UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Standing Desk Wellbeing Analysis: The Effects of Standing Desks and Greenery in the Workplace

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Executive Summary

The primary focus of this study was to investigate the effects of standing desk usage and exposure to greenery in the workplace at the University of British Columbia (UBC). We specifically focused on how these two independent variables interacted with happiness, productivity, social connectedness, and well-being among employees in the Centre for Interactive Research on Sustainability (CIRS) on UBC campus. Our results were based on data collected via self-report questionnaire, Stroop Test trials, and a blood pressure/heart rate monitor. Participants were divided into three conditions depending on the set-up of their work station: 1) use of a standing desk and visual exposure to greenery (Desks and Plants) , 2) no use of a standing desk but with visual exposure to greenery (Plants Only), and 3) neither standing desk nor greenery (No Desks or Plants). Ultimately, we found that those who use standing desks and who are exposed to plant life are slightly more likely to report higher levels of well-being in all respects. However, these differences were not significant enough for us to confidently conclude that these two independent variables have a distinct psychological or physical benefit among employees.

Introduction

According to its Strategic Plan published in 2012, the University of British Columbia strives to "be a healthy, inspiring workplace that cultivates well-being". In accordance with this statement, UBC has recently begun to adopt the use of sit-stand desks and greenery in its offices. This practice is based off of previous studies, which have shown that the use and exposure to both can lead to an increase in overall health and happiness. As discovered by Lottrup et al. (2013), working in a space decorated with greenery can lead to decreased levels of stress and a positive workplace attitude. Additionally, exposure to such forms of nature has shown to result in improved cognitive functioning (Berman et al., 2008). In terms of using sit-stand desks, one study was able to show that by reducing the time spent sitting (in this particular case by 66 minutes less), employees resultantly experienced 54% less back and neck pain as well as an improved state of mind (Pronk et al., 2012). The Centre for Interactive Research on Sustainability (CIRS) is one example of a building at UBC that incorporates both greenery and sit-stand desks into its workspaces. Expanding on a report issued by UBC students on the benefits of sit-stand desk usage in the CIRS (Cournoyer et al., 2016), this study was motivated to explore similar effects with the added consideration of greenery in the work environment.

Research question and hypothesis

The research question posed in this study is as follows: How do plants and standing desks affect productivity, sense of connectedness, health and happiness in CIRS employees? In response, we hypothesized that the experiment would result in a positive correlation between exposure to plants and/or standing desk use, and employee well-being: self-reported happiness, productivity and social connectedness, faster times on the Stroop test, and slower resting heart rates.

Methods

Research design

This study used a cross-sectional survey design and then applied a quantitative method for data analysis. The cross-sectional design allowed us to observe relatively small samples of employees working on the UBC campus at select points in time, taking snapshots that were used to generalize for the remainder of the building.

Materials

The survey was comprised of several self-report questionnaires, which have been validated in several settings to measure what they purport to achieve. We used the WHO-5 Well-being Index, an adapted version of the Lee & Robbins Social Connectedness scale, and two sets of 5 questions based off of a paper discussing effective ways to assess productivity through questionnaires (Zhang et al., 2012). Each question employed a 6-point likert scale, allowing subjects to rate statements on a scale of 0 to 5, or "never" to "all of the time".

Participants

The data collection took place at the CIRS Building located on UBC campus, which is a four-story, LEED-certified building containing many discrete offices. A total of 28 CIRS employees in various offices agreed to participate in our study. The participants were relatively young, between the ages of 18 and 23. 85% of the participants were female.

Measures

In our study, there were two sets of independent variables: presence or absence of plants in the workspace, and whether or not participants used a standing desk. Initially, we planned to break the standing desk group down further into high- and low- frequency users. However, our small sample size demanded the groups be consolidated.

The primary dependent variable is the participants' overall wellness, which was broken down into three parts: 1) self-reported happiness, social connectivity, and productivity, 2) cognitive speed, which was measured via three trials of the Stroop test, and 3) aerobic health, which was assessed through blood pressure and resting heart rate readings taken with a blood pressure cuff.

Procedure and condition

There were three rounds of data collection, which employed a convenience sampling method to invite those who were willing and able to participate in our study. To begin, we visited the CIRS building at 3:45pm on March 08, 2008. We only recruited 8 participants due to the fact that most others were busy working during that time. However, we aquired business cards from about 20 potential participants who were willing to participate at a more convenient time. The second and third rounds of data collection took place on March 16 and 20 during the morning coffee break period. We managed to collect another 19 completed questionnaires, bringing the total sample size of our study to 28.

The survey took place directly in employees' offices. Once the employee we approached agreed to participate and provided consent, he/she would go through a three-step procedure. First, a Stroop test was conducted. Each participant had to correctly identify 10 sets of words in which the colour of the font was different from the word itself. The task was to select the colour of the font, not the written word. Accuracy had to be 100% for the trial to count, and participants had as many do-overs as they needed to get 3 trials of data. Second, the questionnaire developed for this study was provided. Finally, a blood pressure cuff was used to measure resting heart rate and blood pressure, which are indicators of physical wellness. By placing the Stroop test first and the aerobic measure last, we were able to use the survey as a buffer between the blood pressure and the potentially stressful effects of the Stroop test.

Ethical consideration

We took several measures to protect the rights of participants. The test only began after written consent was provided. Participants were free to skip any survey question they did not feel comfortable answering, without being required to provide a reason. Additionally, while identifying

information (specifically, birthdate and the last 4 digits of their phone numbers) was collected to code the surveys with the physical measures, this data was anonymized and discarded as soon as it had been transferred to a spreadsheet.

Results

Happiness Level Results

Respondents who are exposed to neither plants nor standing desks have generally lower mean happiness scores compared to the other two groups. A one-way ANOVA was used to determine whether the mean happiness scores of each group were different from each other. We found a p-value of $0.014 < 0.05$, which means that there are differences in means between all these three groups. The “Plants Only” group had the highest average happiness level.

Even though respondents who are only exposed to plants have a slightly higher mean happiness level than those who are exposed to both plants and standing desks, the difference in their happiness level is so small that it can be ignored. We can deduct from the data that both plants and standing desks correlate positively with individual happiness level.

Productivity Level Results

Respondents in the "Plants & Desks" and "Plants Only" groups have similar productivity levels, which were generally higher than those in the “No plants or Desks” group. Respondents in the Plants & Desks group have a lower distribution in Medium Productivity Level, and a higher distribution in Low Productivity Level. The varied distribution of individuals in this group indicates that the influence of Standing Desks on productivity may be highly variable. Employing a one-way ANOVA, we find out that the p-value is $0.72 > 0.05$. This indicates that there is no significant difference between the means of productivity levels among all these three groups. Therefore, productivity level does not vary drastically with standing desk or plant use.

Social Connectedness Level Results

A one-way ANOVA for social connectedness returns a p-value of $0.03 < 0.05$, indicating significant differences between the mean social connectedness level between all these three groups. The majority of the respondents in the Plants & Desks group (84.38%) report Strong social connectedness. 72.23% of the respondents in the "No Plants or Desks" group also have Strong social connectedness. Respondents in "Plants & No Standing Desk" have the lowest percentage (35.56%) of Strong social connectedness among the three groups. While respondents who used neither standing desks nor plants were less likely to report Strong social connectedness than the other two groups, the distributions in the “Plants Only” group are quite scattered and inconsistent. Therefore, we are not able to identify any meaningful relationship between standing desk use, plant presence, and social connectedness from the collected data due to the high variability in our limited sample size.

Health Level Results

Respondents in the "Plants & Desks” group were the most likely to report “Strong health” (47.37%). Respondents in "Plants Only" and "No Plants or Desks" groups have similar a distribution percentage in the “Strong health” category. Surprisingly, respondents in "Plants & Desks" and "Plants Only" reported a higher percentage of Poor health conditions than respondents in the “No plants or Desks” group. The “No plants or Desks” group also returned the highest distribution of participants in medium health (53.34%). Since the distributions are quite scattered and some of the relations don’t make any logical sense, we are unable to identify any meaningful patterns from the data in health level.Our one-way ANOVA analysis corroborates this: the p-value

is 0.16 > 0.05, which means that there is no significant difference between the means of general health level among the three groups. In that case, it is very likely that the use of plants and standing desks will not have big influence on general health level.

Stroop Test Results

Respondents in the Plants and Desks group have slightly faster Stroop Test response times than respondents in other groups. Standing desk usage correlates positively with faster response times, but the relationship between presence of plants and response times is unclear.

Aerobic Health Results

There were no major differences between blood pressure between groups, but resting heart rate varied very slightly between groups. The group with the fastest mean resting heart rate was the No Plants or Desks group, which is consistent with our predictions. However, the Plants Only group had slightly slower resting heart rates than the Plants & Desks group, which is surprising because standing up has an clear direct effect on heart rate and therefore on aerobic health, while there is no obvious mechanism by which plants moderate heart rate.

Discussion

While our sample is small and biased, and our results are inconclusive, at the very least, it appears that plants and standing desks do not worsen employees' lives. The group which used neither standing desks nor plants reported less happiness and social connectivity than the others, their resting heart rates were marginally faster and their Stroop test scores were marginally lower. Selection bias certainly played a role. Our sample was overwhelmingly young and female, and those demographics were overrepresented in standing desk users in particular. One office exclusively contained subjects who had English as a second language, which is known to affect Stroop test cores (Marian, et al, 2013). A causal relationship between our independent and dependant variables cannot be established. It is entirely possible that subjects who reported high levels of well-being would be more likely to make lifestyle interventions such as standing desks and plants. Alternately, it is possible that collective office culture is the determining factor in both employee wellbeing and the accessibility of those interventions. Future studies should be interventative, examining the effects of introducing plants and standing desks to places which had none previously, to control for individual differences and office culture. They should also examine a wider variety of demographics in a wider variety of industries, in offices where people work both collaboratively and independently.

Recommendations for our UBC client

Standing desks and plants seem to be a good investment. People who used standing desks and/or plants had slightly faster Stroop scores, slower resting heart rates, higher self-reported happiness, and greater social connectivity than people who did not, though the variability between groups is great enough that we cannot say those results are definite or consistent. If this is a causal relationship and those are improvements that can be accounted for by the presence of standing desks and plants, then the ripple effects of those small interventions translate to improvements in physical and mental health which reduce sick days and the amount of time spent per task while increasing a sense of community and boosting employee morale. Employees spoke enthusiastically about standing desks and the greenery in the CIRS building. While our data cannot conclusively prove that those investments translate to concrete improvements, they also give us no reason to believe that they are harmful.

Appendix

1. References

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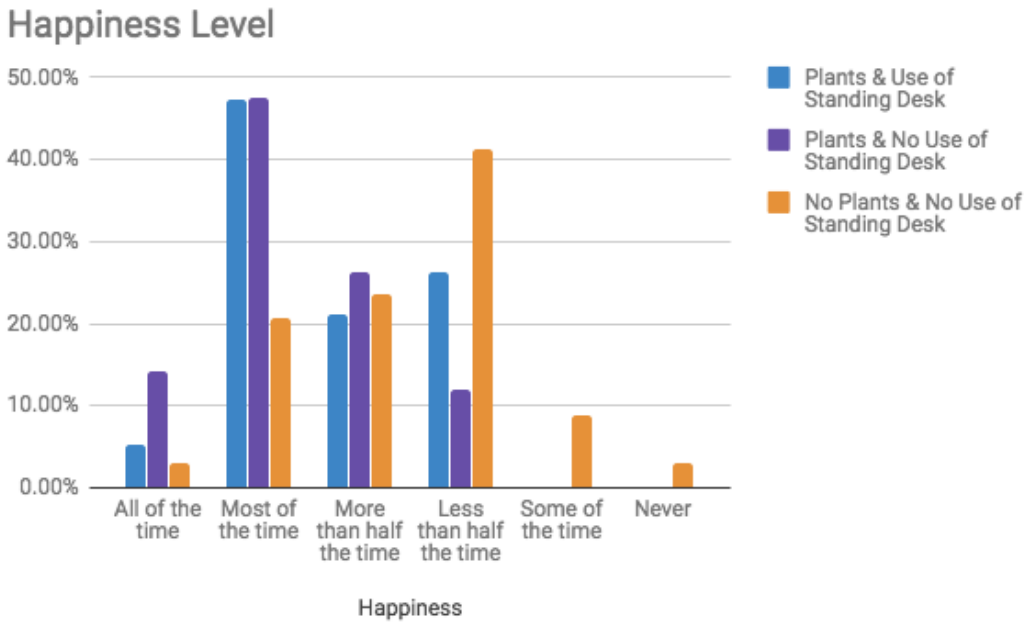
2. Results & Analysis

Happiness Level



Happiness	High Happiness Level	Medium Happiness Level	Low Happiness Level
Plants & Use of Standing Desk	52.63%	68.42%	0.00%
Plants & No Use of Standing Desk	61.91%	73.81%	0.00%
No Plants & No Use of Standing Desk	23.53%	44.12%	11.76%

*Assumptions:
High Happiness Level → All of the time & Most of the time
Medium Happiness Level → More than half the time & less than half of the time
Low Happiness Level → Some of the time & Never

One-way ANOVA

Anova: Single Factor

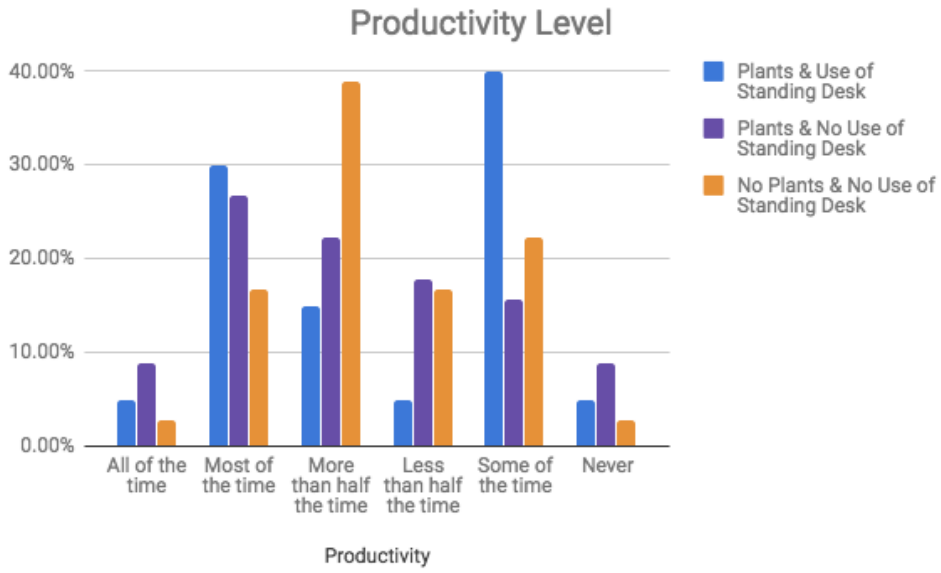
SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Plants & Use of Standing Desk	3	1.3807	0.460233333	0.040099213
Plants & No Use of Standing Desk	3	1.5017	0.500566667	0.018256973
No Plants & No Use of Standing Desk	3	0.1176	0.0392	0.00460992

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.391755047	2	0.195877523	9.332521909	0.014394881	5.14325285
Within Groups	0.125932213	6	0.020988702			
Total	0.51768726	8				

Productivity Level



Productivity	High Productivity Level	Medium Productivity Level	Low Productivity Level
Plants & Use of Standing Desk	35.00%	20.00%	45.00%
Plants & No Use of Standing Desk	35.56%	40.00%	24.45%
No Plants & No Use of Standing Desk	19.45%	55.56%	25.00%

*Assumptions:
High Productivity Level → All of the time & Most of the time
Medium Productivity Level → More than half the time & less than half of the time
Low Productivity Level → Some of the time & Never

One-way ANOVA

Anova: Single Factor

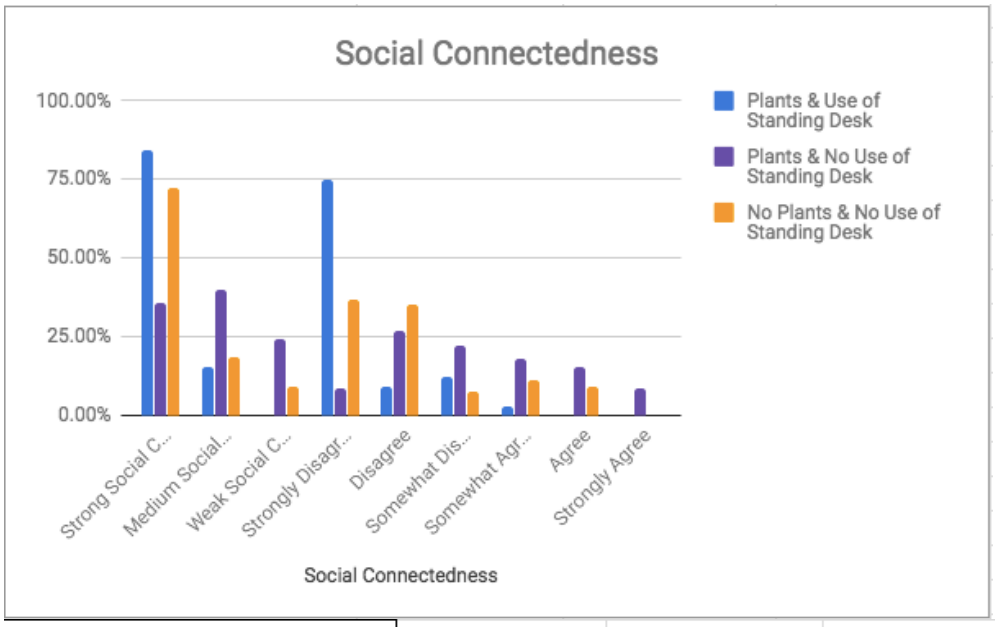
SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Plants & Use of Standing Desk	3	0.90	0.30	0.01
Plants & No Use of Standing Desk	3	1.16	0.39	0.03
No Plants & No Use of Standing Desk	3	0.94	0.31	0.01

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.01	2.00	0.01	0.35	0.72	5.14
Within Groups	0.11	6.00	0.02			
Total	0.12	8.00				

Social Connectedness Level



Social Connectedness	Strong Social Connectedness	Medium Social Connectedness	Weak Social Connectedness
Plants & Use of Standing Desk	84.38%	15.63%	0.00%
Plants & No Use of Standing Desk	35.56%	40.00%	24.45%
No Plants & No Use of Standing Desk	72.23%	18.52%	9.26%

*Assumptions:
Strong Social Connectedness Level → All of the time & Most of the time
Medium Social Connectedness Level → More than half the time & less than half of the time
Weak Social Connectedness Level → Some of the time & Never

One-way ANOVA

Anova: Single Factor

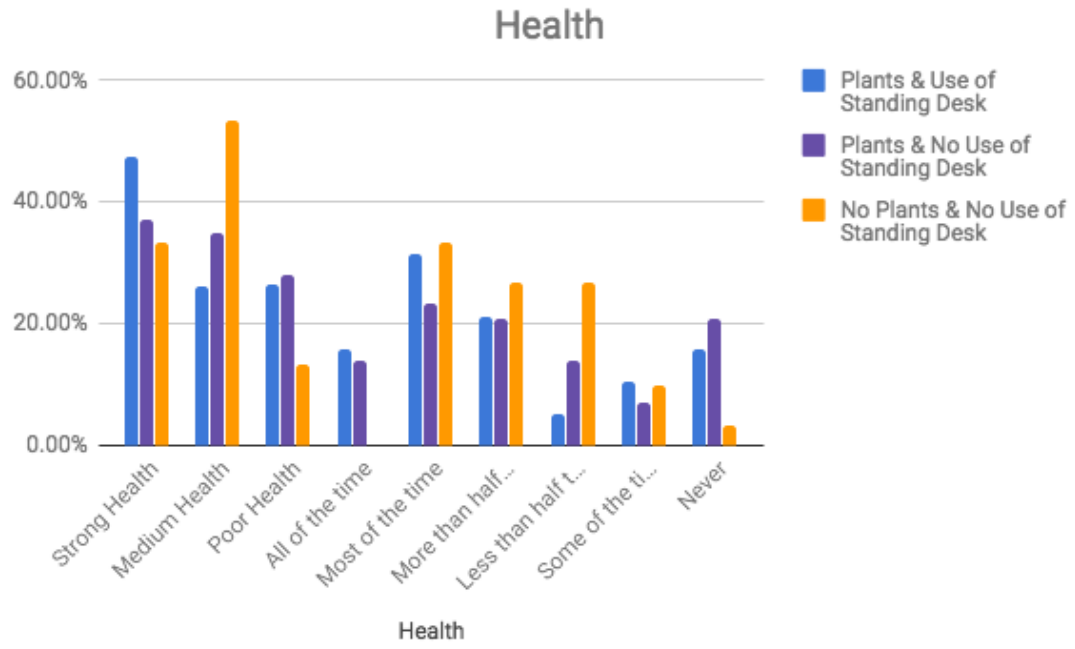
SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Plants & Use of Standing Desk	3	1.92	0.64	0.06
Plants & No Use of Standing Desk	3	0.74	0.25	0.02
No Plants & No Use of Standing Desk	3	0.34	0.11	0.02

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.45	2.00	0.23	6.95	0.03	5.14
Within Groups	0.20	6.00	0.03			
Total	0.65	8.00				

Health Level



Health	Strong Health	Medium Health	Poor Health
Plants & Use of Standing Desk	47.37%	26.31%	26.32%
Plants & No Use of Standing Desk	37.21%	34.88%	27.91%
No Plants & No Use of Standing Desk	33.33%	53.34%	13.33%

*Assumptions:
Strong Health Level → All of the time & Most of the time
Medium Health Level → More than half the time & less than half of the time
Poor Health Level → Some of the time & Never

One-way ANOVA

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Plants & Use of Standing Desk	3	1.18	0.39	0.01
Plants & No Use of Standing Desk	3	1.15	0.38	0.02
No Plants & No Use of Standing Desk	3	0.68	0.23	0.01

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.05	2.00	0.03	2.58	0.16	5.14
Within Groups	0.06	6.00	0.01			
Total	0.11	8.00				

Stroop Test Results

Stroop Test Analysis	Stroop Test Average
Plants & Use of Standing Desk	12.73 s
Plants & No Use of Standing Desk	14.77 s
No Plants & No Use of Standing Desk	13.56 s

Aerobic Health Results

Aerobic Health Analysis	Average
Plants & Use of Standing Desk	66.5
Plants & No Use of Standing Desk	64.667
No Plants & No Use of Standing Desk	73.713

3. Questionnaire

Contains elements from the WHO-5 Well-Being Index, and an adapted version of the Lee & Robbins Social Connectedness scale (1995).

Happiness
The following questions relate to your perceived happiness in the past two weeks. Please indicate on the scale below to what extent each of the following statements applies to you.

	All of the time	Most of the time	More than half the time	Less than half the time	Some of the time	Never
1. I have felt cheerful and in good spirits.	5	4	3	2	1	0
2. I have felt calm and relaxed.	5	4	3	2	1	0
3. I have felt active and vigorous.	5	4	3	2	1	0
4. I woke up feeling fresh and rested.	5	4	3	2	1	0

5. My daily life has been filled with things that interest me.	5	4	3	2	1	0

Productivity

The following questions relate to your productivity level while at work. Please indicate on the scale below to what extent each of the statements apply to you.

	All of the time	Most of the time	More than half the time	Less than half the time	Some of the time	Never
1. I am productive while I'm at work.	5	4	3	2	1	0
2. I tend to procrastinate while I'm at work.	5	4	3	2	1	0
3. I find it difficult to concentrate on tasks while I'm at work.	5	4	3	2	1	0
4. I feel as though I accomplish less than I want to while I'm at work.	5	4	3	2	1	0
5. My quality of work tends to reflect what I expect of myself.	5	4	3	2	1	0

Social Connectedness

The following questions relate to your perceived sense of social connectedness within your workplace. Please indicate on the scale below to what extent you agree with each of the following statements (6 = strongly disagree, 1 = strongly agree).

1. I feel disconnected from the world around me.	6	5	4	3	2	1

2. Even around my coworkers, I don't feel that I really belong.	6	5	4	3	2	1
3. I feel so distant from my co-workers.	6	5	4	3	2	1
4. I have no sense of togetherness with my co-workers.	6	5	4	3	2	1
5. I don't feel related to my co-workers.	6	5	4	3	2	1
6. I catch myself losing all sense of connectedness when at work.	6	5	4	3	2	1
7. I don't feel I participate with anyone or any group at work.	6	5	4	3	2	1

Health

The following questions relate to your general health and energy level while at work. Please indicate to what extent each of the following statements applies to you.

	All of the time	Most of the time	More than half the time	Less than half the time	Some of the time	Never
1. I am alert while working at my desk.	5	4	3	2	1	0
2. I experience fatigue while working at my desk.	5	4	3	2	1	0
3. My general health is excellent.	5	4	3	2	1	0
4. My energy level at work is high.	5	4	3	2	1	0
5. I have been diagnosed with a chronic medical condition that affects me while at work. (do not answer if not applicable)	5	4	3	2	1	0

Standing Desk Usage

The following questions relate to your habitual use of your sit-standing desk while working in the Centre for Interactive Research on Sustainability (CIRS) at UBC.

1. Have you used any form of a standing desk in the past two weeks?
    a. Yes
    b. No
2. How often do you use a standing desk?
    a. Daily
    b. Roughly _____ times a week
    c. Never
3. What type of standing desk do you use most often?
    a. Stand-only
    b. Sit-stand convertible
4. What percentage of the time you spend standing at your desk, as opposed to sitting?
    a. Sitting: _____%
    b. Standing: _____%

Exposure to Greenery

The following questions relate to your exposure to greenery/plants while working at your desk in the CIRS at UBC.

1. Do you have any plants/greenery on your desk?
    a. Yes; please indicate how many: _____
    b. No

2. While working at your desk, are there any plants/greenery within your immediate eyesight?
    a. Yes; please indicate how many: _____
    b. No

3. If you answered yes to any of the above questions, please list the type/size/number of the plants to the best of your knowledge (*e.g. 2 small flower pots, 1 large fern, etc.*):
    a. _____
    b. _____
    c. _____
    d. _____
    e. _____