reasons why we did not find any significant benefits of the intervention on wellbeing was due to the rigour applied in ensuring a high quality research design.

At times, the way mindfulness presented in the literature is flawed. Lomas et al., (2017) found that in much of the research they reviewed, mindfulness overall as a construct did

not improve, only certain facets such as non-reacting or non-judging did, however, this was at times presented as a mindfulness improvement. Wylde et al., (2017) found similar results where only acting with awareness and non-reactivity to inner experience increased with a mindfulness intervention, not mindfulness as a whole. Lomas et al., (2017) highlight concerns that focusing on components of the construct then presenting that impact as an overall improvement in mindfulness does not accurately represent the data. Their recommendation is for studies to be more transparent in what they report by avoiding generalised statements and more specific about which aspect has improved to ensure readers are not misled.

In our study, we only looked at mindfulness as a whole construct and did not break it down into specific subscales. When reviewing impact on mindfulness using the Mindfulness Attention and Awareness Scale, the total outcome was the used measure. While this may be interesting for future research to look at how components of mindfulness changed, we did not review this data separately. Additionally, we have been clear to talk about wellbeing or to indicate where there were subscale changes only.

We attempted to control for issues such as experimenter bias and blinding by having researcher one remain blind to the group assignment when analysing the data and using online interventions to minimise experimenter bias and experimenter influence on outcome. We used a randomised control trial with both an active control group (Zen Koi) and a passive waitlist control group. Expectancy bias was managed by surveying participants on their expectations prior to being assigned a condition and then comparing their expectancy of any benefit against both their subjective belief in how the app had helped at T2 and their reported results using recognised wellbeing measures.

Finally, unlike the research conducted with the support of Headspace, we had no conflict of interest. While researcher one's organisation funded some of the study to enable the use of the Headspace app, there was no desire to prove the app useful or otherwise, only to understand if Headspace may be a useful tool within their particular environment to offer employees. It is possible that by attending to and controlling for these limitations found in other studies we have produced a more methodologically sound design which has led to differing outcomes.

Time spent using mindfulness intervention and increase in mindfulness (H3)

We predicted that longer periods using the Headspace app would positively affect mindfulness and wellbeing; however, no significant impact was found regarding the amount of time participants used the app. Moreover, no increase in mindfulness resulted from using the Headspace app as an intervention in this study. Headspace founder Puddicombe (2012) recommends that just ten minutes of mindfulness per day would produce beneficial impact and the studies funded by Headspace use this protocol. Our hypothesis extrapolated that if ten minutes per day of Headspace use could produce a significant result, any benefit gained through a short intervention may be amplified by longer exposure. Our research does not support that hypothesis.

While there were no quantitative measures to support longer usage having a higher effect, anecdotally one participant did claim that they felt they had better results from longer use stating *‘the sense of calm that the Headspace sessions gave me seemed to fade fairly quickly when I stuck to the 10 minute sessions. When I increased the duration to 15 minutes, the effect lasted longer.’* This may be an area that to be reviewed in future research with a mix of quantitative and qualitative measures. Alternatively, this comment could reflect some of the expectancy effects discussed below.

As our hypothesis was for mindfulness to increase based on longer use of the mindfulness app we did not run separate correlations on each of the facets of mindfulness but instead looked at overall effect, which was not significant. Further analysis may have proven specific facets had improved in our research. Supplementary research may further investigate this area to understand if some facets of mindfulness are more susceptible to change than others.

Expectations and impact on effect (H4)

The most consequential results in our research were related to H4, regarding expectancy in the benefits of the intervention as measured prior to being assigned a condition at T1, and subjective benefit measured at T2, having taken part in the experimental condition for four weeks. We looked at expectancy effect for a number of reasons. The first was

to control for expectancy bias. Kreplin et al., (2018), identified expectation bias as an area requiring better controls in future mindfulness research. They suggested blinding controls and measurements be put in place to moderate or at least acknowledge unintentional positive expectancy. We were unable to run a double blind design where participants were unaware of which condition they were assigned. To mitigate this, expectancy bias was controlled through measuring participant expectations prior to assignment of the condition.

We also wanted to understand how expectancy influenced the outcome of the experiment. Mindfulness has been positively represented in the media and therefore it was possible that participants entered into the study expected a positive outcome which could have an impact on their experience. We had also noted that many of the current studies, in particular regarding mindfulness within the workplace, relied upon self-reporting and we were interested in understanding whether expectancy was playing a part in those reported results.

There were significant negative results between the expectancy of the benefit of the app measured at T1, and subscales on Ryff's Wellbeing Scale at T2, for the whole group, group one, and group two. As a total sample, the group had a significant negative correlation between their expectations in the benefit of the intervention at T1 and the Autonomy and Personal Relations with Others subscales of Ryff's Wellbeing Scale at T2. Within group one, the Headspace mindfulness intervention, there was also a negative correlation between expectancy in the benefit of the intervention and the Autonomy and Self-Acceptance subscales of Ryff's Wellbeing Scale at T2. Additionally, there was a negative correlation with expectation in the benefit of the intervention and the Personal Relations with Others subscale of Ryff's Wellbeing Scale in the Zen Koi active control at T2.

Autonomy was negatively impacted across the whole sample and group one, mindfulness control. Drawing from Self-Determination Theory, autonomy is described as a human need and has implications regarding choice and control. Ryan, Deci, & Hoyle (2006) note that even with limited or forced choice scenarios, one may still feel a sense of autonomy if there is an endorsement of the final choice. As a whole, participants may have felt that their wellbeing was resultant on the condition they had

been assigned and that it was ‘out of their hands’ because their condition assignment was controlled by the researchers. For group one mindfulness intervention, high expectancy of a positive outcome may have increased reliance on the app. It is possible this reduced participants’ feelings of autonomy, as they perceived that their wellbeing was directly related to outcomes from using the mindfulness intervention.

There was a negative correlation at T2 of both the whole sample size and group two, Zen Koi active control, with the Personal Relations with Others subscale of Ryff’s Wellbeing Scale. This indicates that the participants who thought the app would most assist but did not receive the anticipated intervention had a significant reduction in the quality of their relationships. Quality of relationship is important as a key distinct component of positive psychological functioning (Ryff, 1995). It is possible that not being able to talk about their experiences in line with the requirements of the study, especially with other peers also taking part in the research, decreased relations with others. Lapierre (2019) found that smartphone dependency has a negative impact on relationships by reducing satisfaction and certainty. Volkmer and Lerner (2019) found that people who have a higher use of mobile phone use have lower wellbeing, life satisfaction, and mindfulness measurements. Encouraging participants to be on their phone each day to use the app may have had a negative impact which, contrary to those in the mindfulness intervention, was not balanced by feeling the practice was beneficial.

Self-Acceptance is described by Ryff and Keyes (1995) as the ‘*positive evaluations of oneself and one’s past life*’ (p. 720). It is surprising that those in the mindfulness intervention had a lower self-regard at T2, when they had a high expectancy of the benefit of the intervention. As mindfulness is presented as a tool to assist in aiding acceptance, it is possible that those that had a higher expectancy believed they would have an exponential outcome in this area, which was not met. Alternatively, it may have drawn more attention to the reality of their current life and their desired state that had a bigger gap than they thought and mindfulness alone was not enough to change this. Research shows mindfulness can sometimes have the adverse effect of drawing attention to the participants’ limitations (Sauer et al., 2013). As we also know that there was no significant change in the Mindfulness Awareness and Attention Scale, perhaps the inability to shift their acceptance did not align with their pre-existing beliefs and therefore had a more highly detrimental impact.

Of particular interest is that contrary to the Zen Koi active control, the Headspace mindfulness intervention group showed a positive correlation with the expectancy in the benefits of the intervention at T1 and their self-reported belief of how much the app had helped, taken at T2. It is important to note that this was participants' subjective belief in how much the app had helped; their actual reported wellbeing measures were not significant. This result for the Headspace intervention only is therefore similar to a placebo effect. In a placebo effect, any attribution of impact is attributed to the individual's mind-set rather than the intervention itself (Crum & Langley, 2007).

The research around placebo effects has mainly occurred within pharmacology where drug trials are easily controlled. Participants are generally blind to which condition they are allocated and all participants are provided with identical looking pills, one of which is a non-active sugar pill. The intent is to understand how the active condition, the test drug, affects the user in comparison compared to the sugar pill control (Boot, Simons, Stothart, & Stutts, 2013). It has been shown that even taking an inert placebo can produce a significant medical health improvement (Peciña et al., 2012).

Outside of drug trials and in psychological settings it is much more difficult to blind participants to which condition they have been placed in, hence why we used an active control which makes it more difficult to identify between the intervention and the control (Boot et al., 2013). The research in the psychological space is less effusive about the role of placebo or expectancy, and appears mixed. Wampold, Imel, and Minami, (2007) claim placebo effect exceeds many accepted medical interventions. However, Hróbjartsson, and Gøtzsche, (2007) disputed the research design of Wampold et al., (2007) as 'powerful spin' for having a too small sample size, and high reporting and sample-size bias, therefore they felt the stated placebo effect was neither robust nor significant.

Beauchamp et al., (2011) found expectancy based interventions used on adolescents who were told they were healthier than their peers were and completing the recommended amount of exercise did not have a significant impact on physical health benefits. Crum and Langley (2007) disagree, stating that symbols, beliefs, and expectations have the power to elicit strong physiological manifestations. In their

research, which involved telling a group of housekeepers that their daily work involved significant health benefits, they found a marked change within four weeks in measured physical health over the control group. This included a decrease in weight, blood pressure, body fat, waist-to-hip ratio, and body mass index.

In our research while there was a positive correlation between higher expectancy the intervention would help and the perceived benefits of those in the mindfulness intervention, there were no perceived benefits within the control groups. Additionally, while there were self-reported perceived benefits, there were no actual wellbeing improvements. It raises an interesting question when discussing a mind-based intervention such as mindfulness, that if participants believe they are being positively impacted, does this in turn have the potential for them to be benefited regardless of the measured outcome? After all, as Grossman (2008) states all mindfulness scales are effectively subjective and therefore reliant on a match between individual perception and reality.

When split by condition, the relationship between expectancy in the benefits of the intervention and positive and negative emotion as measured by the Positive and Negative Affect Schedule differed slightly between groups. For the group one mindfulness intervention data set, those with greater expectancy that the intervention would benefit also had a positive emotion score in the Positive and Negative Affect Schedule. A higher score on the Positive subscale of the Positive and Negative Affect Schedule indicates participants were feeling stronger or more frequent emotions such as interested, excited, strong, enthusiastic, and proud. This is similar to the study by Howells et al., (2014) who found mindfulness resulted in an increase in positive affect, however differs to the findings of Kiken & Shook (2014) who found mindfulness attenuated negative thoughts but did not increase positivity. As noted in the literature review positive and negative affect while negatively correlated, are distinctive dimensions and independent measures therefore an increase in positive affect would not also necessarily reduce negative affect (Ryff, 1995).

Interestingly, when looking at group one mindfulness intervention, regardless of expectancy in the app, there was no significant change between T1 and T2 in positive emotion as measured by the Positive and Negative Affect Schedule. This is unexpected

as the Positive and Negative Affect Schedule is measuring feelings and the expectancy in benefit of intervention measure tells us that the group were feeling more positive so we may expect to see a correlated shift in the reported results as these two would appear more closely aligned than other measures such as physical health. This did not occur.

While we found those with greater expectations in the group one mindfulness intervention reported a greater increase in positive emotion, this was only present in that group. Conversely, in group two, the Zen Koi active control, there was a negative correlation with those who had a higher expectation in the benefit of the intervention at T1 how they perceived it to have helped them at T2. The negative relationship between expected and perceived benefit in the intervention may be attributed to disappointment that they were not in the mindfulness intervention group. Despite not notifying participants which group they were in many would have realised that the Zenkoi app was not a mindfulness app. Participants may have felt more negative about the outcome of the intervention because expectation in the benefits of the intervention and what occurred did not match. This indicates that expectancy and experience need to be in line with your expectations to have a positive impact; the mindfulness intervention met the expectations of users, however the active control did not. Comparing this against the perceived positive emotion increase in the high expectancy mindfulness intervention group we can draw again from self-determination theory the conclusion that participants feel good when their expectations and what occurs next.

Those that had high expectations in the Zen Koi active control group had a positive recorded correlation with the Affective Rumination subscale of the Work Related Rumination Scale. Cropley and Millward (2003) identify one of the challenges of job strain as the inability to cognitively switch off after work. While rumination can be seen as either a positive or a negative outcome to job strain depending on the nature of the thought processing, work-related affective rumination, where psychophysiological arousal remains high is negatively valenced and detrimental to the recovery process (Querstret & Cropley, 2012). An increase in affective rumination indicates that participants in this group experienced more disrupted recovery from work demands and therefore had a poorer health outcome in this area. It is also possible that there is a correlation with the Zen Koi group between the heightened psychophysiological arousal shown through the Affective Rumination subscale of the Work Related Rumination

Scale and the negative correlation on the Personal Relations with Others subscale of Ryff's Wellbeing scale mentioned earlier. If someone is aroused, it may be demonstrated in moodiness, or other negative behaviours, which in turn may influence personal relationships or desire to be around others.

Overall, it appears that expectancy has a stronger impact on and self-reported impact on wellbeing than mindfulness interventions. This may explain some of the positive outcomes discovered by Carter, Tobias, & Spiegelhalter (2016), where results from multiple studies of mindfulness in organisational practice were largely based on self-reported responses by employees concerning their own impression of their improved ability to, for example, control emotions, remain calm and connect to others. It raises interesting implications as to whether belief in a result is as beneficial as an actual measured change overall and exposes challenges with research that uses self-reported benefits over controlled measures. This may imply that those studies that use a self-reported non-controlled measure are only reporting an expectancy effect rather than a true outcome. This is not unique to studies focused on mindfulness but all self-reporting measures (Sauer et al., 2013).

Personality and impact on the study (H5)

The relationship between personality and mindfulness is still relatively unexplored with literature agreeing the link between the two is still equivocal (Barrick & Mount, 1993; Latzman & Masuda, 2013). Studies have provided contradictory results, which may be due to low validity or related to a lack of methodological specificity (Hanley, 2016). Much of the findings that tie links between personality, mindfulness, and wellbeing specifically relate to neuroticism, which along with conscientiousness has the most significant relationship between dispositional mindfulness and personality (Hanley, 2016). Mindfulness has been shown to be negatively associated with (Latzman & Masuda, 2013), and able to moderate neuroticism (Tucker et al., 2014). Mindfulness acts as a moderator for subjective wellbeing when the levels of neuroticism are on the higher end of the scale (Wenzel, von Versen, Hirschmüller, & Kubiak, 2015). Conscientiousness is also positively associated with mindfulness (Latzman & Masuda, 2013) and both neuroticism and conscientiousness are all associated with mindfulness and impact on negative affect (Giluk, 2009).

We predicted that those with higher conscientiousness would be more likely to continue the study (H5a). Individuals who are more conscientious are described as dependable and rule abiding which is why we expected they would be more likely to follow the instructions through to the end (Rau & Williams, 2016). This did not occur in our research. The participants had all volunteered to take part in the research unlike a forced training scenario where employees are required to undertake some form of training or intervention as part of the workplace role out. This voluntary action and sense of helping out a colleague by taking part in our research may have reduced any specific impact of personality on drop outs. The fact that participants were willing and committed to the study may have influenced a better response rate and commitment to the full program however, we did have people drop out from the mindfulness intervention between signing up and the last questionnaire potentially due to competing priorities or a perceived lack of benefit from taking part.

While we acknowledged that neuroticism is the personality trait most commonly linked to mindfulness and wellbeing, we also were also interested in understanding if those with higher agreeableness would be more influenced by the mindfulness intervention (H5b) as agreeableness has also been linked to mindfulness impact (Latzman & Masuda, 2013). We theorised that someone higher on the agreeableness scale may have a more positive affect in comparison to another individual with a higher rating on neuroticism, which may have a higher negative affect. While we did see a negative correlation between negative emotion and those who scored higher on the Agreeableness there was no correlation with positive affect nor with wellbeing overall. We also saw a negative relationship between emotional stability which is the Ten Item Personality Index equivalent to neuroticism and negative affect. Overall personality was not a moderator or significant influencer in our research.

mhealth implications

The mobile app technology industry is worth billions of dollars and readily embraced by users across the world. While studies such as Wylde et al., (2014) and Economides et al., (2018) were able to show positive impact on wellbeing through use of the Headspace app as a mindfulness intervention, we could not replicate these results.

Though the cost ratio benefit of using a free or low cost smartphone app within organisation is enticing, the benefit must still be reliably realised to ensure that the time out for employees is justified and expectations met.

As both the Headspace intervention and the Zen Koi control are mobile-based tools, it is challenging to tell whether a face-to-face delivery would have provided significantly different results. Despite the growing popularity of apps, there are still many supporters of face-to-face interventions over online training (Hyland et al., 2015). However, one benefit of online interventions for the sake of research is the reduction of experimenter bias or influence, for example being overly enthusiastic in the delivery in a way that influences outcomes (Kreplin et al., 2018). In this study, we attempted to counter experimenter bias through blinding researcher one who conducted the interpretation of data based on unidentified data sets, only receiving the coded groups and comments post evaluation, using online interventions and online questionnaires to not influence answers.

There are implications regarding conflict of interest through Headspace funding and endorsing much of the study related to the mobile mindfulness, in particular the Headspace app. Of those studies listed on Headspace's research page, some acknowledged that there was a potential conflict however stated this was negated by the independent nature of analysis (despite being employed by Headspace). Others either did not acknowledge it at all. While the Headspace researchers identify no conflict of interest, Kreplin et al., (2018) highlight concerns regarding unintentional experimenter bias as a methodological flaw that has the potential to heavily influence results through unconsciously influencing outcomes or interpreting statistics with a confirmation bias. Rigorous controls must be put in place to remove any potential bias or conflict of interest, especially when studies are funded by the developers or owners of apps. Otherwise, the results do not truly represent independent research.

Unexpected side effects

It is perhaps important to note that one participant contacted researcher two to withdraw midway between T1 and T2 of the mindfulness intervention due to sleep disturbances that they felt were instigated by the use of Headspace. The participant later contacted

researcher two to acknowledge that since stopping the mindfulness intervention the nightmares had also stopped. Mindfulness practice can reveal underlying latent issues that may become apparent in unexpected ways to the participant (Van Gordon, Shonin, & Garcia-Campayo, 2017). Studies also show long-term meditators have a higher potential for lucid dreaming however this does not usually occur with those undertaking shorter courses (Baird, Riedner, Boly, Davidson, & Tononi, 2019) and was an unexpected outcome we had not foreseen.

Few studies seek to understand the adverse side effects of mindfulness and it can be difficult to know how wide ranging they are (Van Gordon et al., 2017). Participants rarely state openly if they had negative effects and often just drop out. We attempted to follow up with those that dropped out to understand the reasons why but did not receive a good return rate therefore; we cannot determine whether others dropped out because of negative side effects. The negative effects of mindfulness interventions is something that needs to be looked at in more detail in the future, particularly for apps where no face-to-face support is provided. (Van Dam et al., 2018)

Limitations

Our pre-experiment power analysis suggested that 35 participants were required per group to achieve sufficient power in the statistical analysis. Initial enrolments in the study (n=104) looked promising and were only one person under the desired total group size. Due to drop outs, our sample decreased below desired numbers. While research in the literature has been undertaken with a wide range of participant numbers, sometimes as low as six people within a group, we believe that supplementary research with a larger number of participants would be beneficial.

We had hoped to gather participants from a diverse range of work roles especially in the blue-collar field as much of the existing research in the literature has been on homogenous groups such as nurses or call centre workers, which raises questions about applicability in the broader working community. While there was a cross section of blue and white-collar workers, position types and levels within the organisation, a greater cohort of blue-collar workers would be desirable for a more realistic representation of this particular workforce.

The Mindfulness Attention and Awareness Scale is a measure of dispositional mindfulness. Considered one of the most popular mindfulness measures for experimental research, it is psychometrically rigorous as a general indicator of mindfulness (Baer et al., 2006; Brown & Ryan, 2003; Hyland et al., 2015). Some say those that have a greater dispositional tendency to be mindful would be easily prompted for mindfulness in the workplace (Dane & Brummel, 2014). However, there are some arguments in the literature that suggest because dispositional mindfulness is trait based and heavily ingrained through genetic predisposition and environment it would be unlikely to alter through a mindfulness intervention as disposition is significantly harder to change over a short period of time (Chiesa et al., 2011; Lomas et al., 2017). Additionally, some argue that dispositional mindfulness is independent of other forms of mindfulness and yet unclear if it is its own construct (Rau & Williams, 2016). These arguments may explain why we did not see any increase in mindfulness in the mindfulness intervention group. If this research was repeated a supplementary measure could be used which measures state mindfulness.

The use of apps was not strictly controlled. Ideally, how often and for how long participants used the app, and the content they saw, would all have been under our control. In an attempt to mitigate this as best as we could, participants assigned to an app were asked to use it for 10 minutes per day, five days per week. However, some participants used the apps less than the requested five days per week and others used it more. Those who used an app two times or less per week were excluded from the study. Some participants used the apps for longer periods each day. Participants using the mindfulness app could choose a topic with a particular focus such as sleep or anxiety. This variance may have had an impact on the results. Further research could put stronger controls in place regarding use of the apps. This would include controlling the amount of time per day, recording usage, and restricting the topics or ensuring there was consistent program of mindfulness rather than a free choice of topics as each topic was also varying length and had different focus outcomes.

It was not possible to blind groups to which group they were assigned. While we did not tell participants whether they were in the mindfulness intervention or the active control, most would have been able to ascertain which group they were in. Initial

design of the study had idealised the possibility of having Headspace provide an active control with the same look and feel as Headspace so that participants could not obviously identify whether they were in an intervention or a control, however, this was unable to be secured for this study. On reflection, this had the benefit of ensuring there was no conflict of interest with Headspace. However, further research would use conditions with greater similarities between the intervention and active control.

The control condition could be improved in further research as some users noted *‘the carp game app I was allocated really was a disjuncted [sic] and not meditative piece of kit. Having a game that requires task to achieve levels and interruptions to the flow of the game and frequent in game ads, upgrade and purchase opportunities does not provide the outcome I would have been seeking from a meditation.’* This is something to consider with future research design in ensuring that the active control condition does not have interruptions that may disturb flow reducing user experience and potentially negatively influencing the outcome.

There were a number of external contributing factors for participants conducting this study. When asked if anything else may have contributed to their results we received answers broad ranging from change in roles, serious illness for family members or the participant, through to death in the family. Other participants had positive events that may have influenced their results, such as short holidays or reduced work hours. Without removing participants from their natural environment, it is improbable to control for all other variables. Because the data was blind to researcher one, there was no allowance given to external factors. While these events may have influenced the outcome of this study, this type of variance in factors is realistic in the real world environment and was not confined to any particular group. If an app is able to provide significant sustainable wellbeing outcomes it would need to do so taking into account all aspects of the individual. Additionally, because participants were randomly assigned and external factors were not confined to any one group, the potential impact was consistent across the study.

Conclusion

Overall, this research challenges much of the literature around the positive impact of mindfulness app interventions on wellbeing in the workplace. Our research design put rigorous steps in to ensure a high quality study. This included a range of measures not only for mindfulness but also ensuing multifaceted areas of wellbeing were being considered, that the sample group was from a broad range of work types, and both active and passive controls, and blinding, were used to protect the integrity of the data.

While no significant relationship was shown between mindfulness and wellbeing overall, we found noteworthy linkage related to expectancy. The most significant result from this study was that higher expectation in the intervention resulted in the biggest impact on perceived improvements. This may account for positive findings of previous studies, especially where those studies rely on self-report measures. While expectation did not result in a total measured wellbeing improvement, it did relate to some wellbeing measures and not always in a good way, for example decreasing autonomy and personal relations with others.

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Appendices

Appendix A

AsPredicted registration

PREVIEW : "Mobile mindfulness; a comparative study of mindfulness and relaxation apps"

Author(s)

Antonia Buckman (Massey University) - xxxxxxxx@massey.ac.nz

Make sure all email addresses are correct, otherwise authors will not have access to this submission and it will never be approved.

Submission

1) Have any data been collected for this study already?

No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?

Mobile mindfulness; a comparative study of mindfulness and relaxation apps into workplace and the impact on employee wellbeing and performance.

Hypothesis 1: Mindfulness apps have a greater positive impact on employee wellbeing and performance over relaxation apps.

Hypothesis 2: Emphasizing the anticipated benefit of mindfulness on wellbeing and performance prior to intervention enhances the positive affect.

Hypothesis 3: Benefits are sustained over time.

3) Describe the key dependent variable(s) specifying how they will be measured.

Participants will complete a pre start questionnaire, repeated at the end of the four week intervention and again four weeks post-intervention. The questionnaire is designed to measure employee wellbeing and includes: Ten Item Personality Inventory (TIPI), Mindful Attention Awareness Scale (MAAS), Work Related Rumination Scale, Negative and Positive Work Rumination Scale (NAPWRS), Physical Stress Index (PSI), Life Satisfaction, Wellbeing Scale.

4) How many and which conditions will participants be assigned to?

Participants will be required to read online information and then complete an online consent and battery of tests to establish a baseline. They will then be randomly assigned to one of four groups by my Supervisor so that I am blind to allocation:

1. Waitlist control

2. Relaxation app 'Soar, Tree of life' <https://www.soartreeoflife.com/>

3. Mindfulness app 'Headspace' <https://www.headspace.com/>

4. Mindfulness app 'Headspace' <https://www.headspace.com/> with additional information regarding the positive impact of mindfulness on wellbeing and performance.

Participants assigned an app will be asked to complete 10 minutes per day on the app for the period of five days per week, for four weeks.

<https://aspredicted.org/preview.php>

3/06/2018

AsPredicted: Preview

Page 2 of 2

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.

Mixed model ANOVAs with a 4 (group) x 3 (time) design. Follow up t-tests. May also run some regression between wellbeing/mindfulness measure and how often people completed the questionnaires, how much they thought the intervention would help etc.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

Participants who use the app for two or less times per week will be excluded.

7) How many observations will be collected or what will determine sample size?

No need to justify decision, but be precise about exactly how the number will be determined.

This is being offered to a work place of over 1,000 employees. At this stage there is no cap in numbers at this stage. A power analysis suggests that 35 people per group are required to be statistically significant.

8) Anything else you would like to pre-register?

(e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)

The researcher will be blind to who was allocated to which control and all identifying data will be anonymous. Supervisor will allocate data and be the only person who can see the names of participants for allocation purposes.

The questionnaire will also include some questions regarding role, length of time in the workplace as well as how often the apps were used and belief of potential impact on wellbeing.

Appendix B

Recruitment Information



**MASTERS THESIS STUDYING IMPACT OF
MINDFULNESS ON EMPLOYEE WELLBEING**

**RESEARCH
VOLUNTEERS
NEEDED!**

4 week trial using a free online app, only 10
minutes per day + pre and post online survey.
Confidential, all data is anonymous.

STUDY STARTS 20/6/2018
TO REGISTER OR FOR MORE INFORMATION CONTACT:
ANTONIA.BUCKMAN@URBANUTILITIES.COM.AU

Appendix C

Information sheet and online consent

Information Sheet

Thank you for your interest in this study. My name is Antonia Buckman; I am a member of the People and Safety team at Queensland Urban Utilities and also completing my Masters by Thesis in Psychology through Massey University, New Zealand. The research data collected through this intervention will be used for my thesis.

The aim of this research is to understand the potential benefits of mindfulness apps on employee wellbeing.

Procedure

Participation is voluntary. Those who choose to take part will be asked to use an app for 10 minutes per day, five days per week for four weeks. The app will be allocated and provided free of charge to use for that time and can be used on any mobile device, tablet or computer.

The study has three groups to which volunteers are assigned at random. One group will use the mindfulness app Headspace, one group will use a relaxation app developed by Coventry University in the UK and one group will be on a waiting list. Those using the relaxation app and those in the waiting list group will be able to use the Headspace app free of charge for four weeks at the end of the experiment if they wish to do so. All groups have equal importance to the study as it is important that we can compare the benefits of mindfulness against another activity, in this case a relaxation app, but also how it compares to doing nothing extra.

All participants will be asked to complete a questionnaire at the start and end of the four week intervention, and again at four weeks post intervention so we can understand if impact is sustained over time. The questionnaire is online and takes approximately 25 minutes to complete.

It is important for my data integrity that participants complete the questionnaire at the three stages of research so that I have a complete data set. This includes those in the waitlist control group.

Confidentiality

For the purpose of this study I cannot know which group people have been allocated to therefore all identifiable data will be securely stored offsite at Massey University. My supervisor Dr. Ute Kreplin, will randomly assigning people to a control group and providing the relevant link to the app. The email address she will use to send the app is U.Kreplin@massey.ac.nz.

At the end of the experiment all identifying data will be destroyed and I will only be provided with anonymous data for analysis. At no time will I have access to your responses in a way where I could identify who has completed the questionnaire. No identifying data will be made available to QUU at any stage of the study. This is important for your confidentiality and also for the nature of this study.

A summary of the results of this study will be made available to all participants, QUU, and may also be published in a scientific journal.

Participant rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to: *decline to answer any particular question; withdraw from the study (until identifying information is destroyed at the end of data collection); ask any questions about the study at any time during participation; provide information on the understanding that your name will not be used unless you give permission to the researcher; be given access to a summary of the project findings when it is concluded.*

Further information

Any questions regarding this study can be directed to Massey University Researcher Antonia Buckman at either antonia.buckman@urbanutilities.com.au or Antonia.Buckman.1.@uni.massey.ac.nz or Massey University, School of Psychology Supervisor Dr. Ute Kreplin U.Kreplin@massey.ac.nz

The questionnaire requires some self-reflection, in the unlikely event that this causes some unwanted emotion or anxiety QUU employees are encouraged to contact the free and confidential Employee Assistance Program on 1800 604 640. Alternatively you can speak to your GP or access a service through Living Well <https://www.livingwell.org.au/get-support/other-services-2/general-counselling-services-in-queensland/>.

Antonia Buckman

Massey University School of Psychology – Te Kura Hinengaro Tangata
Palmerston North, New Zealand

T +64 6 3569-099 ext. 85071: W psychology.massey.ac.nz

This project has been reviewed and approved by the Massey University Human Ethics Committee: Southern B, Application 18/31.

If you have any concerns about the conduct of this research, please contact Dr. Gerald Harrison (Acting Chair), Massey University Human Ethics Committee: Southern B, telephone 06 356 9099 x 83570, email humanethicsouthb@massey.ac.nz

Consent

I have read the Information Page and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I understand that I have an obligation to respect the nature of the study and will not disclose information regarding which group I have been placed in.

I know that the information regarding my answers will be securely stored offsite and data will be made anonymous before being accessed by the researcher.

Consent I agree to participate in this study under the conditions set out above.
(Please click on the 'I agree' choice if you wish to proceed.)

Appendix D

Reminder emails

Initial email with link and ID

Thank you for registering your interest to take part for Antonia Buckman's research to complete her Master's Thesis.

Below is a link to complete the questionnaire and your unique ID. You will need to use this unique ID each time you complete the questionnaire so that we can track any changes to your results.

Please complete this questionnaire by **p.m. Thursday, 19 July 2018**. Once you have completed the questionnaire I will send you instructions on which group you have been assigned and details for the app.

Your data will be kept confidential and stored onsite at Massey University, New Zealand until the end of the study. Antonia will only receive data, not the names of participants.

On her behalf thank you for taking part in this study, without the data that you provide this study would not be able to take place.

Reminder email questionnaire #1 not started

Thank you for registering to take part in Antonia Buckman's research study on the impact of mindfulness on employee wellbeing.

On Monday we sent you a questionnaire asking for insight on your current wellbeing. If you have already completed and submitted the survey, thank you for your valuable input. If not, below is a link to complete the questionnaire and your unique ID. You will need to use this unique ID each time you complete the questionnaire so that we can track any changes to your results.

Please complete this questionnaire by **5pm Thursday, 19 July 2018**. Once you have completed the questionnaire I will send you instructions on which group you have been assigned and details for the app.

Your data will be kept confidential and stored onsite at Massey University, New Zealand until the end of the study. Antonia will only receive data, not the names of participants.

On her behalf thank you for taking part in this study, without the data that you provide this study would not be able to take place.

Reminder email questionnaire #1 incomplete

Thank you for registering to take part in Antonia Buckman's research study on the impact of mindfulness on employee wellbeing.

On Monday we sent you a questionnaire asking for insight on your current wellbeing which you started but have not yet completed. Below is a link to complete the questionnaire and your unique ID. You will need to use this unique ID each time you complete the questionnaire so that we can track any changes to your results.

Please complete this questionnaire by **5pm Thursday, 19 July 2018**. Once you have completed the questionnaire I will send you instructions on which group you have been assigned and details for the app.

Your data will be kept confidential and stored onsite at Massey University, New Zealand until the end of the study. Antonia will only receive data, not the names of participants.

On her behalf thank you for taking part in this study, without the data that you provide this study would not be able to take place.

Appendix E

Ten Item Personality Index (TIPI)

Here are a number of personality traits that may or may not apply to you. Please indicate the extent to which you agree or disagree with that statement. You should rate the extent to which the pair of traits applies to you, even if one characteristic applies more strongly than the other I see myself as:	Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
Extraverted, enthusiastic							
Critical, quarrelsome.(r)							
Dependable, self-disciplined.							
Anxious, easily upset. (r)							
Open to new experiences, complex.							
Reserved, quiet.(r)							
Sympathetic, warm.							
Disorganized, careless. (r)							
Calm, emotionally stable.							
Conventional, uncreative. (r)							

Scoring the TIPI

1. Recode the reverse-scored items (i.e., recode a 7 with a 1, a 6 with a 2, a 5 with a 3, etc.). The reverse scored items are 2, 4, 6, 8, & 10.

2. Take the AVERAGE of the two items (the standard item and the recoded reverse-scored item) that make up each scale.

Example using the Extraversion scale: A participant has scores of 5 on item 1 (Extraverted, enthusiastic) and 2 on item 6 (Reserved, quiet). First, recode the reverse-scored item (i.e., item 6), replacing the 2 with a 6. Second, take the average of the score for item 1 and the (recoded) score for item 6. So the TIPI Extraversion scale score would be: $(5 + 6)/2 = 5.5$

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Appendix F

Mindfulness Awareness and Attention Scale (MAAS)

Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.	Almost always	Very frequently	Somewhat frequently	Somewhat infrequently	Very infrequently	Never
I could be experiencing some emotion and not be conscious of it until some time later.	1	2	3	4	5	6
I break or spill things because of carelessness, not paying attention, or thinking of something else.	1	2	3	4	5	6
I find it difficult to stay focused on what's happening in the present.	1	2	3	4	5	6
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	1	2	3	4	5	6
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	1	2	3	4	5	6
I forget a person's name almost as soon as I've been told it for the first time.	1	2	3	4	5	6
It seems I am "running on automatic," without much awareness of what I'm doing.	1	2	3	4	5	6
I rush through activities without being really attentive to them.	1	2	3	4	5	6
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	1	2	3	4	5	6
I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5	6
I find myself listening to someone with one ear, doing something else at the same time.	1	2	3	4	5	6
I drive places on "automatic pilot" and then wonder why I went there.	1	2	3	4	5	6
I find myself preoccupied with the future or the past.	1	2	3	4	5	6
I find myself doing things without paying attention.	1	2	3	4	5	6
I snack without being aware that I'm eating.	1	2	3	4	5	6

Higher scores reflect higher levels of dispositional mindfulness

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Appendix G

Work Related Rumination Scale (WRRS)

The following questions relate to your time after work. Please tick the number that applies to you		Very seldom / Never	Seldom	Sometimes	Often	Very often / always
1	Do you become tense when you think about work related issues in your free time?	1	2	3	4	5
2	I find solutions to work-related problems in my free time.	1	2	3	4	5
3	I make myself switch off from work as soon as I leave.	1	2	3	4	5
4	In my free time I find myself re-evaluating something I have done at work.	1	2	3	4	5
5	Are you troubled by work-related issues when not at work?	1	2	3	4	5
6	Do you feel unable to switch off from work? (reverse scored)	1	2	3	4	5
7	Do you become fatigued by thinking about work-related issues during your free time?	1	2	3	4	5
8	After work I tend to think of how I can improve my work-related performance.	1	2	3	4	5
9	Are you irritated by work issues when not at work?	1	2	3	4	5
10	I am able to stop thinking about work-related issues in my free time.	1	2	3	4	5
11	I find thinking about work during my free time helps me to be creative.	1	2	3	4	5
12	Do you leave work issues behind when you leave work?	1	2	3	4	5
13	Do you think about tasks that need to be done at work the next day?	1	2	3	4	5
14	Do you find it easy to unwind after work?	1	2	3	4	5
15	Are you annoyed by thinking about work-related issues when not at work?	1	2	3	4	5

Mean score for each factor

Questions 1, 5, 7, 9, 15; Score..... Affective Rumination
 Questions 2, 4, 8, 11, 13 Score..... Problem solving pondering
 Questions 3, 6, 10, 12, 14 Score..... Detachment

Note: Question 6 is reverse scored.

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Appendix H

Positive and Negative Affect (PANAS)

This scale consists of a number of words that describe different feelings and emotions. Read each item and then list the number from the scale below next to each word. Indicate the extent you have felt this way over the past few weeks.	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
1. Interested	1	2	3	4	5
2. Distressed	1	2	3	4	5
3. Excited	1	2	3	4	5
4. Upset	1	2	3	4	5
5. Strong	1	2	3	4	5
6. Guilty	1	2	3	4	5
7. Scared	1	2	3	4	5
8. Hostile	1	2	3	4	5
9. Enthusiastic	1	2	3	4	5
10. Proud	1	2	3	4	5
11. Irritable	1	2	3	4	5
12. Alert	1	2	3	4	5
13. Ashamed	1	2	3	4	5
14. Inspired	1	2	3	4	5
15. Nervous					
16. Determined	1	2	3	4	5
17. Attentive	1	2	3	4	5
18. Jittery	1	2	3	4	5
19. Active	1	2	3	4	5
20. Afraid	1	2	3	4	5

Positive Affect Score: Add the scores on items 1, 3, 5, 9, 10, 12, 14, 16, 17, and 19.

Scores can range from 10 – 50, with higher scores representing higher levels of positive affect.

Negative Affect Score: Add the scores on items 2, 4, 6, 7, 8, 11, 13, 15, 18, and 20.

Scores can range from 10 – 50, with lower scores representing lower levels of negative affect.

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Appendix I

Ryff's Wellbeing Scale (RWBS)

	Please indicate your degree of agreement (using a score ranging from 1 -6) with the following sentences:	Strongly Agree						Strongly Disagree					
1	I am not afraid to voice my opinions, even when they are in opposition to the opinions of most people	1	2	3	4	5	6						
2	In general, I feel I am in charge of the situation in which I live	1	2	3	4	5	6						
3	I am not interested in activities that will expand my horizon	1	2	3	4	5	6						
4	Most people will see me as loving and affectionate	1	2	3	4	5	6						
5	I live my life one day at a time and don't really think about the future	1	2	3	4	5	6						
6	When I look at the story of my life, I am pleased with how things have turned out	1	2	3	4	5	6						
7	My decisions are not usually influence by what everyone else is doing	1	2	3	4	5	6						
8	The demands of my everyday life get me down	1	2	3	4	5	6						
9	I think it is important to have new experiences that challenge how you think about yourself and the world.	1	2	3	4	5	6						
10	Maintaining close relationships has been difficult and frustrating for me	1	2	3	4	5	6						
11	I have a sense of direction and purpose in life.	1	2	3	4	5	6						
12	In general, I feel confident and positive about myself.	1	2	3	4	5	6						
13	I tend to worry about what other people think of me.	1	2	3	4	5	6						
14	I do not fit very well with the people and the community around me	1	2	3	4	5	6						
15	When I think about it, I haven't really improved much as a person over the years.	1	2	3	4	5	6						
16	I often feel lonely because I have few close friends with whom to share my concerns.	1	2	3	4	5	6						
17	My daily activities often seem trivial and unimportant to me.	1	2	3	4	5	6						
18	I feel like many of the people I know have gotten more out of life than I have.	1	2	3	4	5	6						
19	I tend to be influenced by people with strong opinions.	1	2	3	4	5	6						
20	I am quite good at managing the many responsibilities of my daily life.	1	2	3	4	5	6						
21	I have a sense that I have developed a lot as a person over time.	1	2	3	4	5	6						
22	I enjoy personal and mutual conversations with family members or friends.	1	2	3	4	5	6						
23	I don't have a good sense of what it is I'm trying to accomplish in life.	1	2	3	4	5	6						
24	I like most aspects of my personality.	1	2	3	4	5	6						
25	I have confidence in my opinions, even if they are	1	2	3	4	5	6						

	contrary to the general consensus.						
26	I often feel overwhelmed by my responsibilities.	1	2	3	4	5	6
27	I do not enjoy being in new situations that require me to change my old familiar ways of doing things	1	2	3	4	5	6
28	People would describe me as a giving person, willing to share my time with others	1	2	3	4	5	6
29	I enjoy making plans for the future and working to make them a reality.	1	2	3	4	5	6
30	In many ways, I feel disappointed about my achievements in life.	1	2	3	4	5	6
31	It's difficult for me to voice my own opinions on controversial matters	1	2	3	4	5	6
32	I have difficulty arranging my life in a way that is satisfying to me.	1	2	3	4	5	6
33	For me, life has been a continuous process of learning, changing and growth.	1	2	3	4	5	6
34	I have not experienced many warm and trusting relationships with others.	1	2	3	4	5	6
35	Some people wander aimlessly through life, but I am not one of them.	1	2	3	4	5	6
36	My attitude about myself is probably not as positive as most people feel about themselves.	1	2	3	4	5	6

Reverse score grey (3, 5, 10, 13, 14, 15, 16, 17, 18, 19, 23, 26, 27, 30, 31, 32, 34, 36, 39, 41)

Add together the final degree of agreement in the 6 dimensions.

- Autonomy: questions 1, 7, 13, 19, 25, 31, 37
_____/42
- Environmental Mastery: questions 2, 8, 14, 20, 26, 32, 38
_____/42
- Personal Growth: questions 3, 9, 15, 21, 27, 33, 39
_____/42
- Positive Relations: questions 4, 10, 16, 22, 28, 34, 40
_____/42
- Purpose in Life: questions 5, 11, 17, 23, 29, 35, 41
_____/42
- Self-acceptance: questions 6, 12, 18, 24, 30, 36, 42
_____/42

TOTAL _____252

Higher scores indicate a greater level of wellbeing

** Note: Reproduced by permission of Carol Ryff, author.*

Appendix J

Physical Stress Indicator (PSI)

Over the past month, how often have you experienced each of the following symptoms?	Not at all	Once or Twice	Once or twice per week	Most days	Every day
1. An upset stomach or nausea	1	2	3	4	5
2. Trouble sleeping	1	2	3	4	5
3. Headache	1	2	3	4	5
4. Acid indigestion or heartburn	1	2	3	4	5
5. Eye strain	1	2	3	4	5
6. Diarrhoea	1	2	3	4	5
7. Stomach cramps (Not menstrual)	1	2	3	4	5
8. Constipation	1	2	3	4	5
9. Ringing in the ears	1	2	3	4	5
10. Loss of appetite	1	2	3	4	5
11. Dizziness	1	2	3	4	5
12. Tiredness or fatigue	1	2	3	4	5

Sum responses to all of the items into a total score which will range from 12 to 60.

A higher score indicates greater level of physical stress.

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Appendix K

Satisfaction with Life Scale (SWLS)

Below are five questions which you may agree or disagree with. Using the 1-7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding the item.	Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
In most ways my life is close to my ideal	7	6	5	4	3	2	1
The conditions of my life are excellent	7	6	5	4	3	2	1
I am satisfied with my life	7	6	5	4	3	2	1
So far I have gotten the important thing I want in life	7	6	5	4	3	2	1
If I could live my life over I would change almost nothing	7	6	5	4	3	2	1

Sum of scores:

- 31 - 35 Extremely satisfied
- 26 - 30 Satisfied
- 21 - 25 Slightly satisfied
- 20 Neutral
- 15 - 19 Slightly dissatisfied
- 10 - 14 Dissatisfied
- 5 - 9 Extremely dissatisfied

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