

THE IMPACT OF WELL DESIGN STRATEGIES ON EMPLOYEE
SATISFACTION WITH INTERIOR ENVIRONMENTAL QUALITY AND
PERCEIVED HEALTH AND WELL-BEING: A MULTI-OFFICE PRE- VERSUS
POST-OCCUPANCY STUDY

A Thesis

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by

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ABSTRACT

There has been an increase in interest in healthy indoor environments over the last decade. WELL is currently the most comprehensive building certification system that aims to enhance human health and well-being, but little research has been published on the impact WELL spaces have on their occupants. This research examined three locations of an architecture and design firm that moved from offices that were not designed with WELL strategies to offices that were. Pre- and post-occupancy evaluations were conducted to understand the impact spaces designed with WELL strategies have on their occupants' satisfaction with IEQ and perceived health and well-being. Results suggest that implementing WELL design strategies in the workplace can lead to increased employee satisfaction with IEQ, improved employee perception that their workplace is conducive to health and well-being, and better employee self-reported mental health.

BIOGRAPHICAL SKETCH

Heather Bazille became intrigued by the effects of the built environment on people over the life course as an undergraduate student. She was exploring the interior architecture program at University of Wisconsin–Madison when she took a course titled Environments and Human Behavior. The course examined the interplay of humans and the built environment—how we shape our environments and in turn, how they shape us. She was so fascinated by the course that she went on to earn a Bachelor of Science in Psychology from University of Wisconsin. After nearly a decade of working in human-centered product and service design research, Heather’s fascination with the interplay between the humans and the built environment led her to the Master of Science program in the Department of Design and Environmental Analysis at Cornell. Her studies at Cornell have focused on the many ways the design of the built environment can impact human mental and physical health as well as human health-related behaviors. She has had the opportunity to explore the health impacts of a variety of environments—from housing and neighborhoods to schools, workplaces, healthcare facilities and cities. She is currently a Research Fellow at the International WELL Building Institute (IWBI), where she is helping organizations share the pre-/post-occupancy evaluation results from their WELL-certified projects.

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CHAPTER 1

INTRODUCTION

There has been an increase in interest in healthy indoor environments over the last decade (Allen & Macomber, 2020; Battisto & Wilhelm, 2019; Bluysen, 2013; Heidari et al., 2016; Stephens, 2020; Wierzbicka et al., 2018), and the COVID-19 pandemic has thrust public health into the limelight and heightened awareness of how the indoor spaces where we live, work, study, and socialize can impact our health and well-being. Launched in 2014, WELL was the first building certification developed as a framework for rating healthy spaces (Matos, 2014). It is currently the most comprehensive building certification system that aims to enhance human health and well-being (McArthur & Powell, 2020), but little research has been published on the impact WELL-certified spaces have on their occupants (Candido et al., 2020; Licina & Langer, 2021; Licina & Yildirim, 2021). More post-occupancy evaluation (POE) evaluations of WELL-certified spaces are needed to establish the success and shortcomings of the current certification system and guide future versions of the WELL Building Standard. This research examines three locations of an international architecture and design firm that moved from offices were not designed with WELL strategies to offices that were. Pre- and post-occupancy evaluations were conducted to understand the impact spaces designed with WELL strategies have on their occupants, particularly on their satisfaction with interior environmental quality, perception their workplace is conducive to health and well-being, and self-reported health and well-being.

WELL Building Standard

Version one of the WELL Building Standard (International WELL Building Institute (IWBI), 2021) consists of 105 WELL Features. The features include evidence-based design strategies aimed at enhancing human health and well-being. They are organized under seven WELL Concepts: Air, Comfort, Fitness, Light, Mind, Nourishment, and Water. Each feature is categorized as either a precondition (required) or an optimization (optional). There are three levels of certification: silver, gold, and platinum. For a project to earn silver WELL certification, the project must achieve all applicable preconditions. To earn gold or platinum WELL certification, a project must achieve all applicable preconditions plus 40% of all applicable optimizations or 80% of all applicable optimizations, respectively. There are three project types that can receive certification: New and Existing Interiors, New and Existing Buildings, and Core and Shell. The preconditions and optimizations vary slightly based on the project type.

Feature 86: Post-Occupancy Surveys. Feature 86 (Post-Occupancy Surveys) of the WELL Building Standard v1 (IWBI, 2021) requires all New and Existing Buildings and New and Existing Interiors projects with 10 or more occupants administer an interior environmental quality (IEQ) post-occupancy evaluation (POE) survey annually to a representative sample of at least 30% of the occupants. The survey must assess, at minimum, the occupants' perception of the building or space's acoustics, air quality, cleanliness, furnishings, layout, lighting, maintenance, and thermal comfort. It is recommended the survey be administered by a third-party survey provider to ensure credibility and objectivity of the results.

Post-Occupancy Evaluation and Evidence-Based Design

Post-Occupancy Evaluations (POEs). POEs are used to systematically gather feedback from a representative sample of occupants to better understand how successfully a building or space has achieved its design goals. They should ideally be conducted at least one year after move-in to avoid what is known as the honeymoon effect (Shepley, 2009). Occupants of new buildings and spaces typically undergo a “honeymoon” period during which their satisfaction is based more on the newness of the building or space than the actual design or day-to-day performance of it (Gifford, 2016).

Post-occupancy evaluation is a critical step in an evidence-based design (EBD) process (Center for Health Design, 2010) (see Figure 1). POEs provide actionable insights that can be used to help address any gap between the design intentions and the actual outcomes of a project. Results of a post-occupancy evaluation can also be used as evidence to inform future evidence-based design projects or standards. If possible, it is best to conduct both a pre-occupancy evaluation and a post-occupancy evaluation, because the results of a pre-occupancy evaluation can be used as baseline data to compare the post-occupancy data (Shepley, 2011). Pre-occupancy evaluations (PrOEs) should ideally be conducted more than three months prior to occupancy, because if the PrOE is conducted too close to the occupancy of the new space, the anticipation of the move may impact the responses. When possible, multiple sites should be evaluated to make the PrOE/POE results more generalizable.

Figure 1

The WELL evidence-based design process



Adapted from Center for Health Design (2021)

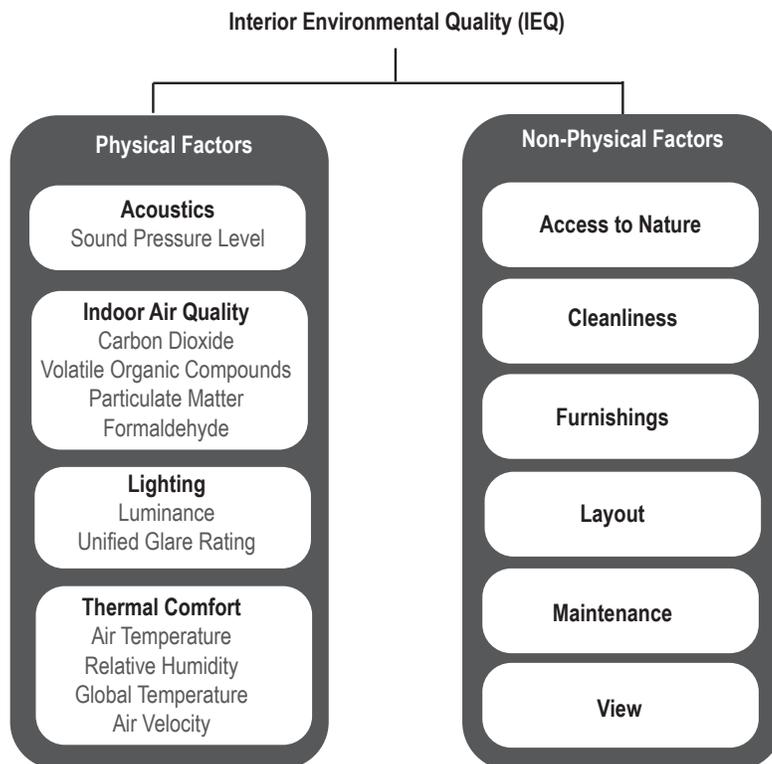
Interior Environmental Quality (IEQ)

According to the Centers for Disease Control and Prevention (CDC), “interior environmental quality (IEQ) refers to the quality of a building’s environment in relation to the health and well-being of those who occupy it” (2021). Geng et al. (2019) distinguishes between physical and non-physical factors used to determine interior environmental quality (see Figure 2).

Physical factors include indoor air quality, acoustics, lighting (quality of both artificial and natural lighting), and thermal comfort. Physical factors are most often used in research to determine IEQ, likely because they can be objectively measured with physical instrumentation. Non-physical factors generally refer to IEQ factors that are difficult to objectively measure with physical instrumentation, such as access to nature, cleanliness, furnishings, layout, maintenance, and view.

Figure 2

Physical and non-physical factors in IEQ studies



Adapted from Geng et al. (2019)

Physical and non-physical IEQ factors as perceived by occupants can be measured subjectively using tools such as surveys and interviews. User perception is crucial in measuring person-environment relationships and therefore essential in determining environmental quality (Fleury-Bahi et al., 2017). Three of the surveys most widely used to measure IEQ factors subjectively are:

1. Sustainable and Healthy Environments (SHE) Survey (formerly BOSSA (Candido et al., 2015))
2. BUS (Building Use Studies) Wellbeing Survey (a combination of the pre-existing BUS Methodology Occupant Satisfaction Survey (Leaman & Bordass, 2010) and Delos Building Wellness Survey)
3. CBE (Centre for Built Environment) Occupant Survey (Zagreus et al., 2004)

All three of the surveys use occupant satisfaction to measure interior environmental quality.

To date, two studies have been published on the impact of WELL-certified buildings and spaces on occupant satisfaction with interior environmental quality. Candido et al. (2020) used the BOSSA survey to compare employee satisfaction with IEQ in two WELL-certified offices and seven non-WELL-certified offices in Australia and found the employees in the WELL-certified offices were overall more satisfied with the interior environmental quality in their offices. Employees in the WELL-certified offices were more satisfied with spatial comfort, connection to the outdoor environment, interior air quality (IAQ), thermal comfort, visual comfort, and noise distraction and privacy, although statistical significance was not determined. The biggest differences in employee satisfaction were found

between spatial comfort and connection to the outdoor environment. The authors (Candido et al., 2020) also compared employee satisfaction with IEQ between the two WELL-certified offices and a benchmark of 9,794 POE surveys from the BOSSA database and found employees were overall more satisfied with IEQ in the WELL-certified offices, reporting higher satisfaction with spatial comfort, connection to the outdoor environment, interior air quality (IAQ), thermal comfort, visual comfort, and noise distraction and privacy. The biggest differences in employee satisfaction were again found between spatial comfort and connection to the outdoor environment. Licina and Yildirim (2021) used a survey that included the CBE Occupant Survey IEQ questions to compare employee satisfaction with indoor environmental quality of the same cohort employees from three different companies in Western Europe as they transitioned from three buildings that were not WELL-certified to three buildings that were and found mixed results between the three companies. Employees of all three of the companies reported significantly higher satisfaction with the comfort of the furnishings in their new WELL-certified offices, but they reported no significant difference in satisfaction with noise, sound privacy, visual privacy, visual comfort, and ease of interaction. Employees in two of the three buildings reported significantly higher satisfaction with indoor air quality, workplace cleanliness, building cleanliness, and furniture adjustability. Employees in one of the three buildings reported significantly higher satisfaction with temperature, building maintenance, amount of light, and amount of space.

IEQ, Health, and Well-Being

The first energy crisis in the 1970s led to a push to tighten up buildings to make them more energy efficient. Around the same time, people began

experiencing unexplainable symptoms, such as dry cough, headache, and fatigue, that appeared to be linked to time spent in a building (Allen & Macomber, 2020). In 1984, the World Health Organization (WHO) coined the term “sick building syndrome” (SBS) in a WHO Committee report. In the report, WHO described SBS as “a medical condition where people in a building suffer from symptoms of illness or feel unwell for no apparent reason.” In the same report, they estimated that up to 30% of all new, remodeled, or renovated buildings worldwide had occupants with SBS (WHO, 1984). Since then, numerous studies have been conducted on sick building syndrome and the impact of IEQ, most commonly indoor air quality, on human health.

In more recent years, there has been a shift from focusing solely on designing environments that do not make humans ill to designing ones that promote human health and well-being. Health is seen as being on a continuum from illness to well-being and how an individual experiences their environment can play a role in harming or promoting their mental and physical health (Roskams & Haynes, 2019). Therefore, occupants affect the ability to provide truly healthy workplaces, capable of promoting health and well-being as well as minimizing the risk of disease.

The two studies mentioned earlier in this chapter that looked at the impact of WELL-certified buildings and spaces on occupant satisfaction with interior environmental quality also looked at the impact of the buildings and spaces on occupant health. Candido et al. (2020) used the BOSSA survey to compare overall employee performance, health, and productivity in two WELL-certified offices with overall employee performance, health, and productivity in seven non-WELL-certified offices in Australia and found it was better in the WELL-certified offices. The authors (Candido et al., 2020) also compared

overall employee performance, health, and productivity in the two WELL-certified offices with overall employee performance, health, and productivity in 9,794 offices from the BOSSA database and again found it was better in the WELL-certified offices. Statistical significance was not determined. Licina and Yildirim (2021) compared sick building syndrome symptoms in the same cohort employees from three different companies as they transitioned from three buildings that were not WELL-certified to three buildings that were and found no significant differences in reported symptoms between the WELL certified buildings and the WELL-certified buildings, except for the symptom of tiredness that was lower in WELL buildings.

Research Questions

This exploratory study investigates offices designed with WELL strategies from the occupant perspective. It builds on the currently limited existing research that looks at the impact of spaces designed with WELL strategies on occupant satisfaction with interior environmental quality and occupant health and well-being by increasing the number of post-occupancy evaluations of the spaces as well as providing a more holistic view of the impact of WELL spaces on human health and well-being. It focuses on the following outcomes: satisfaction with interior environmental quality, perception the workplace is conducive to health and well-being, and self-reported health and well-being. These outcomes were studied over time as three locations of the same organization moved from offices not designed with WELL strategies to new offices that were. The study addresses three primary research questions.

1. Research Question 1 (RQ1): Are there significant differences in occupant satisfaction with IEQ between the offices designed with

WELL strategies and the offices not designed with WELL strategies?

2. Research Question 2 (RQ2): Are there significant differences in occupant perception that the workplace is conducive to health and well-being between the offices designed with WELL strategies and the offices not designed with WELL strategies?
3. Research Question 3 (RQ3): Are there significant differences in self-reported occupant health and well-being between the offices designed with WELL strategies and offices not designed with WELL strategies?

Based on the intention of the WELL Building Standard, the hypotheses of this study are that occupant satisfaction with IEQ is higher, occupants perceive the workplace to be more conducive to health and well-being, and occupant self-reported health and well-being is better for the offices designed with WELL strategies compared with the pre-occupancy baseline measurements. In addition to the three primary research questions, this study also explores the relationships between occupant satisfaction with interior environmental quality in the offices designed with WELL strategies and (1) occupant perception the workplace is conducive to health and well-being and (2) occupant self-reported health and well-being.

CHAPTER 2

METHODS

Three locations of a global architecture and design firm—Chicago, London, and Miami—relocated to new offices between September 2017 and February 2018, because they had outgrown their old offices. The firm designed the three new offices with WELL strategies with the intent of pursuing WELL certification. All three locations maintained an open plan layout pre to post occupancy. Pre- and post-occupancy surveys were administered to the three locations by Delos, the parent company of the International WELL Building Institute, to assess the impact of the transitions from offices that were not designed with WELL strategies to offices that were designed with WELL strategies on the employees' health and well-being, satisfaction, and performance. The data from the surveys was given to the author to analyze in February 2020. This chapter provides an overview of the offices that were evaluated, a breakdown of the survey participants' demographics, descriptions of the variables studied, and a summary of the tools and procedures used in the research and analysis.

Sites

Chicago, Illinois, USA

The employees in the Chicago location moved into their new office in September 2017. They moved from a 9,041 square foot LEED Gold (v3) office (see Figure 3) the firm had occupied since 2011 on the seventeenth floor of a twenty-one-story building in the Loop, the central business district and heart of downtown Chicago, to a 13,412 square foot office (see Figures 4 & 5) on the

eleventh floor of a nearby twenty-story building in the Loop. The new Chicago office earned LEED Platinum (v4) certification in April 2018 and WELL Gold (v1) certification in December 2020.

Figure 3

Floor plan of old Chicago office

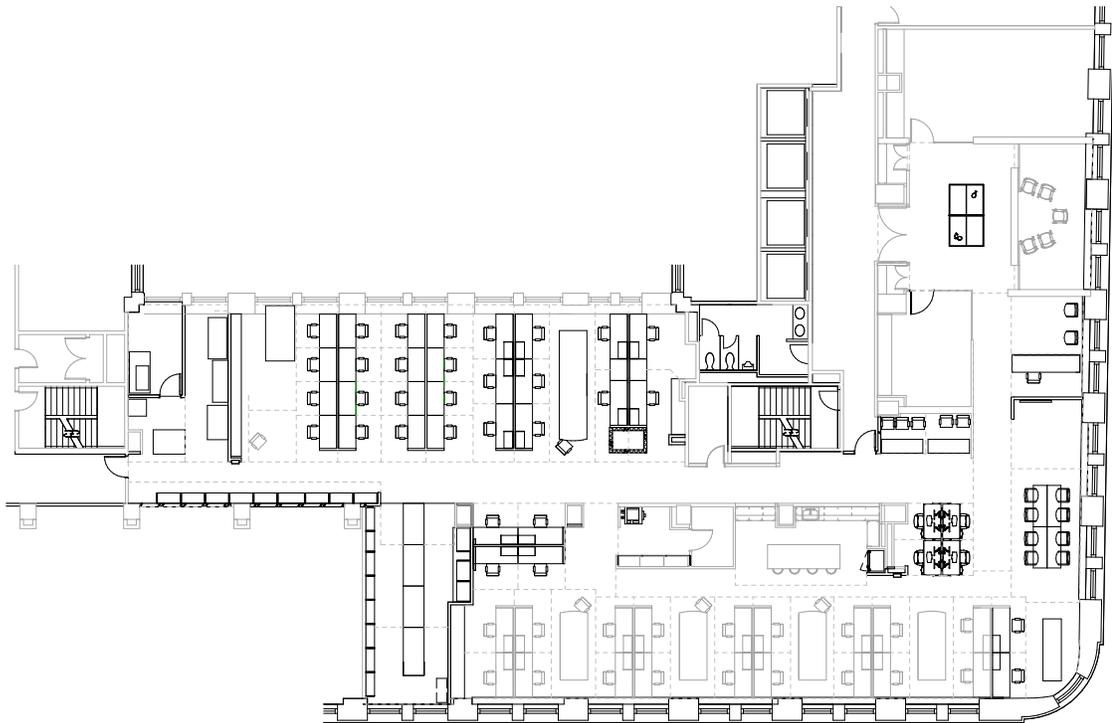


Figure 4

Floor plan of new Chicago office

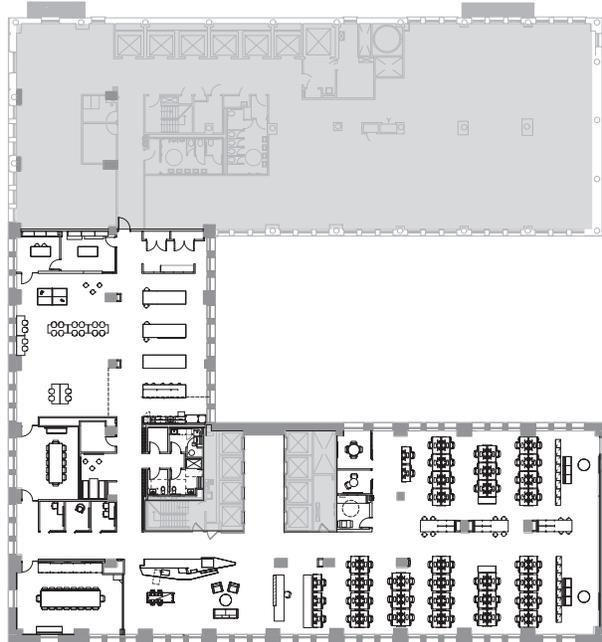


Figure 5

New Chicago office, photo courtesy of the firm



London, England, UK

The employees in the London location moved into a new office in December 2017. Most of the employees moved from a 3,990 square foot, two-story office that the firm had occupied since 2012 on the fourth and fifth floor of a five-story building in the Soho neighborhood (see Figure 6) to a 12,069 square foot, two-story office on the ground and lower ground floor of a nearby seven-story building in the adjacent Fitzrovia neighborhood (see Figures 7 & 8). A small number of employees moved to the new office from two other smaller offices in the city. One of the smaller offices was a temporary overflow space that was also located in the Soho neighborhood and the other one was a small company HKS acquired located in the Richmond neighborhood. The new London office was designed with the intent to pursue WELL Gold (v1) certification but at the time of the analysis was no longer pursuing it. The office also aimed to achieve a BREEAM (Building Research Establishment Environmental Assessment Methodology) rating of “Excellent” but did not achieve it.

Figure 6

Floor plans of old London office, fourth (left) and fifth floor (right)

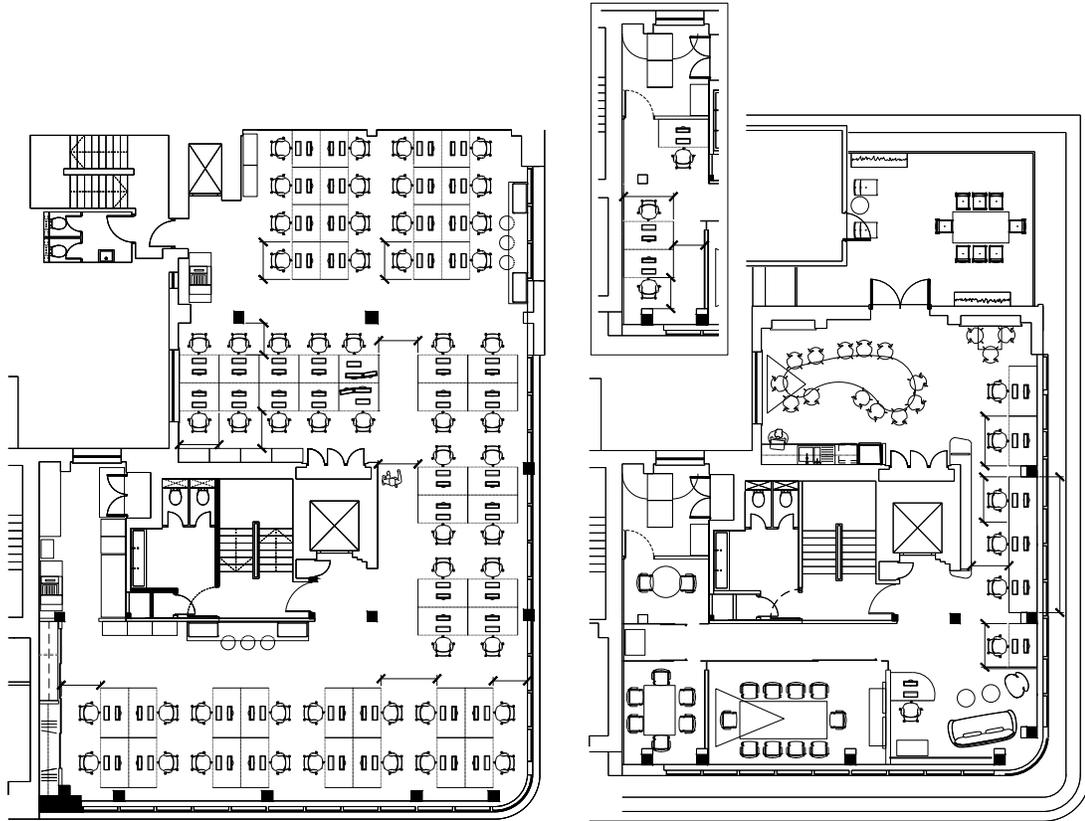


Figure 7

Floor plans of new London office, ground floor (top) and lower ground floor (bottom)

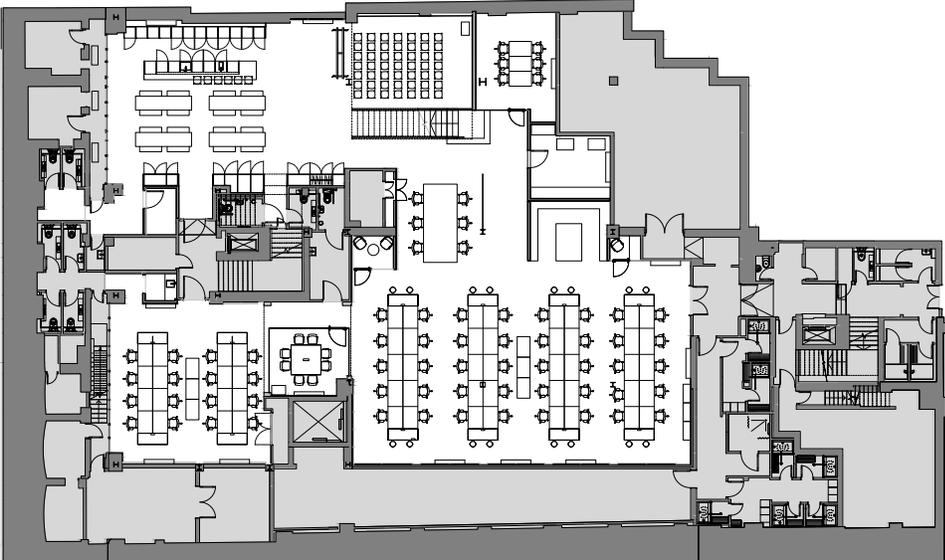
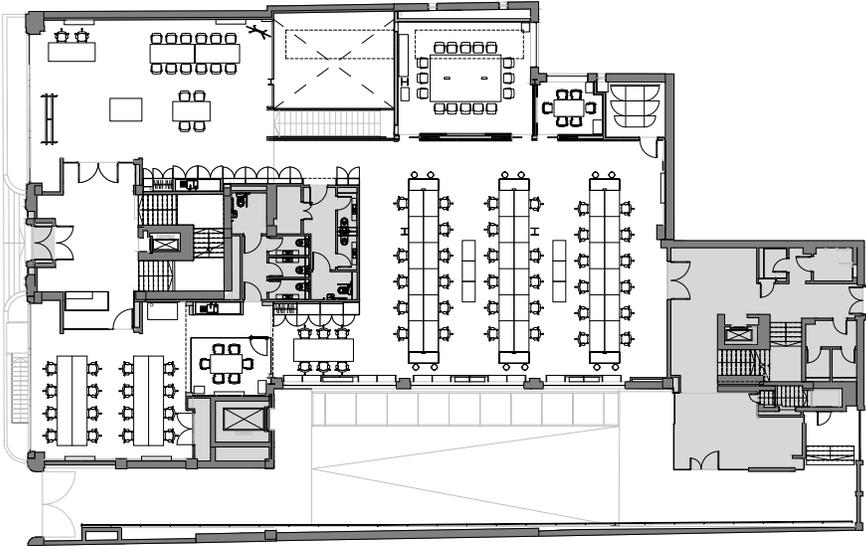


Figure 8

New London office, ground floor (top) and lower ground floor (bottom), photos courtesy of the firm © Kristen McCluskie



Miami, Florida, USA

The employees in the Miami location moved into a new office in February 2018. They moved from a 9,200 square foot office (see Figure 9) the firm had occupied since 2012 on the eighth floor of a thirteen-story building in Coral Gables, a city located six miles southwest of downtown Miami and four miles south of Miami International Airport, to a 10,235 square foot office (see Figures 10 & 11) on the fourth floor of a nearby six-story building in Coral Gables. The new Miami office earned LEED Gold (v4) certification in August 2019, and at the time of the analysis, was pursuing WELL Gold (v1) certification.

Figure 9

Floor plan of old Miami office

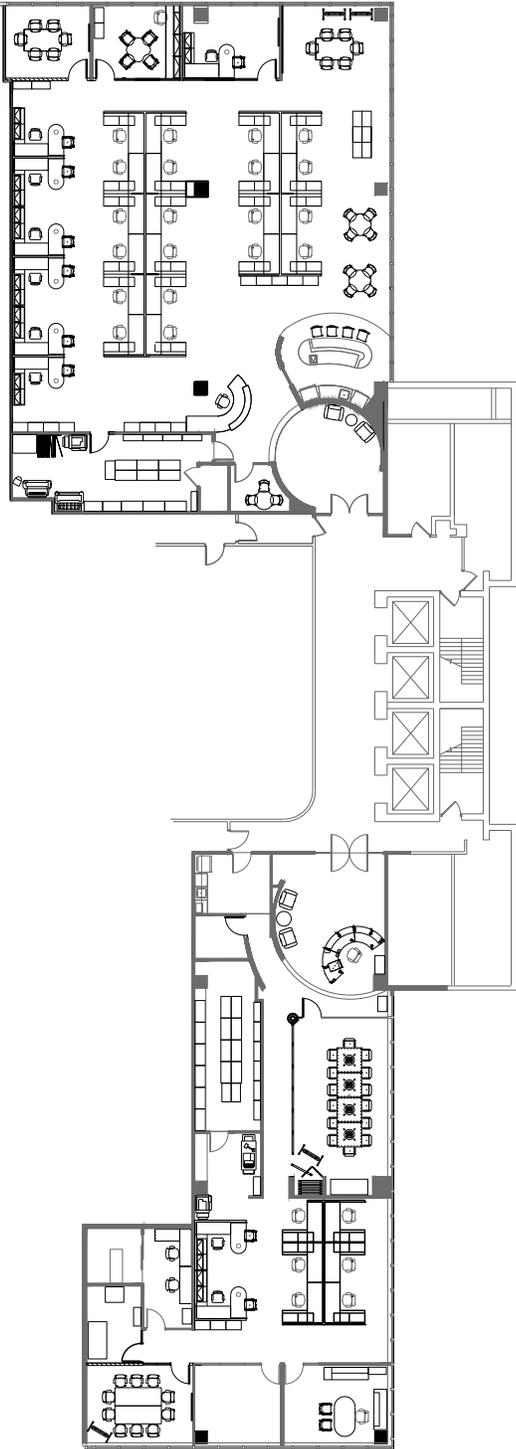


Figure 10

Floor plan of new Miami office

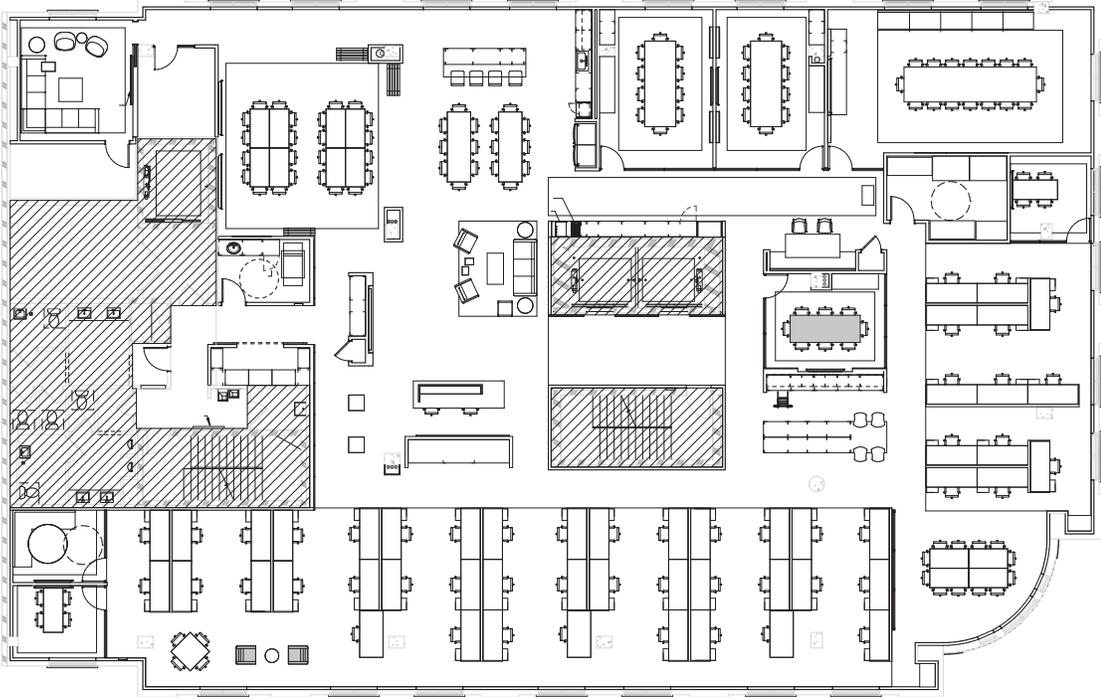


Figure 11

New Miami office, photo courtesy of the firm



Procedure and Participants

The Building Wellness Survey

The Building Wellness Survey is a 66-item survey developed by Delos, the parent company of the International WELL Building Institute, to assess the impact of the transition to a WELL-certified space on employees' health and well-being, satisfaction, and productivity (Timm, 2018). A copy of the survey can be found in Appendix A.

The Building Wellness Survey was administered by Delos online via SurveyMonkey to all three of the locations both pre- and post-occupancy. A web link to the survey was emailed to all employees who regularly occupied

the office. The email was sent by an employee in the office who was well-known and respected to encourage participation.

The employees' participation in the survey was completely voluntary, and they were not compensated for completing it. At the beginning of the survey, participants were informed their responses were completely confidential and anonymous and results would only be presented in aggregate. The survey took 10–15 minutes to complete and could be completed via a computer or any mobile device using Apple iOS, Android, or Blackberry software. During the survey period, participants could begin the survey and return to it if they needed to pause and leave it at any time. At the end of the survey, they were asked to voluntarily provide their work email address, so their survey responses could be tracked over the course of the study. Participants were assured that if they provided their email address, it would not be shared with their employer.

Chicago. The pre-occupancy survey was administered to the Chicago employees in March/April of 2017—approximately six months prior to occupying their new office. There were 38 participants, who represented a participation rate of 95% of the location's 40 employees. (Forty responses to the survey were received, but two of them were discarded, because they contained only answers to the demographic questions.) The post-occupancy survey was administered to the Chicago employees in June of 2018—approximately nine months after occupying their new office. There were 40 participants, who represented a participation rate of 80% of the location's 50 employees. (Forty-one responses to the survey were received, but one of them was discarded, because it contained only answers to the demographic questions.) The demographic breakdown of the Chicago pre- and post-

occupancy survey participants by gender, age, tenure with the firm, and number of hours worked weekly in the office can be found in Table 1.

Table 1*Demographic breakdown of Chicago survey participants*

Characteristic	Pre		Post	
	n	%	n	%
Gender				
Female	27	44	20	45
Male	34	56	23	52
Other	0	0	0	0
No Response	0	0	1	2
Age				
≤ 30	19	31	9	20
31–40	26	43	20	45
41–50	9	15	10	23
51–60	4	7	2	5
≥ 61	3	5	3	7
Tenure				
< 1 year	15	25	8	18
1–2 years	25	41	10	23
3–5 years	7	11	13	30
> 5 Years	14	23	13	30
Hours Worked Weekly in Office				
≤ 12	2	5	0	0
13–24	2	5	2	5
25–35	2	5	6	15
36–40	5	13	11	28
≥ 40	27	71	21	53

London. The pre-occupancy survey was administered to the London employees in July 2017—approximately five months prior to occupying their new office. There were 61 participants, who represented a participation rate of approximately 71% of the location’s 86 employees. (Sixty-two responses to the survey were received, but one of them was discarded, because it contained only answers to the demographic questions.) The post-occupancy survey was administered to the London employees in December 2018—approximately one year after occupying their new office. There were 44 participants, who represented a participation rate of approximately 54% of the location’s 82 employees. (Fifty-one responses to the survey were received, but seven of them were discarded—two of them contained only answers to the demographic questions and five of them were from employees who had already completed the survey (identified by their voluntarily provided email addresses).) The demographic breakdown of the London pre- and post-occupancy survey participants by gender, age, tenure with the firm, and number of hours worked weekly in the office can be found in Table 2.

Table 2*Demographic breakdown of London survey participants*

Characteristic	Pre		Post	
	n	%	n	%
Gender				
Female	27	44	20	45
Male	34	56	23	52
Other	0	0	0	0
No Response	0	0	1	2
Age				
≤ 30	19	31	9	20
31–40	26	43	20	45
41–50	9	15	10	23
51–60	4	7	2	5
≥ 61	3	5	3	7
Tenure				
< 1 year	15	25	8	18
1–2 years	25	41	10	23
3–5 years	7	11	13	30
> 5 Years	14	23	13	30
Hours Worked Weekly in Office				
≤ 12	2	3	2	5
13–24	1	2	3	7
25–35	6	10	2	5
36–40	15	25	18	41
≥ 40	37	61	19	43

Miami. The pre-occupancy survey was administered to the Miami employees in July/August of 2017—approximately six months prior to occupying their new office. There were 27 participants, who represented a participation rate of approximately 93% of the location’s 29 employees. (Twenty-nine responses to the survey were received, but two of them were discarded, because they contained only answers to the demographic questions.) The post-occupancy survey was administered to the Miami employees in December 2018—approximately 10 months after occupying their new office. There were 22 participants, who represented a participation rate of 67% of the location’s 33 employees. (Twenty-three responses to the survey were received, but one of them was discarded, because it contained only answers to the demographic questions.) The demographic breakdown of the Miami pre- and post-occupancy survey participants by gender, age, tenure with the firm, and number of hours worked weekly in the office can be found in Table 3.

Table 3*Demographic breakdown of Miami survey participants*

Characteristic	Pre		Post	
	n	%	n	%
Gender				
Female	15	56	13	59
Male	11	41	9	41
Other	0	0	0	0
No Response	1	4	0	0
Age				
≤ 30	13	48	9	41
31–40	8	30	6	27
41–50	3	11	4	18
51–60	3	11	1	5
≥ 61	0	0	2	9
Tenure				
< 1 year	6	22	2	9
1–2 years	6	22	7	32
3–5 years	6	22	5	23
> 5 Years	9	33	8	36
Hours Worked Weekly in Office				
≤ 12	0	0	0	0
13–24	0	0	0	0
25–35	2	7	3	14
36–40	3	11	3	14
≥ 40	22	81	16	73

Stakeholder Interviews

Structured interviews were conducted via Zoom in July 2020 by the author with the WELL project administrator, the primary individual overseeing the WELL certification, at each of the three locations to understand the original design intent, issues that occurred during and after design and construction, and how the office was currently being used. The individuals were identified by the author's main contact at the firm and then recruited by the author via email. The interviews were scheduled for 30 minutes and recorded with the permission of the interviewees. A copy of the interview protocol can be found in Appendix B.

Site Visits

The author was scheduled to spend one eight-hour workday passively observing in each of the three new offices between late February and mid-March of 2020, but the site visits to the London and Miami offices were canceled due to COVID-19 travel restrictions.

Constructs and Measures

The Building Wellness Survey was used to measure employee satisfaction with interior environmental quality, employee perception the workplace is conducive to health and well-being, and employee self-reported health and well-being. The survey questions used to measure the constructs are described below.

Satisfaction with Interior Environmental Quality

Based on the requirement of Feature 86 of the WELL v1 Building Standard, employee satisfaction with the following IEQ factors was measured: acoustics, air quality, cleanliness, physical comfort (furnishings and layout), lighting, maintenance, and thermal comfort. In addition, employee satisfaction

with access to nature was measured due the growing body of research that suggests a positive relationship between nature and human health and well-being (Ko et al., 2020; Lottrup et al., 2013; Raanaas et al., 2011).

Access to Nature. Employee satisfaction with access to nature in their workplace was measured using one question from the Building Wellness Survey in which they were asked to rate their satisfaction on a 7-point Likert scale that ranged from *very satisfied* to *very dissatisfied*. Prior to the question, the survey pointed out that for the purposes of the survey, access to nature described exposure to the natural environment. It also explained that access to nature did not simply mean exposure to or engagement with the outside natural world but could also be defined as bringing elements of the natural environment into an interior space. Examples of these types of elements were listed as plants and gardens, as well as artwork, furniture, and designs depicting or resembling natural environments.

Acoustics. Employee satisfaction with the acoustics in their workplace was measured using one question from the Building Wellness Survey in which they were asked to rate their satisfaction on a 7-point Likert scale that ranged from *very satisfied* to *very dissatisfied*. Examples of acoustics in the workplace were listed as noise levels, ability to hear others, and sound privacy.

Air Quality. Employee satisfaction with the air quality in their workplace was measured using one question from the Building Wellness Survey in which they were asked to rate their satisfaction with the air quality in their workplace in terms of being breathable, clean, and odorless on a 7-point Likert scale that ranged from *very satisfied* to *very dissatisfied*.

Cleanliness. Employee satisfaction with the cleanliness of their workplace was measured using one question from the Building Wellness

Survey in which they were asked to rate their satisfaction with this variable in their workplace on a 7-point Likert scale that ranged from *very satisfied* to *very dissatisfied*.

Lighting. Employee satisfaction with the lighting in their workplace was measured using one question from the Building Wellness Survey in which they were asked to rate their satisfaction with the lighting on a 7-point Likert scale that ranged from *very satisfied* to *very dissatisfied*.

Maintenance. Employee satisfaction with maintenance of their workplace was measured using one question from the Building Wellness Survey in which they were asked to rate their satisfaction with the level of overall maintenance on a 7-point Likert scale that ranged from *very satisfied* to *very dissatisfied*.

Physical Comfort (Furniture and Layout). Employee satisfaction with the furniture and layout in their workplace was measured using one question from the Building Wellness Survey in which they were asked to rate their satisfaction with their physical comfort on a 7-point Likert scale that ranged from *very satisfied* to *very dissatisfied*. Physical comfort was defined as issues related to their comfort with the furniture and the overall layout of the space.

Thermal Comfort. Employee satisfaction with the thermal comfort in their workplace was measured using one question from the Building Wellness Survey in which they were asked to rate their satisfaction with their thermal comfort on a 7-point Likert scale that ranged from *very satisfied* to *very dissatisfied*. Thermal comfort was defined as issues related to temperature, humidity, and air movement.

Perception Workplace is Conducive to Health and Well-being

Employee perception that the workplace is conducive to their health and well-being was measured using one question from the Building Wellness Survey in which they were asked to rate their agreement with the following statement: “The workplace is conducive to my health and well-being.” The rating was on a 5-point Likert scale from *strongly agree* to *strongly disagree*.

Self-Reported Health and Well-Being

Employee self-reported health and well-being was measured using the mental health (Mental Component Summary (MCS)) and physical health (Physical Component Summary (PCS)) scores derived from version two of the Short-Form Health Survey (SF-12v2)—included in the Building Wellness Survey. The SF-12v2 is an international psychometrically validated 12-item survey used extensively to measure how well a person is functioning in life and his or her perceived well-being in physical, mental, and social domains of health (Killewo et al., 2010). The survey assesses eight health concepts: vitality (1 item), social functioning (1 item), role limitations caused by emotional problems (2 items), emotional well-being (2 items), physical functioning (2 items), role limitations caused by physical health problems (2 items), bodily pain (1 item), and general health (1 item). The vitality, social functioning, role limitations caused by emotional problems, and emotional well-being items are used to calculate the mental health score. The physical functioning, role limitations caused by physical health problems, bodily pain, and general health items are used to calculate the physical health score (see Table 4).

Table 4*SF-12v2 survey questions breakdown by health concept and score*

Score	Health Concept	BWS Survey Item
Mental Health (MCS)	Vitality	63b. Energy
	Social Functioning	64. Social time
	Role-Emotional	61a. Accomplished less
		61b. Less careful
	Emotional Well-Being	63a. Calm and peaceful
		63c. Downhearted and blue
Physical Health (PCS)	Physical Functioning	59a. Moderate activities
		59b. Climbing several flights
	Role-Physical	60a. Accomplished less
		60b. Limited in kind
	Bodily Pain	62. Pain-interfere
	General Health	58. EVGFP rating

Adapted from (Ware Jr, 2002)

Mental and physical health are each scored on a scale from 0–100, with a score of 50 representing the US national average score. Although one of the locations in this study was in the UK, the US national average score was used as a comparison for all three locations, because research has shown that the survey yields similar results when administered in the UK (Ware Jr et al., 1998).

Data Analysis

Participant IDs were assigned to the survey responses. First, unique IDs were assigned to the responses that included the participant's email address. Then, dummy IDs were assigned to the remaining responses. (A by-location breakdown of the number of participants who provided their email address as well as the number of matched pre-post pairs can be found in Appendix C). The answers to the satisfaction with IEQ questions were coded, so 1 equaled very dissatisfied and 7 equaled very satisfied; and the answers to the statement "The workplace is conducive to my health and well-being." were coded, so 1 equaled strongly disagree and 5 equaled strongly agree. The mental health (Mental Component Summary (MCS)) and physical health (Physical Component Summary (PCS)) scores were calculated using the PRO CoRE, a software licensed by QualityMetric, the copyright owner of the SF-12v2.

A statistical analysis was performed using R 4.0.3 for macOS. To test the three hypotheses, linear mixed effects analyses were performed using the pre- and post-occupancy survey data from the Building Wellness Survey and ImerTest to compare employee satisfaction with IEQ, employee perception the workplace is conducive to health and well-being, and employee self-reported health and well-being. The analyses were first performed by location. Time (pre-occupancy, post-occupancy) was entered into the models as a fixed effect. As a random effect, the models had an intercept for participant ID. When the analyses were performed using the London survey data, an additional random effect of pre office (Soho primary, Soho overflow, Richmond) was added to the models. The survey datasets from the three locations were then combined, and the same analyses were performed on the

combined dataset. Time (pre-occupancy, post-occupancy) was again entered into the models as a fixed effect. As random effects, the model had intercepts for both participant ID and location (Chicago, Miami, London). Visual inspection of residual plots did not reveal any obvious deviations from homoscedasticity or normality.

To explore the relationship between employee satisfaction with IEQ in the offices designed with WELL strategies and (1) employee perception the workplace is conducive to health and well-being and (2) employee self-reported health and well-being, Spearman correlation analysis was performed using the post-occupancy survey data from the Building Wellness Survey and rcorr. Again, the analysis was first performed by location, and then, the post-occupancy survey datasets from the three locations were combined, and the same analysis was performed on the combined post-occupancy dataset.

In addition, employees' post-occupancy answers to an open-ended question on the Building Wellness Survey that asked, *What aspect(s) of the workplace has/have the most impact on your own health and well-being?* were analyzed to try to further understand the relationship between the IEQ of the offices designed with WELL strategies and employee health and well-being. Each aspect of the workplace mentioned was written on a separate notecard. The location and participant ID of the employee who mentioned the aspect was written in the right-hand corner of the card. When all the aspects mentioned were documented on a notecard, the notecards were organized into piles by aspect. Aspects that did not pertain to the physical workplace environment were placed together in an "other" pile. The number of employees who mentioned each of the aspects was tallied by location as well as in total.

CHAPTER 3

RESULTS

In this chapter, the results of the data analysis are first presented by location and then in aggregate. A comparison of the results by location will be discussed in the next chapter.

Chicago

RQ1: Satisfaction with Interior Environmental Quality

Linear mixed effects analysis revealed Chicago employees' satisfaction with all eight of the IEQ factors under study—access to nature, acoustics, air quality, lighting, cleanliness, maintenance, physical comfort, and thermal comfort—increased significantly after moving from their old office that was not designed with WELL strategies to their new office that was (see Table 5).

Chicago employees were not satisfied ($M < 5$) with any of the eight IEQ factors under study in their old office, whereas the employees were satisfied ($M \geq 5$) with all eight of the IEQ factors in their new office (see Figure 12). Chicago employees reported being most satisfied with the air quality and lighting in the new office.

Table 5

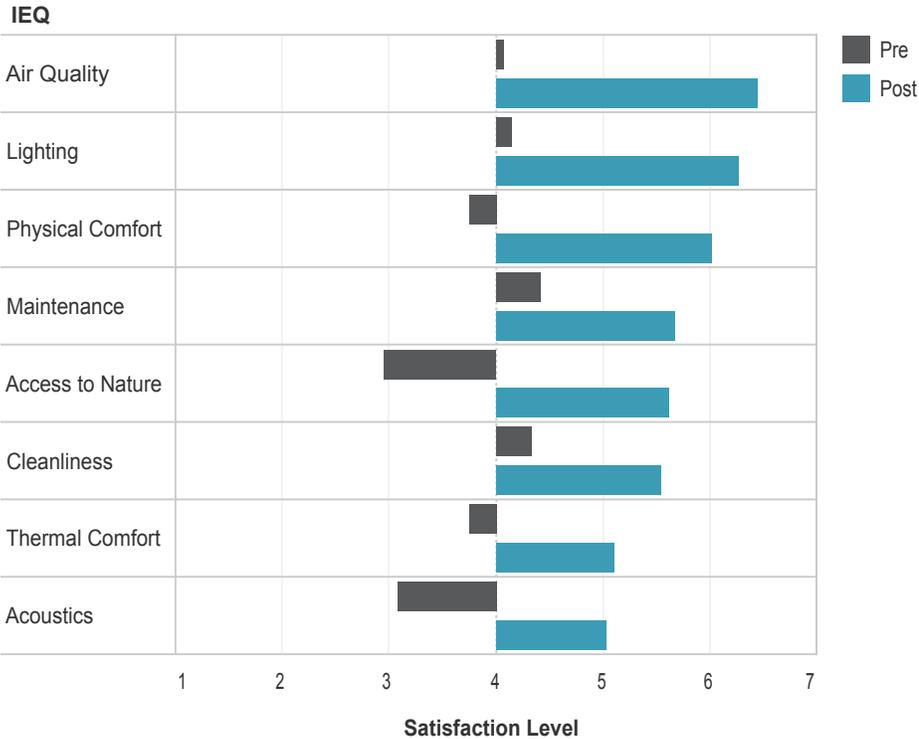
Linear mixed effects of Chicago employees' satisfaction with IEQ pre versus post occupancy

IEQ Factor	Time	n	M	SD	t	df	p
Access to Nature	Pre	38	2.95	1.33	-11.23	39.96	< .001***
	Post	40	5.62	.98			
Acoustics	Pre	38	3.08	1.60	-5.97	47.35	< .001***
	Post	39	5.05	1.49			
Air Quality	Pre	37	4.08	1.40	-9.19	47.42	< .001***
	Post	40	6.45	.96			
Cleanliness	Pre	38	4.34	1.17	-4.77	41.87	< .001***
	Post	40	5.55	1.22			
Lighting	Pre	38	4.16	1.57	-8.41	34.26	< .001***
	Post	40	6.28	1.18			
Maintenance	Pre	37	4.43	1.19	-5.88	44.69	< .001***
	Post	40	5.68	.94			
Physical Comfort	Pre	37	3.76	1.16	-9.34	39.67	< .001***
	Post	40	6.02	1.10			
Thermal Comfort	Pre	37	3.76	1.71	-4.05	34.93	< .001***
	Post	40	5.12	1.76			

*p < .05, **p < .01, ***p < .001

Figure 12

Chicago employees' satisfaction with IEQ pre versus post occupancy



RQ2: Perception Workplace is Conducive to Health and Well-Being

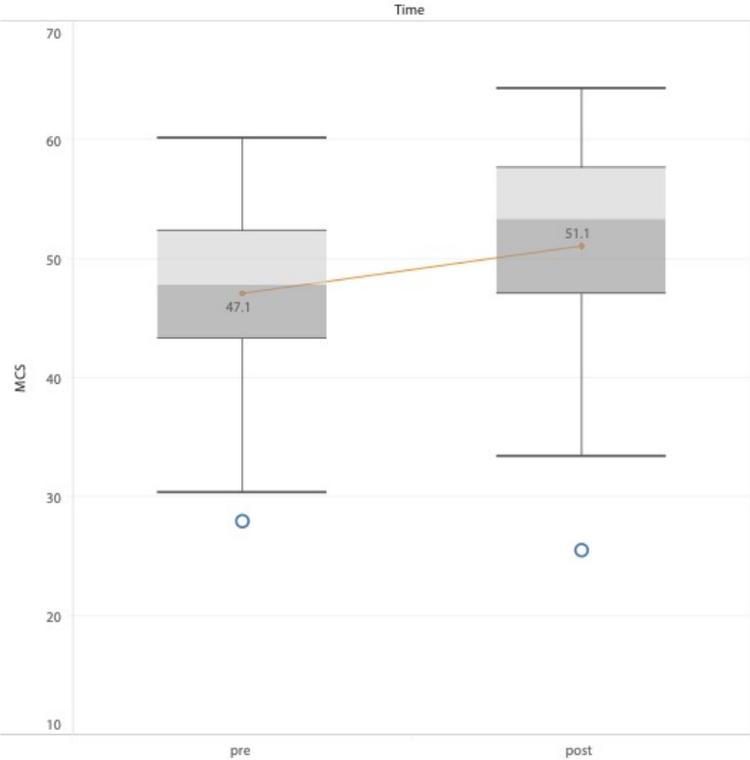
Linear mixed effects analysis revealed Chicago employees perceived their workplace to be significantly more conducive to their health and well-being post occupancy, $t(31.57) = -7.79, p < .001$. Chicago employees did not perceive their workplace to be conducive to their health and well-being when working in their old office that was not designed with WELL strategies ($M = 2.74, SD = .82, n = 35$) but did perceive their workplace to be conducive to their health and well-being after moving into their new office designed with WELL strategies ($M = 4.17, SD = .97, n = 36$).

RQ3: Self-Reported Health and Well-Being

Mental Health. Linear mixed effects analysis revealed Chicago employees' self-reported mental health significantly improved pre (M = 47.1, SD = 7.42, n = 34) to post occupancy (M = 51.1, SD = 8.81, n = 36), $t(37.30) = -2.49$, $p < .05$. The average mental health score increased from below to above the US national average of 50 after moving into their new office designed with WELL strategies (see Figure 13).

Figure 13

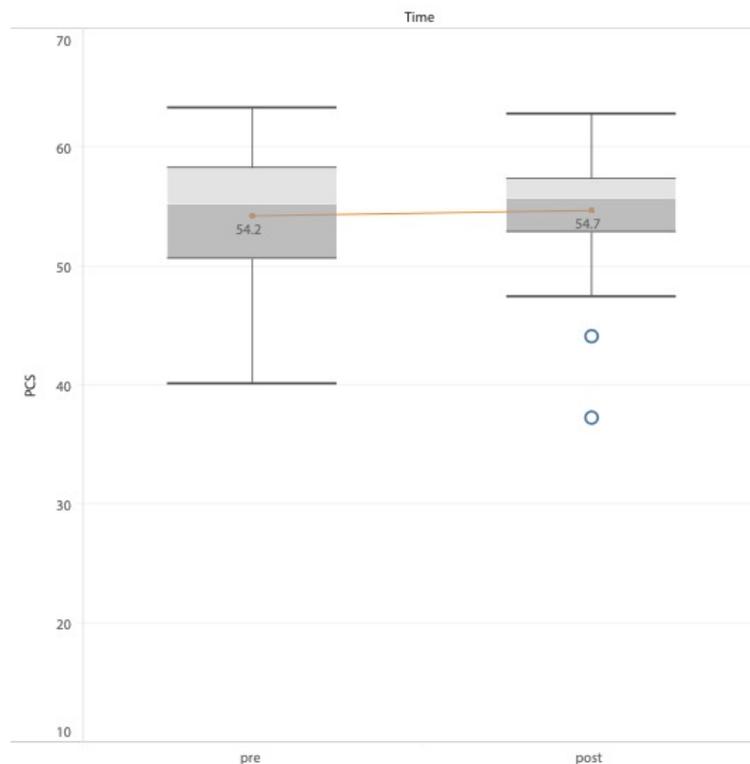
Distribution of Chicago employees' mental health scores pre versus post occupancy



Physical Health. Linear mixed effects analysis revealed Chicago employees' self-reported physical health improved pre (M = 54.2, SD = 5.39, n = 34) to post occupancy (M = 54.7, SD = 4.92, n = 36), although the improvement was not statistically significant. The average self-reported physical health score was above the US national average of 50 both before and after moving into their new office designed with WELL strategies (see Figure 14).

Figure 14

Distribution of Chicago employees' physical health scores pre versus post occupancy



Relationship Between IEQ and Health and Well-Being

Spearman correlation analysis ($n = 34$) indicated Chicago employees' satisfaction levels with air quality, access to nature, acoustics, lighting, physical comfort, and thermal comfort in their new office were significantly correlated with how conducive to their health and well-being they perceived their workplace to be. It also indicated Chicago employees' satisfaction level with physical comfort was significantly positively correlated with their perceived physical health, but employees' satisfaction levels with none of the IEQ factors under study were significantly correlated with their perceived mental health post occupancy, except physical comfort which was significantly positively correlated with self-reported physical health (see Figure 15).

Figure 15

Spearman correlations between Chicago employees' satisfaction with IEQ and their perception of health and well-being in the workplace post occupancy

	Workplace Health and Well-Being	Employee Mental Health	Employee Physical Health	
Access to Nature	0.51**	0.19	0.13	Very Strong (+)
Acoustics	0.61***	0.32	0.11	Strong (+)
Air Quality	0.42*	0.10	0.33	Moderate (+)
Cleanliness	0.33	0.14	-0.02	Weak (+)
Lighting	0.48**	0.15	0.08	Very Weak (+)
Maintenance	0.33	0.31	-0.08	Very Weak (-)
Physical Comfort	0.58***	0.04	0.39*	Weak (-)
Thermal Comfort	0.57***	-0.01	0.15	Moderate (-)
				Strong (-)
				Very Strong (-)

Thirty-one of the 40 post-occupancy survey participants in the Chicago location responded to the open-ended question *What aspect(s) of the workplace most impacts your health and well-being?*. The most mentioned IEQ factors were lighting ($n = 17$) and physical comfort ($n = 14$). Twelve of the 17 participants who mentioned lighting specifically called out daylight or natural light. Eleven of the 14 participants who mentioned an aspect related to physical comfort mentioned an aspect related to the layout of the office—eight praising the variety of different space types in the office. The remaining three that mentioned an aspect related to physical comfort mentioned an aspect related to the ergonomics of their workstations. Other IEQ factors that were mentioned included: air quality, which was mentioned four times; access to nature, acoustics, and thermal comfort, which were each mentioned twice; and cleanliness of the workspace, which was mentioned once.

London

RQ1: Satisfaction with Interior Environmental Quality

Linear mixed effects analysis revealed London employees' satisfaction with five of the eight IEQ factors under study—air quality, cleanliness, maintenance, physical comfort, and thermal comfort—increased significantly after moving from their old office that was not designed with WELL strategies to their new office that was. It also revealed employees' satisfaction with access to nature decreased significantly after the move. Employees' satisfaction with acoustics and lighting increased, but the increases were not significant (see Table 6).

London employees were not satisfied ($M < 5$) with any of the eight IEQ factors under study in their old office. The employees were satisfied ($M \geq 5$) with the air quality and physical comfort in their new office as well as the

cleanliness and maintenance of it. They were not satisfied ($M < 5$) with the access to nature, acoustics, lighting, and thermal comfort in their new office (see Figure 16).

Table 6

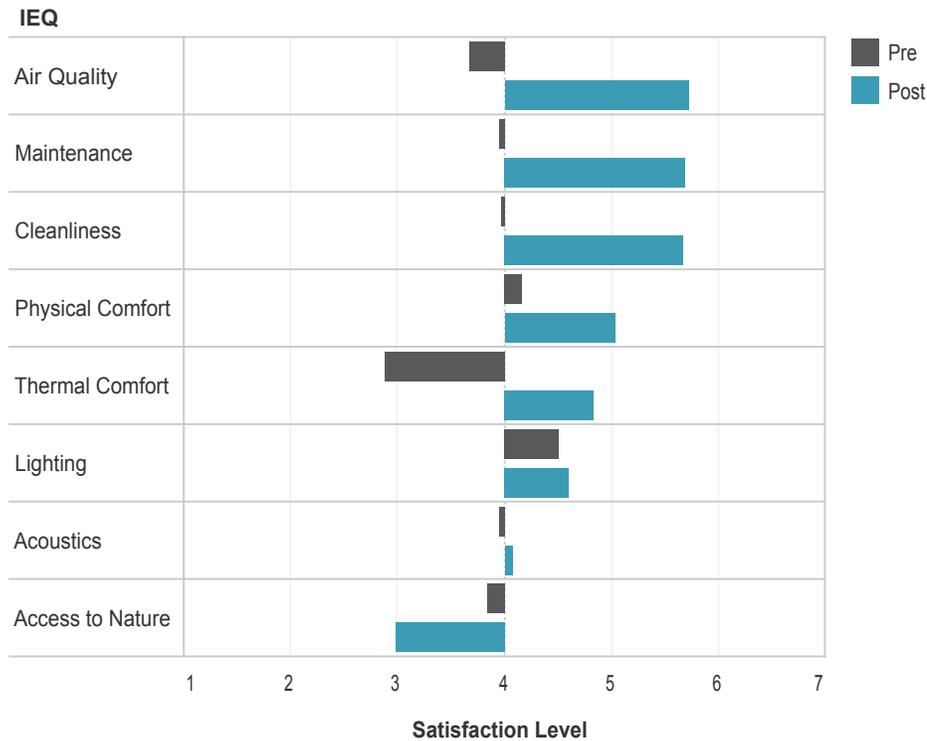
Linear mixed effects analysis of London employees' satisfaction with IEQ pre versus post occupancy

IEQ Factor	Time	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>
Access to Nature	Pre	58	3.84	1.70	2.55	58.65	.013*
	Post	43	3.00	1.41			
Acoustics	Pre	57	3.95	1.57	.42	45.16	.679
	Post	44	4.09	1.88			
Air Quality	Pre	61	3.69	1.66	-7.23	57.16	< .001***
	Post	44	5.73	1.34			
Cleanliness	Pre	60	3.97	1.33	-7.17	45.39	< .001***
	Post	44	5.68	1.36			
Lighting	Pre	59	4.51	1.63	-.31	99.32	.754
	Post	44	4.61	1.96			
Maintenance	Pre	60	3.95	1.24	-7.07	98.20	< .001***
	Post	44	5.70	1.23			
Physical Comfort	Pre	61	4.18	1.42	-2.99	70.86	.004**
	Post	44	5.05	1.55			
Thermal Comfort	Pre	61	2.89	1.61	-6.09	66.60	< .001***
	Post	44	4.84	1.83			

* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 16

London employees' satisfaction with IEQ pre versus post occupancy



RQ2: Perception Workplace is Conduciveness to Health and Well-being

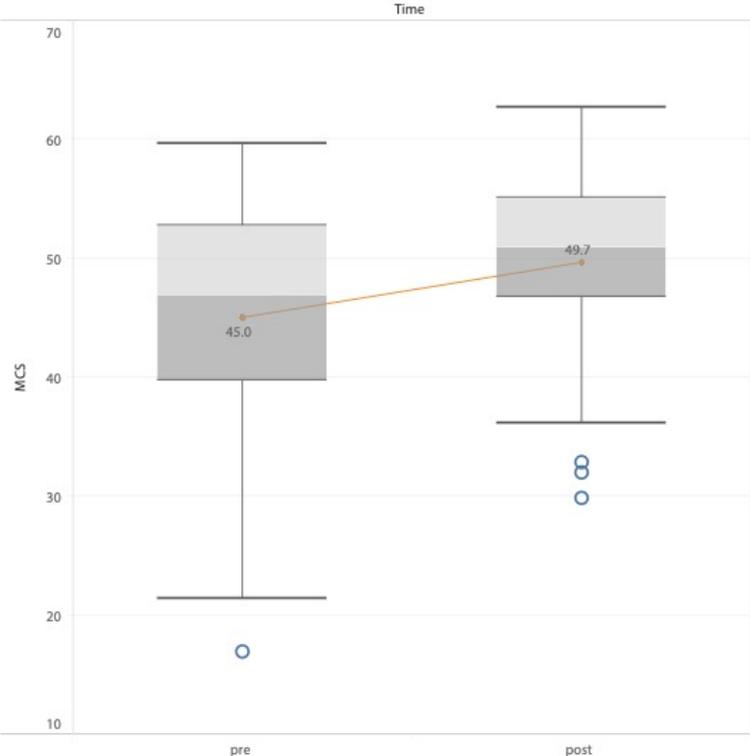
Linear mixed effects analysis revealed London employees perceived their workplace to be significantly more conducive to their health and well-being post occupancy, $t(56.39) = -3.23, p = .002$. They did not perceive their workplace to be conducive to their health and well-being when working in their old office that was not designed with WELL strategies ($M = 2.75, SD = 1.12, n = 56$). Despite the significant improvement in perception post occupancy, they still did not perceive their workplace to be conducive to their health and well-being when working in their new office that was designed with WELL strategies ($M = 3.45, SD = 1.02, n = 42$).

RQ3: Self-Reported Health and Well-Being

Mental Health. Linear mixed effects analysis revealed London employees' self-reported mental health significantly improved pre (M = 45, SD = 10.2, n = 57) to post occupancy (M = 49.7, SD = 8.1, n = 41), $t(-2.07) = 33.09$, $p < .05$. The average mental health score was below the US national average of 50 both before and after moving into their new office designed with WELL strategies (see Figure 17).

Figure 17

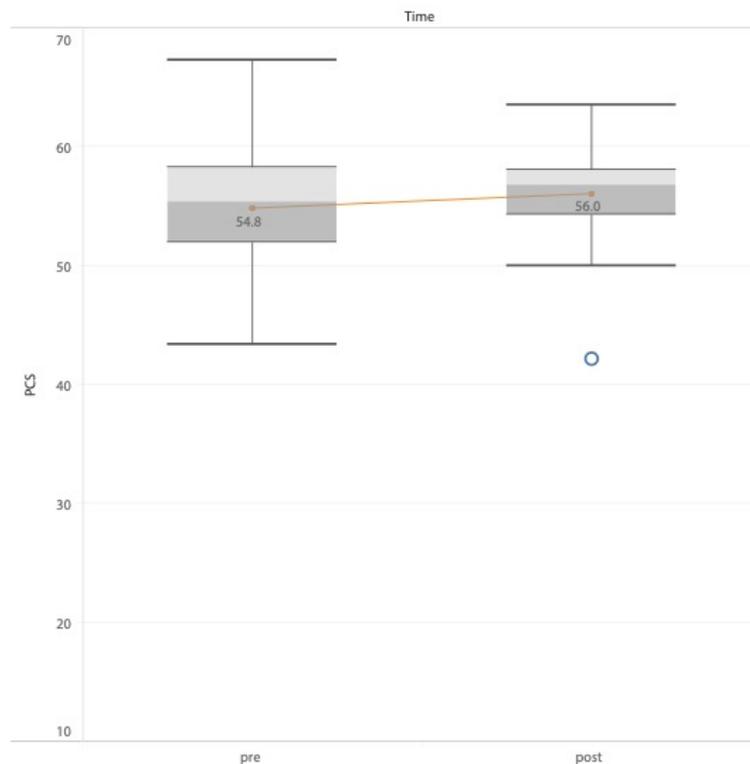
Distribution of London employees' mental health scores pre versus post occupancy



Physical Health. Linear mixed effects analysis revealed London employees' self-reported physical health significantly improved pre ($M = 54.8$, $SD = 4.71$, $n = 57$) to post occupancy ($M = 56$, $SD = 3.8$, $n = 41$), $t(-2.06) = 77.38$, $p < .05$. The average physical health score was above the US national average of 50 both before and after moving into their new office designed with WELL strategies (see Figure 18).

Figure 18

Distribution of London employees' physical health scores pre versus post occupancy



Relationship Between IEQ and Health and Well-Being

Spearman correlation analysis ($n = 39$) indicated London employees' satisfaction levels with access to nature, acoustics, lighting, and physical comfort in their new office were significantly positively correlated with how conducive to their health and well-being they perceived their workplace to be. It also indicated London employees' satisfaction levels with none of the IEQ factors under study were significantly correlated with their perceived mental or physical health post occupancy (see Figure 19).

Figure 19
Spearman correlations between London employees' satisfaction with IEQ and their perception of health and well-being in the workplace post occupancy

	Workplace Health and Well-Being	Employee Mental Health	Employee Physical Health	
Access to Nature	0.42**	-0.01	-0.03	Very Strong (+)
Acoustics	0.60***	0.16	0.04	Strong (+)
Air Quality	0.25	0.13	0.12	Moderate (+)
Cleanliness	0.24	0.04	0.23	Weak (+)
Lighting	0.39*	-0.21	0.12	Very Weak (+)
Maintenance	0.18	0.26	0.29	Very Weak (-)
Physical Comfort	0.37*	0.13	0.11	Weak (-)
Thermal Comfort	0.27	0.10	-0.02	Moderate (-)
				Strong (-)
				Very Strong (-)

Thirty-one of the 44 post-occupancy survey participants in the London location responded to the open-ended question *What aspect(s) of the workplace most impacts your health and well-being?* The most mentioned IEQ factors were lighting ($n = 15$) and physical comfort ($n = 11$). Eleven of the

15 participants who mentioned lighting specifically called out daylight or natural light—nine of which complained of the lack of it. Eight of the 11 participants who mentioned an aspect related to physical comfort mentioned an aspect related to the layout of the office—six praising the variety of different space types in the office. The remaining three that mentioned an aspect related to physical comfort mentioned an aspect related to the ergonomics of their workstations. Other IEQ factors that were mentioned included: air quality, which was mentioned four times; access to nature, which was mentioned three times; acoustics, which was mentioned twice; and thermal comfort, which was mentioned once.

Miami

RQ1: Satisfaction with Interior Environmental Quality

Linear mixed effects analysis revealed Miami employees' satisfaction with five of the eight IEQ factors under study—access to nature, cleanliness, lighting, maintenance, and physical comfort—increased significantly after moving from their old office that was not designed with WELL strategies to their new office designed that was. Employees' satisfaction with acoustics, air quality, and lighting also increased, but the increases were not significant (see Table 7).

Miami employees were not satisfied ($M < 5$) with any of the eight IEQ factors under study in their old office. The employees were satisfied ($M \geq 5$) with the access to nature, lighting, and physical comfort in their new office as well as the cleanliness and maintenance of it. They were not satisfied ($M < 5$) with the acoustics, air quality, and thermal comfort in their new office (see Figure 20).

Table 7

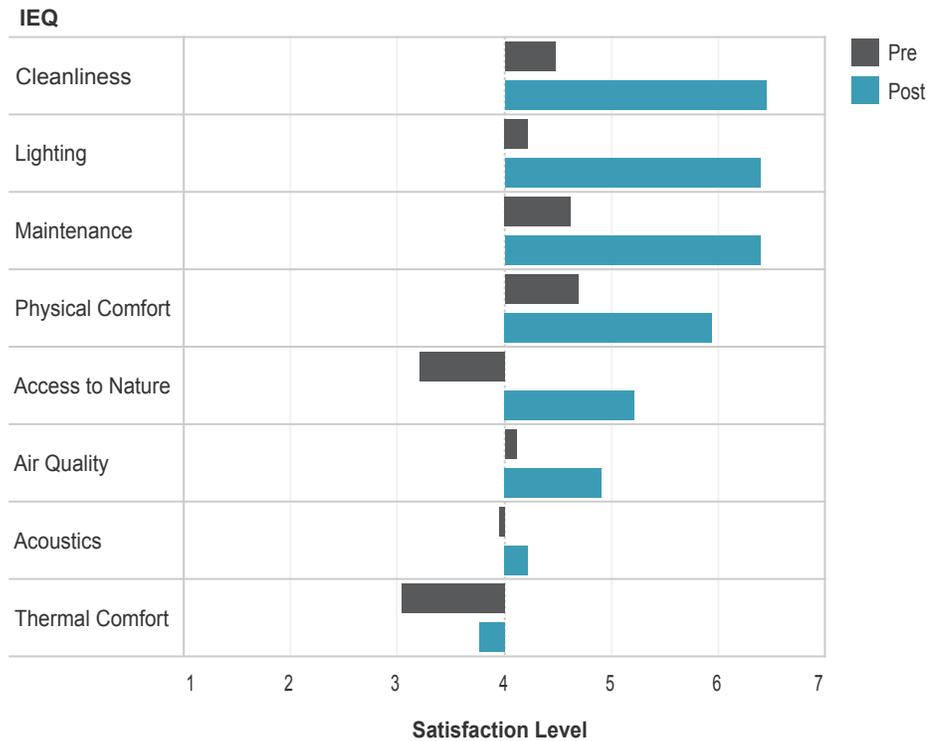
Linear mixed effects analysis of Miami employees' satisfaction with IEQ pre versus post occupancy

IEQ Factor	Time	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>
Access to Nature	Pre	27	3.22	1.53	-5.77	29.57	< .001***
	Post	22	5.23	1.27			
Acoustics	Pre	27	3.96	1.34	-.80	22.41	.432
	Post	22	4.23	1.93			
Air Quality	Pre	27	4.11	1.65	-1.36	33.73	.184
	Post	22	4.91	2.69			
Cleanliness	Pre	27	4.48	1.60	-5.13	47.00	< .001***
	Post	22	6.45	.91			
Lighting	Pre	27	4.22	1.45	-5.33	47.00	< .001***
	Post	22	6.41	1.40			
Maintenance	Pre	27	4.63	1.36	-5.87	29.96	< .001***
	Post	22	6.41	.80			
Physical Comfort	Pre	27	4.70	1.44	-3.50	31.40	.001**
	Post	22	5.95	1.25			
Thermal Comfort	Pre	27	3.04	1.79	-1.48	17.13	.157
	Post	22	3.77	2.09			

* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 20

Miami employees' satisfaction with IEQ pre versus post occupancy



RQ2: Perception Workplace is Conduciveness to Health and Well-being

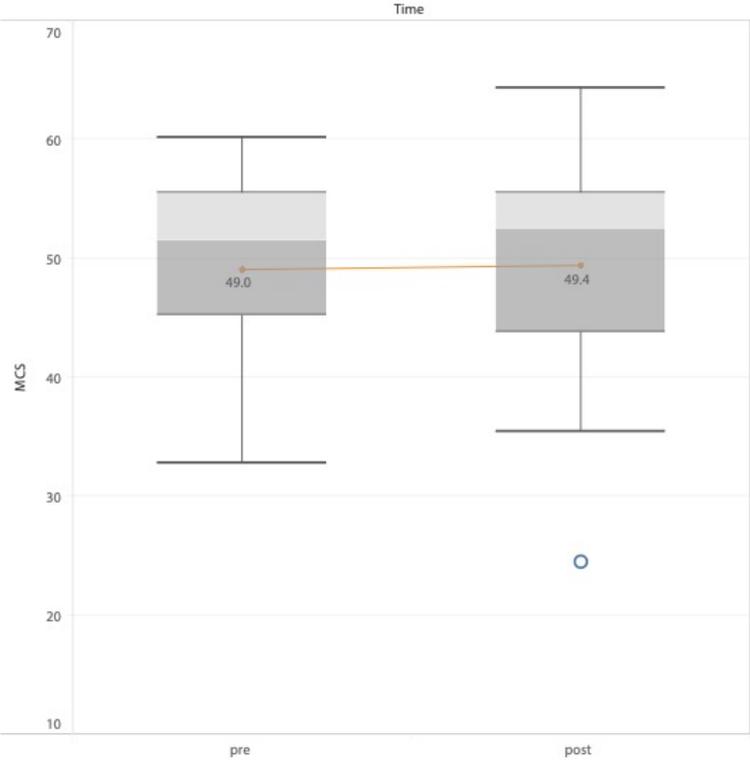
Linear mixed effects analysis revealed Miami employees perceived their workplace to be significantly more conducive to their health and well-being post occupancy, $t(43.00) = -2.64, p = .012$. They did not perceive their workplace to be conducive to their health and well-being when working in their old office that was not designed with WELL strategies ($M = 2.87, SD = 1.18, n = 23$). Despite the improvement in perception post occupancy, they still did not perceive their workplace to be conducive to their health and well-being when working in their new office that was designed with WELL strategies ($M = 3.73, SD = .99, n = 22$).

RQ3: Self-Reported Health and Well-Being

Mental Health. Linear mixed effects analysis revealed Miami employees' self-reported mental health improved pre ($M = 49, SD = 8.28, n = 24$) to post occupancy ($M = 49.4, SD = 8.99, n = 22$), although the improvement was not statistically significant. The average perceived mental health score was below the US national average of 50 both before and after moving into their new office designed with WELL strategies (see Figure 21).

Figure 21

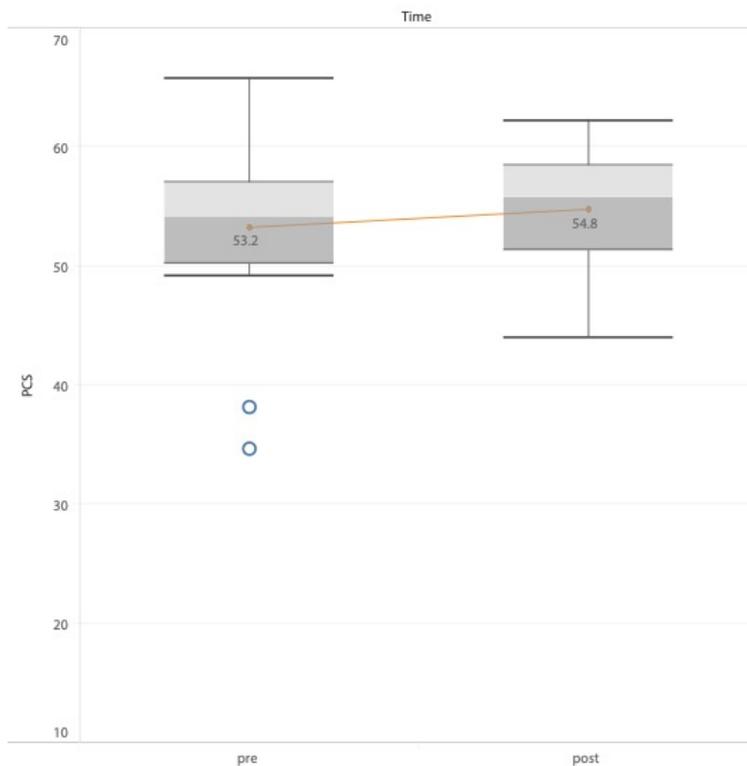
Distribution of Miami employees' mental health scores pre versus post occupancy



Physical. Linear mixed effects analysis revealed Miami employees' self-reported physical health improved pre ($M = 53.2$, $SD = 6.36$, $n = 24$) to post occupancy ($M = 54.8$, $SD = 4.96$, $n = 22$), although the improvement was not statistically significant. The average physical health score was above the US national average of 50 both before and after moving into their new office designed with WELL strategies (see Figure 22).

Figure 22

Distribution of Miami employees' physical health scores pre- versus post-occupancy



Relationship Between IEQ and Health and Well-Being

Spearman correlation analysis ($n = 22$) indicated Miami employees’ satisfaction levels with access to nature, acoustics, lighting, and physical comfort in their new office were significantly positively correlated with how conducive to their health and well-being they perceived their workplace to be. It also indicated Miami employees’ satisfaction level with access to nature was significantly negatively correlated with employee perceived physical health post occupancy, but their satisfaction levels with none of the IEQ factors under study were significantly correlated with their perceived mental health (see Figure 23).

Figure 23
Spearman correlations between Miami employees’ satisfaction with IEQ and their perception of health and well-being in the workplace post occupancy

	Workplace Health and Well-Being	Employee Mental Health	Employee Physical Health	
Access to Nature	0.07**	-0.09	-0.43*	Very Strong (+)
Acoustics	0.43***	0.37	-0.07	Strong (+)
Air Quality	-0.12	-0.14	-0.11	Moderate (+)
Cleanliness	0.19	0.06	-0.23	Weak (+)
Lighting	0.09*	-0.09	0.11	Very Weak (+)
Maintenance	0.03	-0.04	-0.29	Very Weak (-)
Physical Comfort	0.25*	-0.01	0.15	Weak (-)
Thermal Comfort	0.08	-0.01	-0.27	Moderate (-)
				Strong (-)
				Very Strong (-)

Fifteen of the 22 post-occupancy survey participants in the Miami location responded to the open-ended question *What aspect(s) of the*

workplace most impacts your health and well-being?. The most mentioned IEQ factors were lighting ($n = 5$) and physical comfort ($n = 3$). Four of the 5 participants who mentioned lighting specifically called out daylight or natural light. All three of the participants who mentioned an aspect related to physical comfort mentioned an aspect related to the layout of the office. Other IEQ factors that were mentioned included: air quality, access to nature, acoustics, and thermal comfort, which were each mentioned once.

Chicago, London, and Miami Combined

RQ1: Satisfaction with Interior Environmental Quality

Linear mixed effects analysis revealed Chicago, London, and Miami employees' satisfaction with all eight of the environmental conditions under study—access to nature, acoustics, air quality, lighting, cleanliness, maintenance, physical comfort, and thermal comfort—increased significantly after they moved from their old offices that were not designed with WELL strategies to their new offices that were (see Table 8).

Chicago, London, and Miami employees were not satisfied ($M < 5$) with any of the eight IEQ factors under study in their old offices. The employees were satisfied ($M \geq 5$) with the air quality, lighting, and physical comfort in their new offices as well as the cleanliness and maintenance of them. They were not satisfied ($M < 5$) with the access to nature, acoustics, and thermal comfort in their new offices (see Figure 24).

Table 8

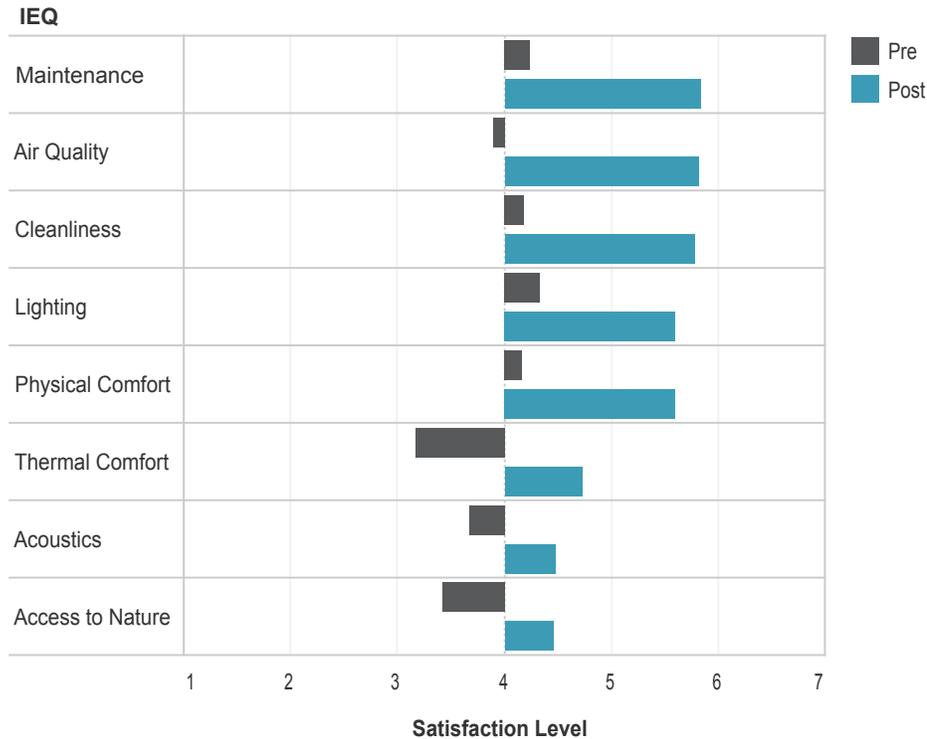
Linear mixed effects analysis of Chicago, London, and Miami employees' satisfaction with IEQ pre versus post occupancy

IEQ Factor	Time	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>
Access to Nature	Pre	123	3.43	1.60	-4.58	224.62	< .001***
	Post	105	4.47	1.74			
Acoustics	Pre	122	3.68	1.58	-3.56	225.00	< .001***
	Post	105	4.48	1.79			
Air Quality	Pre	125	3.90	1.59	-8.88	227.76	< .001***
	Post	106	5.83	1.69			
Cleanliness	Pre	125	4.19	1.35	-9.31	227.43	< .001***
	Post	106	5.79	1.26			
Lighting	Pre	124	4.34	1.57	-5.69	226.76	< .001***
	Post	106	5.61	1.79			
Maintenance	Pre	124	4.24	1.28	-10.26	226.38	< .001***
	Post	106	5.84	1.08			
Physical Comfort	Pre	125	4.17	1.38	-7.81	227.64	< .001***
	Post	106	5.60	1.41			
Thermal Comfort	Pre	125	3.18	1.71	-6.42	227.48	< .001***
	Post	106	4.73	1.91			

* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 24

Chicago, London, and Miami employees' satisfaction with IEQ pre versus post occupancy



RQ2: Perception Workplace is Conducive to Health and Well-being

Linear mixed effects analysis revealed employees perceived their workplaces to be significantly more conducive to their health and well-being post occupancy, $t(211.06) = -6.97, p < .001$. Chicago, London, and Miami employees did not perceive their workplaces to be conducive to their health and well-being when working in their old offices that were not designed with WELL strategies ($M = 2.77, SD = 1.04, n = 114$). Despite the improvement in perception post occupancy, they still did not perceive their workplaces to be

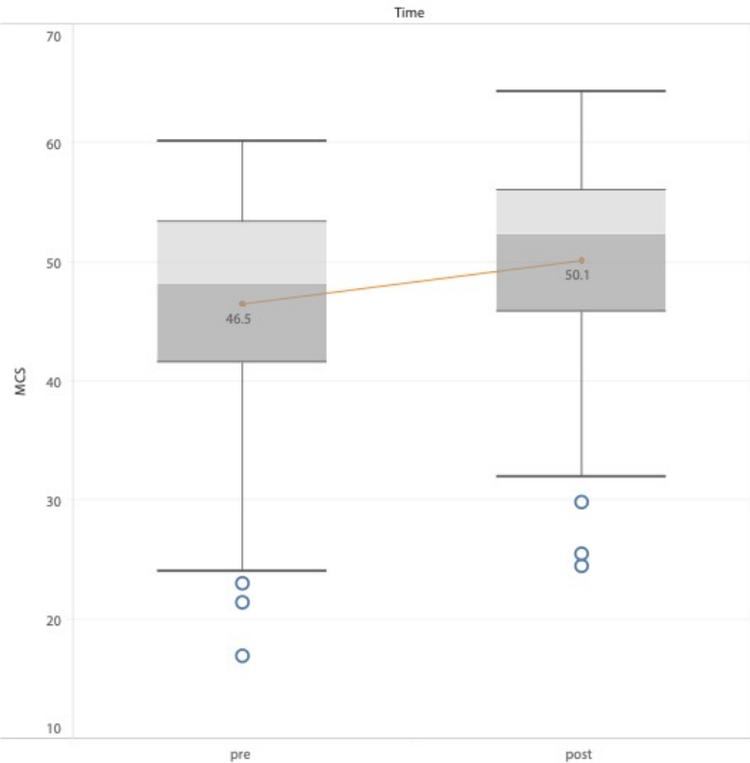
conducive to their health and well-being when working in their new offices that were designed with WELL strategies ($M = 3.77$, $SD = 1.03$, $n = 100$).

RQ3: Self-Reported Health and Well-Being

Mental Health. Linear mixed effects analysis revealed Chicago, London, and Miami employees' self-reported mental health significantly improved pre ($M = 46.5$, $SD = 9.15$, $n = 115$) to post occupancy ($M = 50.1$, $SD = 8.51$, $n = 99$), $t(-3.43) = 101.74$, $p < .001$). The average mental health score moved from below to above the US national average of 50 after moving into the new offices designed with WELL strategies (see Figure 25).

Figure 25

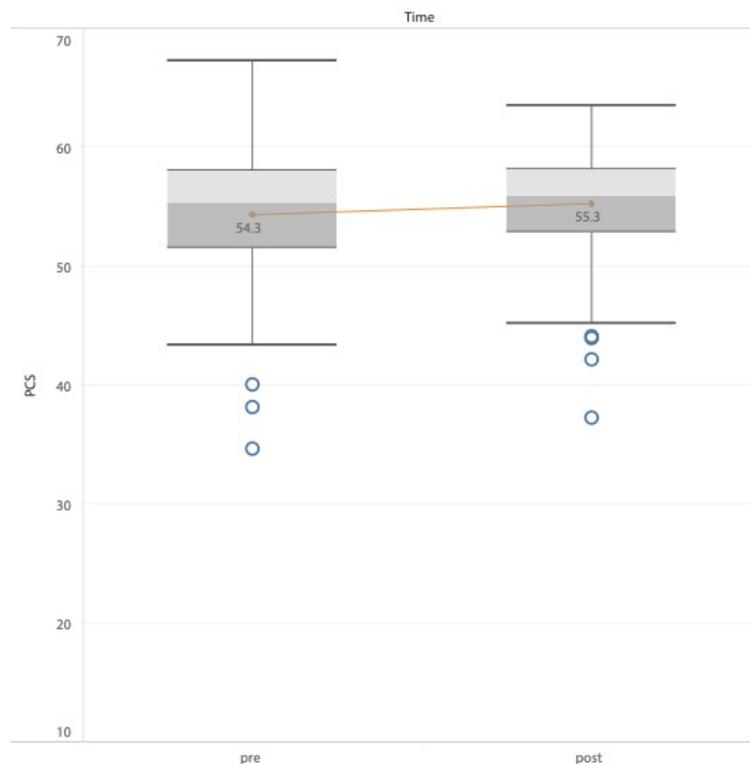
Distribution of Chicago, London, and Miami employees' mental health scores pre versus post occupancy



Linear mixed effects analysis revealed Chicago, London, and Miami employees' self-reported physical health improved pre ($M = 54.3$, $SD = 5.28$, $n = 115$) to post occupancy ($M = 55.3$, $SD = 4.5$, $n = 99$), although the improvement was not statistically significant. The average physical health score was above the US national average of 50 both before and after moving into the new offices design with WELL strategies(see Figure 26).

Figure 26

Distribution of Chicago, London, and Miami employees' physical health scores pre versus post occupancy



Relationship Between IEQ and Health and Well-Being

Spearman correlation analysis ($n = 95$) indicated Chicago, London, and Miami employees' satisfaction levels with access to nature, acoustics, air quality, cleanliness, lighting, physical comfort, and thermal comfort in their new offices were significantly positively correlated with how conducive to their health and well-being they perceived their workplaces to be. It also indicated Chicago, London, and Miami employees' satisfaction level with acoustics was significantly correlated with their mental health post occupancy, but their satisfaction levels with none of the IEQ factors under study were significantly correlated with their perceived physical health (see Figure 27).

Figure 27

Spearman correlations between Chicago, London, and Miami employees' satisfaction with IEQ and their perception of health and well-being in the workplace post occupancy

	Workplace Health and Well-Being	Employee Mental Health	Employee Physical Health	
Access to Nature	0.47***	0.10	-0.13	Very Strong (+)
Acoustics	0.58***	0.31*	0.02	Strong (+)
Air Quality	0.28**	0.08	0.09	Moderate (+)
Cleanliness	0.21*	0.04	0.00	Weak (+)
Lighting	0.45***	0.03	0.03	Very Weak (+)
Maintenance	0.15	0.18	0.02	Very Weak (-)
Physical Comfort	0.43***	0.11	0.17	Weak (-)
Thermal Comfort	0.34***	0.09	-0.02	Moderate (-)
				Strong (-)
				Very Strong (-)

Eight-four of the 106 post-occupancy survey participants in the Chicago, London, and Miami locations responded to the open-ended question *What aspect(s) of the workplace most impacts your health and well-being?*. The most mentioned IEQ factors were lighting ($n = 37$) and physical comfort ($n = 28$). Twenty-seven of the 37 participants who mentioned lighting specifically called out daylight or natural light. Twenty-two of the 28 participants who mentioned an aspect related to physical comfort mentioned an aspect related to the layout of the office—fifteen praising the variety of different space types in the office. The remaining six that mentioned an aspect related to physical comfort mentioned an aspect related to the ergonomics of their workstations. Other IEQ factors that were mentioned included: air quality, which was mentioned nine times; access to nature, which was mentioned six times; acoustics, which was mentioned five times; thermal comfort, which was mentioned four times; and cleanliness of the workspace, which was mentioned once.

CHAPTER 6

DISCUSSION

This study was designed to track occupant outcomes, specifically satisfaction with IEQ, perception workplace is conducive to health and well-being, and self-reported health and well-being, across two data collection periods within three locations of a global architecture and design firm as they moved from offices that were not designed with WELL strategies to new offices that were. There were three primary research questions: whether employee satisfaction with IEQ is higher in the offices designed with WELL strategies (RQ1), whether employees perceive their workplace to be more conducive to health and well-being in the offices designed with WELL strategies (RQ2), and whether employee self-reported health and well-being is better in offices designed with WELL strategies (RQ3). In addition, the relationships between employee satisfaction with interior environmental quality and (1) employee perception the workplace is conducive to health and well-being and (2) employee self-reported health and well-being in the offices designed with WELL strategies were explored. The results of this study as well as the possible explanations and implications of them are discussed in this chapter. For lucidity, the discussion is presented in the same framework and order as the results were presented in the previous chapter.

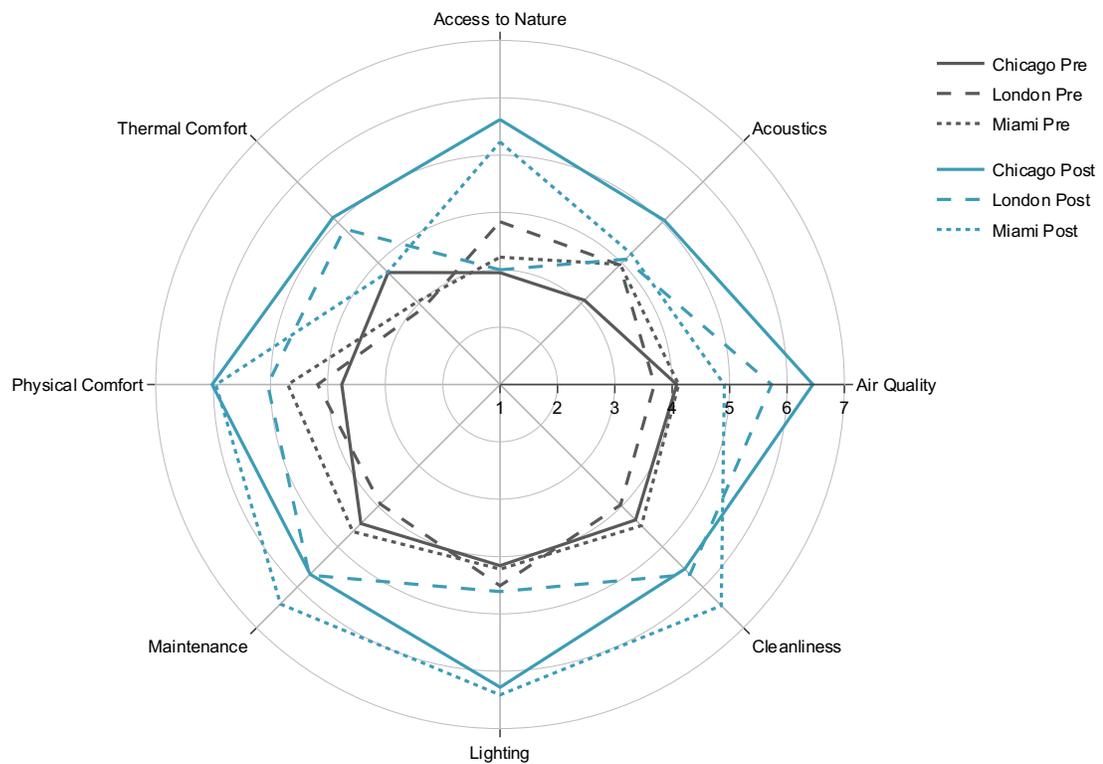
RQ1: Satisfaction with Interior Environmental Quality

The hypothesis that employee satisfaction with IEQ is higher in the offices designed with WELL strategies was mostly supported. The results of the aggregate analysis showed employees' satisfaction with the IEQ factors

under study increased significantly after moving into the offices that were designed with WELL strategies, although there was some variance across the three locations in how much employees' satisfaction with the IEQ factors increased and whether the employees were satisfied with the IEQ factors in the new offices (see Figure 28). The varied results are consistent with the results published by Candido et. al (2020) and Licina and Yildirim (2021).

Figure 28

Comparison of IEQ satisfaction across offices pre and post occupancy



It is important to note that two of the locations—London and Miami—have not received WELL certification to date, so whether they have

successfully implemented the WELL design strategies required to achieve WELL Gold certification cannot be confirmed. The Chicago location received WELL Gold certification in December 2020. Chicago employees reported being satisfied with all of the IEQ factors under study in their new office. Their satisfaction with all of them increased significantly after moving into the office designed with WELL strategies. London employees did not report being satisfied with the access to nature, the acoustics, and the lighting in their new office. Their satisfaction with the access to nature actually decreased significantly after moving into the office designed with WELL strategies. Their satisfaction with the acoustics and the lighting did increase, but the increases were not found to be significant. Miami employees did not report being satisfied with the acoustics, the air quality, and the lighting in their new office. Their satisfaction with them increased, but only the increase in their satisfaction with thermal comfort was found to be significant.

The interview with the WELL Administrator for the new London office revealed the location did not meet the requirements of WELL Feature 88: Biophilia 1 – Qualitative, which requires WELL projects to incorporate biophilic design elements, until January of 2020, when plants were added to the office. A plant wall was originally planned for the office to meet the requirements of the feature but was never built. In addition, one of the floors of the London office is below ground. Based on the 37 employees who identified themselves with their email address, employees sitting on the lower ground level ($n = 22$) reported lower satisfaction ($M = 2.5$) with access to nature and lighting ($M = 4.1$) than those sitting on the ground level ($M = 3.5$; $M = 5.1$, $n = 15$). In response to the open-ended question *What aspect(s) of the workplace has/have the most impact on your own health and well-being?*, several

employees sitting on the lower ground level mentioned the lack of natural light and view to the outside negatively impacting their health and well-being. One employee sitting in the lower level wrote,

Lack of natural light greatly impacts my health and well-being. Working in a basement is not an inspiring situation, and can be depressing at times ... Naturally a positive person, the effects of no views to the outside has made me more negative about my work environment and less motivated to rush in to do my work.

The lack of biophilic elements in the office as well as the lack of outside views and natural light in the lower ground floor may have impacted employees' satisfaction with access to nature and light.

The interview with the WELL Administrator for the new Miami office revealed the location was experiencing issues with their air handling unit, which they were trying to rectify. The issues with the air handling unit may have impacted employees' satisfaction with the air quality and thermal comfort.

RQ2: Perception Workplace is Conducive to Health and Well-being

The hypothesis that employees perceive their workplace to be more conducive to health and well-being in the offices designed with WELL strategies was supported. Overall, results showed employees perceived their workplace to be significantly more conducive to their health and well-being when working in the offices designed with WELL strategies than when working in the offices that were not, although Chicago was the only location that reported their workplace to be conducive to their health and well-being post occupancy. (None of the locations reported their workplace to be conducive to health and well-being pre-occupancy.) As mentioned in the previous section,

the London and Miami locations have yet to achieve WELL certification, which may be attributing to the difference in results.

RQ3: Self-Reported Health and Well-Being

The hypothesis that employee self-reported health and well-being would improve after moving into the offices designed with WELL strategies was partially supported. Overall, employees' self-reported mental health significantly improved after moving into the offices designed with WELL strategies; employees' self-reported physical health improved but the improvement was not significant.

Mental Health. Chicago employees' and London employees' self-reported mental health significantly improved after moving into the offices designed with WELL strategies. Miami employees' self-reported mental health improved after moving into the office designed with WELL strategies, but the improvement was not significant. When combined, Chicago, London, and Miami employees' self-reported mental health significantly improved after moving into the offices designed with WELL strategies.

Physical Health. London employees' self-reported physical health significantly improved after moving into the office designed with WELL strategies. Chicago employee's and Miami employees' self-reported physical health improved after moving into the offices designed with WELL strategies, but the improvements were not significant. When combined, Chicago, London, and Miami employees' self-reported physical health improved after moving into the offices designed with WELL strategies, but the improvement was not significant.

Relationship Between IEQ and Health and Well-Being

Employees' perception their workplace is conducive to health and well-being was significantly positively correlated with their satisfaction with access to nature, satisfaction with acoustics, satisfaction with lighting, and satisfaction with physical comfort in all three offices as well as in aggregate. The results support the argument that not only do IEQ factors that may impact employee health and well-being negatively (e.g., acoustics) need to be managed but IEQ factors that may impact employee health and well-being positively (e.g., access to nature) must also be implemented in order to create workplaces that are truly conducive to health and well-being (Roskams & Haynes, 2019).

Self-reported employee physical health was found to be significantly positively correlated with satisfaction with physical comfort in the Chicago location and significantly negatively correlated with satisfaction with access to nature in the Miami office. Neither of the correlations was found to be significant when analyzing the aggregate sample. When analyzing the aggregate sample, self-reported employee mental health was found to be significantly positively correlated with employee satisfaction with acoustics.

Limitations and Opportunities for Future Research

The key limitations of this study pertain to sample size, survey timing, and mono-method bias. Most of the limitations were outside of the author's control, because the author was not involved in the data collection for this study. One of the limitations of this study is a relatively small sample size ($n = 125$). The results presented provide only a snapshot of the impact of WELL design strategies on employee satisfaction with interior environmental quality, employee perception the workplace is conducive to health and well-being, and employee self-reported health and well-being. More buildings and spaces

designed with WELL strategies need to be evaluated to better benchmark them against building and spaces that have not been design with WELL strategies. The pre-post samples were also unequal in size, which may have impacted the validity of the results. Some employees completed the pre-occupancy survey but not the post-occupancy survey and vice versa. Participant ID was added to the linear mixed effect model as a random effect to account for the variation due to individual differences but may not have accounted for all of the variation.

In addition, the post-occupancy surveys were administered less than a year after the employees occupied the new offices, which could have led to more positive results due to the newness of the offices designed with WELL strategies. The timing of the post-occupancy surveys could have also led to more negative results. Because none of the offices had received WELL certification at the time of the surveys, whether the new offices had successfully implemented the WELL design strategies required to achieve WELL Gold certification could not be verified. Chicago is the only location that has since achieved WELL certification. As mentioned earlier in this chapter, the new London office did not meet the requirements of WELL Feature 88: Biophilia 1 – Qualitative, which requires WELL projects to incorporate biophilic design elements, until January of 2020, when plants were added to the office. In early 2021, the London office also went through a redesign and was downsized in square footage. The lower ground floor was walled off from the ground floor, and the firm is now only occupying the ground floor. The Miami location has rectified the issue they were experiencing with their air handling unit and is preparing for performance verification and final review for WELL certification. Future post-occupancy research should be conducted on these

offices after WELL certification to determine if there were any issues in the offices at the time of the post-occupancy survey that would have kept them from achieving WELL certification and thereby impacted the results of this study.

Lastly, surveys are useful in obtaining occupant perception of interior environmental quality and detect any gaps between the design intentions and the actual outcomes of a project. Yet, subjective measurements can be biased with other factors. Since the employees were informed they were study participants, the “Hawthorne Effect” could have occurred, resulting in alteration of the survey responses (Altomonte et al., 2017). Also, the fact that the employees knew their new offices were designed with WELL strategies may have created bias in their perception. A multi-method approach that pairs objective IEQ and health measures with subjective survey data would allow for triangulation of the data. Combining quantitative and qualitative research methods (e.g., interviews, behavior mapping) would also enrich the evidence and enable the research questions to be answered more deeply.

Conclusion

With the increasing interest in healthy interior environments, we still have a lot to learn about the role healthy building certifications, like WELL, have on human health and well-being. The COVID-19 pandemic, in particular, has served to remind us of our lack of expertise regarding the requirements of health-supportive environments. This study builds on the currently limited existing research that looks at the impact of spaces designed with WELL strategies on occupant satisfaction with interior environmental quality and occupant health and well-being by increasing the number of post-occupancy evaluations of the spaces as well as providing a more holistic view of the

impact of WELL spaces on human health and well-being. The evidence provided by this study suggests that implementing WELL design strategies in the workplace can lead to increased employee satisfaction with interior environment quality, improved employee perception that their workplace is conducive to health and well-being, and better self-reported mental health. Additional research needs to be conducted on WELL spaces to continue to establish the success and shortcomings of the current WELL certification system and guide future versions of the WELL Building Standard.

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Appendix A

Building Wellness Survey



WELL Survey

Thank you for participating in the WELL Survey!

The aim of this survey is to better understand how changes in the workplace environment through WELL certification impact perceptions of occupant health and well-being. It takes 10-15 minutes to complete the survey, and all responses are strictly confidential and anonymous. HKS will NOT have access to any identifiable raw data, and all results will be presented in aggregate, meaning that only data from the whole group will be presented. This survey asks questions about the operations and conditions of your workplace such as temperature, air quality, lighting, access to healthy foods, as well as questions about your perceived health and well-being. Your participation in this study is completely voluntary, and your decision to fill out the survey will in no way influence your job or any benefits you receive from your job now or in the future. During the survey period, you can begin the survey and return to it if you need to pause and leave it at any time. This survey can also be completed through any mobile device using Apple iOS, Android, or Blackberry software.

If you have questions about the survey or experience any technical difficulties, please contact the Research Team by email at Delos.Insights@Delos.com



WELL Survey

Background

* 1. How long have you worked for your current employer?

- Less than 1 year
- 1-2 years
- 3-5 years
- More than 5 years

* 2. In a typical week, how many hours do you work in this building?

- 12 or less
- 13-24
- 25-35
- 36-40
- 41 or more

* 3. Which of the following most accurately describes your job type?

- Administrative support
- Associate
- Managerial
- Supervisor/Director

* 4. What is your age?

- 30 or under
- 31-40
- 41-50
- 51-60
- 61 or over

5. Do you identify as:

- Female
- Male
- Other

6. Do you have a personal workspace ASSIGNED to you in your office?

- Yes
- No



WELL Survey

Assigned workspace

7. Which of the following best describes your ASSIGNED personal workspace?

- Private office
- Shared office
- Workstation with low partitions in an open office
- Workstation with high partitions in an open office
- Open office, just desks, no partitions



WELL Survey

Unassigned workspace

8. Which of the following best describes your UNASSIGNED primary workspace?

- Private office
- Shared office
- Workstation with low partitions in an open office
- Workstation with high partitions in an open office
- Open office, just desks, no partitions
- Café/ Lounge
- Soft Seating
- Conference/ meeting room



WELL Survey

Access to Nature (continued)

27. Which of the following do you think would make you more comfortable/feel better in your workplace?
Check all that apply.

- Potted plants
- Art depicting nature
- Interior design elements that elicit nature
- Garden
- Views to nature outside the building
- Building features that resemble natural environments (e.g., hard wood floors)
- Other (please specify)



WELL Survey

Physical Activity

The next several questions ask about "physical activity." For purposes of this survey, physical activity includes all movement including standing, climbing stairs, walking, bicycling, etc.

28. Approximately how much physical activity do you get every day?

- 0-30 minutes
- 30 minutes - 1 hour
- More than 1 hour

31. You have said you are dissatisfied with your personal level of physical activity throughout the day. How do you feel your workplace can better support your physical activity? Check all that apply:

- Accessibility to active modes of commuting (e.g., biking, walking)
- A conveniently located fitness center at work
- Incentives/discounts for gym memberships
- Workplace policy that promotes physical activity (e.g., more flexible hours to allow for exercising)
- Incentives for active modes of commuting (e.g., biking, walking)
- Accessible and attractive building features, such as staircases, walkable indoor workspace, or walking paths
- Furniture that allows for physical activity throughout the day, such as standing desks
- Other (please specify)



WELL Survey

Water

32. Overall, how satisfied are you with the accessibility and quality of drinking water in your workplace?

Very satisfied

Neutral

Very dissatisfied

WELL Survey

Water (continued)

35. You have said you are satisfied with your ability to eat healthy at your workplace. Check all that contribute to your satisfaction:

- Available food preparation areas including space in refrigerator/freezer
- Condition and cleanliness of dining area
- Alternative food items available for special diets (including allergies)
- Promotion of healthy foods in the work environment
- Healthy options offered on site are affordable
- Ability to choose healthy options
- Conveniently located restaurants, shops, and cafes with healthy food options
- Other (please specify)



WELL Survey

Nourishment (continued)

36. You have said you are dissatisfied with your ability to eat healthy at your workplace. Please check all that apply to your dissatisfaction:

- Lack of food preparation areas including space in refrigerator/freezer
- Condition and cleanliness of dining area
- Lack of alternative food items for special diets (e.g., food allergies)
- Insufficient or lack of promotion of healthy foods
- Healthy options offered on site are expensive
- Inability to choose healthy options
- Lack of conveniently located restaurants, shops, or cafes with healthy food options
- Other (please specify)

41. You have said that you feel unsafe in your workplace with regard to the security of the building. Which of the following contribute to this feeling? Check all that apply:

- Building entrances are not secure
- Isolated areas outside the building are unsafe
- Isolated areas inside the building are unsafe
- Building is located in an unsafe neighborhood
- Administrative policies on security are not adequate
- Other (please specify)



WELL Survey

Security (continued)

42. Where do you feel most unsafe regarding workplace security?

- Office or workspace
- Restrooms
- Public lobbies and corridors
- Elevator
- Stairwells
- Parking areas
- Exterior areas (outside of the building)
- I feel unsafe in all areas
- Other (please specify)

45. You have said you do not agree that your workplace provides and supports workplace wellness programs. Which of the following contributes to your dissatisfaction? Check all that apply:

- Too many long hours spent at the office
- Too many communications expecting replies immediately or outside regular office hours
- Too much time spent away from home due to business travel
- Insufficient health coverage or allotment for sick days
- Insufficient programs for work-related stress, addiction, or other issues affecting work
- Insufficient programs for family support
- No support for telecommuting, flexible hours, or other flexible work schedules
- Lack of health and wellness education
- Insufficient tools and resources to improve my well-being
- Other (please specify)



WELL Survey

Health and Work

46. About how many hours altogether did you work in the past 7 days?

47. How many hours does your employer expect you to work in a typical 7-day week? (If it varies, estimate the average.)

The Health and Work Survey was developed by the World Health Organization (WHO) as part of the WHO Composite International Diagnostic Interview (copyright © 2001 by WHO) and is used here with the permission of the World Health Organization.

Now please think of your work experiences over the past 4 weeks (28 days). In the spaces provided below, type the number of days (0-28) you spent in each of the following work situations.

In the past 4 weeks (28 days), how many days did you...

48. ...miss an entire work day because of problems with your physical or mental health? (Please include only days missed for your own health, not someone else's health.)

49. ...miss an entire work day for any other reason (including vacation)?

50. ...miss part of a work day because of problems with your physical or mental health? (Please include only days missed for your own health, not someone else's health.)

51. ...miss part of a work day for any other reason (including vacation)?

52. ...come in early, go home late, or work on your day off?

53. About how many hours altogether did you work in the past 4 weeks (28 days)? (See examples below)

Examples for Calculating Hours Worked in the Past 4 Weeks

- 40 hours per week for 4 weeks = 160 hours
- 35 hours per week for 4 weeks = 140 hours
- 40 hours per week for 4 weeks with 2 8-hour days missed = 144 hours
- 40 hours per week for 4 weeks with 3 4-hour partial days missed = 148 hours
- 35 hours per week for 4 weeks with 2 8-hour days missed and 3 4-hour partial days missed = 112 hours

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54. Using the same 0-to-10 scale, how would you rate your usual job performance over the past year or two?

0 (Worst Performance)	1	2	3	4	5	6	7	8	9	10 (Top Performance)
<input type="radio"/>										

55. On a scale from 0 to 10 where 0 is the worst job performance anyone could have at your job and 10 is the performance of a top worker, how would you rate the usual performance of most workers in a job similar to yours?

0 (Worst Performance)	1	2	3	4	5	6	7	8	9	10 (Top Performance)
<input type="radio"/>										

56. Using the same 0-to-10 scale, how would you rate your overall job performance on the days you worked during the past 4 weeks (28 days)?

0 (Worst Performance)	1	2	3	4	5	6	7	8	9	10 (Top Performance)
<input type="radio"/>										

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WELL Survey

Well-being

57. How much do you agree or disagree with the following statements?

	Strongly agree		Neither agree or disagree		Strongly disagree
The workplace energizes me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The workplace is conducive to my health and well-being	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel motivated to work at my best everyday	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The workplace supports my thinking and analytical work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I look forward to coming to work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I wish I worked in another building	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The workplace makes me proud to be part of this organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The workplace supports my ability to retreat and have private conversations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is easy to work collaboratively with others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The workplace creates an opportunity for chance meetings helping us to reveal opportunities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The organization cares about how the physical work environment impacts mental health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



WELL Survey

Well-being

58. In general, would you say your health is:

- Excellent
- Very good
- Good
- Fair
- Poor

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WELL Survey

Well-being

59. The following questions are about activities you might do in a typical day. Does your health now limit you in these activities. If so, how much?

	YES, limited a lot	YES, limited a little	NO, not limited at all
Moderate activities such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Climbing several flights of stairs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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WELL Survey

Well-being

60. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
Accomplished less than you would like	<input type="radio"/>				
Were limited in the kind of work or other activities	<input type="radio"/>				

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WELL Survey

Well-being

61. During the past 4 weeks, have you had any kind of problems with your work or other regular daily activities as a result of emotional problems (such as feeling depressed or anxious)?

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
Accomplished less than you like	<input type="radio"/>				
Did work or activities less carefully than usual	<input type="radio"/>				

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WELL Survey

Well-being

62. During the past 4 weeks, how much did pain interfere with your normal work (including work outside the home and housework)?

- Not at all
- A little bit
- Moderately
- Quite a bit
- Extremely

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63. These questions are about how you have been feeling during the past 4 weeks.
For each question, please give one answer that comes closest to the way you have been feeling.

How much in the past 4 weeks...

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
Have you felt calm and peaceful?	<input type="radio"/>				
Did you have a lot of energy?	<input type="radio"/>				
Have you felt down-hearted and blue?	<input type="radio"/>				

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64. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

- All of the time
- Most of the time
- Some of the time
- A little of the time
- None of the time

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WELL Survey

Well-being

Please refer to the following definitions when answering the following question:

***Health* is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.**

***Well-being* is characterized as the presence of positive emotions and moods (e.g., contentment, happiness), the absence of negative emotions (e.g., depression, anxiety), satisfaction with life, fulfillment and positive functioning.**

65. What aspect(s) of the workplace has/have the most impact on your own health and well-being?



WELL Survey

Survey completed

Thank you for taking the time to complete this survey. Your participation is extremely important to us!

This survey will be repeated in the future so that we can continue to understand how features of the workplace environment contribute to occupant health and well-being. In order to track your responses over the course of the study, we ask that you include your work email address at the end of this survey. **Only the Delos Research team will have access to your email address and all survey responses will be encrypted and de-identified to protect participant confidentiality.**

66. Work email address

Appendix B

Stakeholder Interview Protocol

Date and time of interview:

How is this interview being conducted (phone, Skype, etc.):

Name of interviewee:

Role at HKS:

Office Location:

Date of beginning of design and date of occupancy:

Date of Delos Survey (pre/post):

Where are you in the WELL Certification process?

What level of certification are you seeking?

1. Tell me about the design process with WELL for the new office.
 - Why were you chosen to be part of the design team?
 - Who was on the design team (list everyone, roles not names)
 - Have you had prior experience with WELL projects?
2. What was the WELL program / goal(s) for the new office?
3. Do you think those were met? How so, or how not?
4. Did you use any research to inform the design? Primary? Secondary?
 - Journals, books, etc.
 - Interviews or surveys with staff, etc.
 - Behavior mapping, site observation, etc.
4. What were the biggest challenges maintaining WELL objectives during design and construction?
5. What are the biggest challenges now? Who deals with them, and how? Are there WELL features that are not being used as intended?
6. What did NOT happen according to the initial design plan, and why?
7. Have you gotten feedback about the office since it opened, either formally or informally? If so, discuss who, how, and what.
9. What do you feel the (design / construction) team got really RIGHT with the office?
10. What do you wish could have been done differently? Or, if you had to do it all over again, what would you have someone do differently?
11. Anything else to share?

Appendix C

Number of Pre-Post Matched Pairs by Location

Location	Time	Survey Participants	Email Addresses	Pre-Post Matched Pairs
Chicago	Pre	38	31	22
	Post	40	40	
London	Pre	61	45	24
	Post	44	37	
Miami	Pre	27	20	9
	Post	22	17	