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The Effect of Live Plants and Window Views of Green Spaces on Employee Perceptions of Job Satisfaction

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Abstract. **A job satisfaction survey was posted on the Internet and administered to office workers in Texas and the Midwest. The survey included questions regarding job satisfaction, physical work environments, the presence or absence of live interior plants and windows, environmental preferences of the office workers, and demographic information. Approximately 450 completed responses were included in the final sample. Data were analyzed to compare levels of job satisfaction of employees who worked in office spaces with live interior plants or window views of exterior green spaces and employees who worked in office environments without live plants or windows. Statistically significant differences ($P < 0.05$) were found regarding perceptions of overall life quality, overall perceptions of job satisfaction, and in the job satisfaction subcategories of "nature of work," "supervision," and "coworkers" among employees who worked in office spaces with live interior plants or window views and those employees who worked in office environments without live plants or windows. Findings indicated that individuals who worked in offices with plants and windows reported that they felt better about their job and the work they performed. This study also provided evidence that those employees who worked in offices that had plants or windows reported higher overall quality-of-life scores. Multivariate analysis of variance comparisons indicated that there were no statistically significant differences among the categories of "age," "ethnicity," "salary," "education levels," and "position" among employees who worked in offices with or without plants or window views. However, there were gender differences in comparisons of males in that male participants in offices with plants rated job satisfaction statements higher when compared with males working in offices with no plants. No differences were found in comparisons of female respondents.**

With a steady increase in urban development, communities have experienced the negative impacts of overexpansion, greater commercial land use, and decreasing areas of undisturbed parcels of land (Westphal, 2003). Moreover, a greater number of people are working and spending leisure time indoors, and research has shown that people are potentially experiencing some negative consequences as a result of decreasing amounts of time spent in natural surroundings (Kaplan, 1992). Additionally, urban lifestyles that include longer hours at the office, time constraints, and a subconscious separation from nature can have detrimental effects on communal and personal health and happiness (Kaplan, 1992; Lewis, 1994).

Observations of workplace environments have also indicated that employee satisfaction and productivity have decreased with high employee turnover rates becoming commonplace (Bowen and Radhakrishna, 1991; Wright and Cropanzano, 2000; Zadik, 1994). Studies have suggested that physical workplace environments influence psychological and physiological factors of employees, specifically job satisfaction, and that people benefit from interactions with plants and nature (Bringslimark et al., 2007; Goodrich, 1986).

The benefits of plants, trees, and naturalized areas to individuals and society have been substantiated through scientific research since the early 1980s (Ulrich, 1984; Wolverton, 1989) with positive benefits of plants in interior and exterior physical environments being recognized since the early 1970s (Ulrich et al., 1974). Plants and trees not only detoxify the environment and potentially reduce air pollution, but they also reduce noise pollution, the accumulation of dust and airborne particles, and provide visual and physical aesthetic enjoyment to people in densely populated areas (Lohr et al., 1996b; Wolverton, 1989). Because of the ability of plants in interior settings to minimize dust accumulation and reduce pollutants, plants have been known to minimize the harmful effects of sick building syndrome (Wolverton, 1989).

People also receive benefits from plants in both active and passive interactions with nature and vegetative surroundings such as increased productivity and attentiveness, reduced stress and mental fatigue, lower blood pressure, and fewer reports of illness resulting from improved well-being (Honeyman, 1992; Kaplan, 1992; Lewis, 1993; Lohr, 2000; Ulrich and Parsons, 1992). Active interactions such as gardening have been shown to provide both psychological and physiological benefits, including increased self-esteem, reduced stress levels, and improved social interaction (Cammack et al., 2002; Kaplan, 1973; Lewis, 1978; Waliczek et al., 2005).

A study was conducted to determine gardeners' and nongardeners' perception of life satisfaction (Waliczek et al., 2005), and results indicated statistically significant differences in comparisons of the overall life satisfaction scores with gardeners receiving higher mean scores indicating more positive results on the Life Satisfaction Inventory (Neugarten et al., 1961). Additionally, another study was conducted to investigate staff and patient preferences for outdoor settings at a psychiatric hospital in Ontario, Canada (Barnhart et al., 1998). Participants were asked to rank preferential settings for outdoor behaviors such as walking, relaxing, or visiting in groups and to rank images based on setting types such as ''built/enclosed'' or ''natural/open'' (Barnhart et al., 1998). ''Both staff and patients selected natural-open settings for passive behaviors such as sitting and viewing scenery, and natural-enclosed settings for active behaviors such as walking and talking to others'' (Barnhart et al., 1998).

In 1996, a study was conducted (Lohr et al., 1996) to assess the influence that interior plants have on worker productivity and stress reduction in windowless office environments. Some subjects worked on computers in rooms where plants were present, whereas other subjects worked on computers in rooms where there were no plants. Participants in the study performed stressful tasks on the computer while researchers measured their blood pressure, emotions, and reaction times. The study concluded that the presence of plants in the room helped reduced mental fatigue, increased attentiveness, lowered blood pressure, and increased productivity of participants. Additional studies have shown that the presence of live plants, windows, and views of natural surroundings can

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have a positive influence on individuals' perceptions of their environment and personal well-being (Lohr et al., 1996), and other research has noted that plants have a calming, pleasing effect on individuals (Lohr et al., 1996).

According to the United States Census Bureau (2000), many people spend an average of 52 hours per week at the office and most of that time is spent at a desk or workstation. External factors aside, long hours and increased time spent in office environments can lead to reduced job satisfaction (Spector, 1997) and increased levels of stress (Parker, 1992). A person's environment impacts their attitudes and perceptions, and studies have found that employees experience greater job satisfaction when in environments that promote well-being and comfort (Parker, 1992).

The main objective of this study was to investigate the impact of interior plants and window views of green spaces on employee perceptions of job satisfaction. Comparisons were made on measurements of employee job satisfaction of those who worked in office spaces that had live interior plants or window views of green spaces and those that did not.

Materials and Methods

Sample. The sample included office workers from throughout the United States, but predominantly from Texas and the Midwest. Offices were selected for inclusion in the study based on whether they met certain environmental criteria, including the presence or absence of interior plants and the presence or absence of windows and views of green spaces. Workplaces were also chosen based on that they had office workers who worked full-time daily in a primary office type of environment. Office managers were approached in person or through e-mail and asked to participate. Once they agreed, an e-mail was sent directly to office workers on an electronic mailing list or the survey web page link was advertised throughout the company either by an electronic mailing list or monthly newsletter.

Respondents self-selected themselves for inclusion in the study by visiting the web page and choosing to answer the survey. Over 600 respondents accessed the survey. Once logged on, respondents agreed to participate in the study and acknowledged that they understood that participation in the study was voluntary. A financial incentive of a $5.00 gift certificate to Lowe's Home Improvement stores was mailed to each participant once the completed survey was received. Survey respondents provided their names and addresses to have the gift certificate mailed to them. This record of participants ensured that each respondent only provided one survey response.

Five hundred fifty-two completed survey responses were included in the final sample. The sample was sorted into four groups, including those office workers who had "no plants/no windows with views of green spaces," those with "plants/no windows with views of green spaces," or "no plants/windows with views of green spaces" and those with "plants and windows with views of green spaces" (all further listings of window views assume an exterior green space view). The groups were then compared using analysis of variance (ANOVA) tests to ensure that the groups were similar demographically and suitable for comparison.

Because confounding differences were found among the four groups, a subsample of 449 of the original 552 respondents was drawn by sorting and matching the four groups on the variables of "work schedule," "salary," "ethnicity," and "gender" to overcome any initial differences within the groups that either had live plants or window views versus those that did not have live plants of window views. To sort and match the four groups, data were initially analyzed to report and list median values for the variables of interest. From this information, researchers could select respondents within the suitable range of values for the variables, and outlier data were removed entirely from within the sample. The subsample was then analyzed and no statistically significant differences were found between groups on any of the demographic variables with the exception of "gender" (P = 0.000), which, if equalized, would have reduced the subsample sizes to unacceptable levels. Final treatment groups included respondents from offices that had "no plants and no windows" (50.6%), "plants and no windows" (18.2%), "windows and no plants" (13%), and "plants and windows" (18.2%). The research was limited because respondents were not chosen randomly, and the sample was biased based on that respondents had to have access to a computer and an Internet connection to respond.

Instrumentation

The assessment tool used in this study was composed of 80 questions categorized into several sections that asked employees about environmental preferences, elements of job satisfaction, overall life quality, physical workplace, and demographics.

Environmental preferences. The Environmental Preference Assessment (Richmond and McCroskey, 1995) asked participants to respond to a series of questions about their workplace environment and perceptions and attitudes toward architecture and lighting. The instrument was designed to assess people's environmental preference, which was important in determining that all respondents included in the study preferred similar types of environments in which to work. Each question had a Likert scale (Likert, 1967) with a response range from 1 = "strongly disagree" to 5 = "strongly agree." The original instrument reliability was determined by the authors to be 0.85 (Richmond and McCroskey, 1995).

To score the Environmental Preference Assessment instrument, more positive answers to the statements were allocated more points. A calculation supplied by the authors of the instrument (Richmond and McCroskey, 1995) was applied to particular statement answers, which resulted in a total score for each respondent's survey. Scores for the environmental preference instrument ranged between 16 and 80. Scores greater than 58 indicated a preference for older architecture and darker atmospheres, whereas scores less than 38 indicated a preference for newer architecture and more open environments; scores between 38 and 58 indicated no preference for either type of environment.

Elements of job satisfaction and overall life quality. The Job Satisfaction Survey (Spector, 1997) asked participants to respond to a series of questions related to employee job satisfaction. Each question had a Likert scale (Likert, 1967) response range from 1 = "strongly disagree" to 5 = "strongly agree." The survey included 36 statements relating to nine subcategories, including pay, promotion, supervision, fringe benefits, contingent rewards, operating procedures, coworkers, nature of work, and communication. The instrument reliability was 0.91 (Spector, 1985).

The Job Satisfaction Survey was scored by allocating one point for the most negative answer for each statement and five points for the most positive answer to each statement. The negatively worded questions were reversed scored by substituting the most positive rating for the most negative so that all responses were rated on the same scale. Points were summed for an overall score that ranged from 36 through 180. Scores less than 108 indicated less job satisfaction and scores greater than 108 indicated more job satisfaction. Groups of four statements that related to one of the subcategories of pay, promotion, supervision, fringe benefits, contingent rewards, operating procedures, coworkers, nature of work, and communication were also summed to determine subcategory scores. A score of 20 was the highest score possible for each subcategory.

Other multiple-choice questions included in the survey asked about overall life quality such as "When all things in your life are considered, how do you feel today?" and "Overall how would you rank the quality of your life?" These questions were drawn from previous studies and the questions were known to be reliable and valid in studying life quality (Waliczek et al., 1996, 2005).

Demographic and work environment questions. The section of the questionnaire that specifically pertained to demographic information and the presence or absence of live plants within office spaces and window views of green spaces was developed and validated by the researchers and modeled after similar instruments (Waliczek et al., 1996). The demographic section of the instrument contained questions regarding gender, age, educational and occupational level, work schedule, commute time, number of coworkers, and salary range of the respondent. The work environment section included questions that contained yes/no questions on whether the respondents had

plants or a window or a window with a view of a green space.

Data were automatically downloaded into a Microsoft Excel file (Seattle, WA) and then analyzed using the Statistical Package for the Social Sciences (SPSS, 2001) Version 11.5 (Chicago, IL). A Cronbach's alpha reliability test was run on the complete instrument and resulted in a coefficient of 0.76 showing it to have an acceptable level of internal consistency (Sapp and Jensen, 1997). The data were analyzed using frequencies, descriptives, and analysis of variance tests.

Results

Environmental perception comparisons. An ANOVA test found no statistically significant differences ($P = 0.330$) in comparisons of environmental preference scores between the four treatment groups (Table 1). Overall, scores from the Environmental Assessment (Richmond and McCroskey, 1995) test indicated that all participants preferred newer architecture, which generally has more windows and is more open and airy, compared with older architecture, which generally has fewer windows and is "darker." These results helped show that all participants preferred similar types of office conditions.

Elements of job satisfaction comparisons. An ANOVA test compared the four treatment groups' scores concerning overall job satisfaction. There were statistically significant differences ($P = 0.041$) in comparisons of overall perceptions of job satisfaction scores among groups (Table 2). Descriptive statistics showed that respondents in offices with plants and windows rated their overall job satisfaction high (mean score = 115.16; SD = 22.09) as well as participants with plants but no windows (mean score = 112.52; SD = 29.59). Participants with windows but no plants rated their overall job satisfaction lower (mean score = 105.56; SD = 33.27) as well as participants without both windows and plants (mean score = 106.47; SD = 30.91). Therefore, results showed that the two groups without plants rated their job satisfaction below 108, which indicated a poor level of job satisfaction. Additionally, both groups with offices with plants rated their job satisfaction higher than 108, which indicated a suitable level of overall job satisfaction (Spector, 1985).

Overall life quality comparisons. When participants were asked "When all things in your life are considered, how do you feel today?," there was a statistically significant difference ($P = 0.000$) on ANOVA test comparisons of the four groups (Table 3). The post hoc analysis (least significant difference [LSD]) indicated that the "no plants/no windows" mean group score was the same as the "no plants/windows" mean group score but that both of these group scores were different from the "plants/windows" group score and the "plants/no windows" mean group scores. Descriptive statistics showed that 82% of the "plants/windows" group and 69% of the "plants/no windows" group stated that they felt "content" or "very happy" compared with only 60% of the "no plants/windows" group and 58% of the "no plants/no windows" group. Additionally, the "no plants/no windows" group was the only group that stated that they felt "miserable" (0.8%). These results again supported that employees with interior plants in their offices tended to consider themselves happier or more content when compared with employees without plants in their office.

When participants were asked "Overall, how would you rank your overall quality of life," ANOVA tests, again, indicated statistically significant differences ($P = 0.001$) (Table 3). The post hoc analysis (LSD) indicated that the "no plants/no windows" mean group score was different from the other three mean group scores. Descriptive statistics indicated that 80% of the "plants/windows" group stated that they were "mostly" or "very satisfied" and none were "dissatisfied." Sixty-nine percent of the "plants/no windows" group and 67% of the "no plants/windows" group stated that they were "mostly" or "very satisfied," whereas only 60.8% of the "no plants/no windows" group stated that they were "mostly" or "very satisfied." Additionally, the "no plants/no windows" group was the only group that stated they were "dissatisfied" with their quality of life (1.1%).

Perceptions of job satisfaction subcategory score comparisons. Because overall job satisfaction scores indicated differences, subcategory scores within the instrument were also analyzed. ANOVA tests indicated statistically significant differences in the subcategories of "nature of work" ($P = 0.006$), "supervision" ($P = 0.029$), and "coworkers" ($P = 0.041$). There were no statistically significant differences in the subcategories "promotion," "fringe benefits," contingent rewards," "operating conditions," or "communication" (Table 4).

There were statistically significant differences ($P = 0.006$) on the subcategory

Table 1. Analysis of variance test comparing mean scores on the Environmental Preference Assessment[z] of the four treatment groups in the study of the influence of live plants and window views of green spaces on employee perceptions of job satisfaction.

Group	Sample size (no.)	Mean score[y]	SD	df	F	*P*
No plants/no windows	263	30.13	15.51	3	1.146	0.330
No plants/windows	68	29.87	6.57			
Plants/no windows	95	28.40	6.22			
Plants/windows	95	27.77	7.87			

[z]Richmond, V.P. and J.C. McCroskey. 1995. Nonverbal behavior in interpersonal relations. Allyn and Bacon, Boston.
[y]Scores ranged from 16 to 80. Scores greater than 58 indicated a preference for older architecture, whereas scores less than 38 indicated a preference for newer architecture; scores between 38 and 58 indicated no preference.

Table 2. Analysis of variance test comparing mean scores on the Job Satisfaction Survey[z] of the four treatment groups in the study of the influence of live plants and window views of green spaces on employee perceptions of job satisfaction.

Group	Sample size (no.)	Mean score[y]	SD	df	F	*P*
Overall job satisfaction score						
No plants/no windows	264	106.47	30.91	3	2.768	0.041*
No plants/windows	68	105.56	33.27			
Plants/no windows	95	112.52	29.59			
Plants/windows	95	115.16	22.09			

[z]Spector, P.E. 1985. Measurement of human service staff satisfaction: Development of the Job Satisfaction Survey. Amer. J. Community Psych. 13:693–713.
[y]Scores ranged from 36 through 180. Scores greater than 108 indicated more job satisfaction and scores less than 108 indicated less job satisfaction.
*Statistically significant at the 0.05 level.

Table 3. Analysis of variance test comparing individual statement response means of the four treatment group scores on the statements concerning overall life quality in the study of the influence of live plants and window views of green spaces on employee perceptions of job satisfaction.

Subcategory and group	Sample Size (no.)	Mean score[z]	SD	df	F	*P*
Life quality						
When all things in your life are considered, how do you feel today?						
No plants/no windows	264	3.64	0.82	3	7.984	0.000*
No plants/windows	68	3.72	0.79			
Plants/no windows	95	3.88	0.78			
Plants/windows	95	4.08	0.72			
Overall, how would you rank the quality of your life?						
No plants/no windows	263	3.76	0.86	3	5.681	0.001*
No plants/windows	67	3.78	0.76			
Plants/no windows	92	4.03	0.73			
Plants/windows	95	4.09	0.79			

[z]Statements were rated on a 1- to 5-point scale with 5 being the most positive response and 1 being the most negative response.
*Statistically significant at the 0.05 level.

statements concerning ''nature of work'' (Table 4). The post hoc analyses (LSD) indicated that people in offices with plants and windows and people in offices with plants and no windows rated their ''nature of work'' (job duties, regular tasks) the highest (mean scores = 14.27 and 13.57; SD = 3.03 and 3.73) compared with participants without plants and windows or with windows and no plants, which had the lowest ratings (mean scores = 12.74 and 12.87; SD = 4.00 and 4.25) (Table 4).

There were statistically significant differences ($P = 0.029$) on scores from statements related to the subcategory ''supervision'' (likability, fairness, competency, interest in subordinates) (Table 4). The post hoc analyses (LSD) and descriptive statistics showed that people in offices with plants and windows and plants and no windows rated ''supervision'' statements the most positively (mean scores = 14.71 and 14.18; SD = 3.44 and 3.77). Participants without both windows and plants or those with windows but no plants also had lower ratings (mean scores = 13.53 and 12.99; SD = 4.37 and 4.52) (Table 4).

An ANOVA test was conducted and there were statistically significant differences ($P = 0.041$) in the subcategory statement mean scores for ''coworkers'' (likability, competency, communication, teamwork) (Table 4). Descriptive statistics indicated that people in offices with plants and windows or those with plants but no windows rated ''coworkers'' statements the most positively (mean scores = 14.17 and 14.37; SD = 3.01 and 5.26). Participants with windows but no plants and those without plants or windows rated ''coworkers'' statements lower (mean scores = 13.00 and 13.22; SD = 4.45 and 4.11) (Table 4).

Demographic comparisons. Multivariate analysis of variance tests were conducted to determine if differences in mean job satisfaction scores existed between demographic groups within the four office environments. No statistically significant differences were found in comparisons of age, ethnic backgrounds, salary groups, education levels, and employment positions. Therefore, within these demographic comparisons, all groups had similar job satisfaction scores. Thus, plants and windows in office spaces did not appear to affect any particular group differently from another. However, differences were found in gender comparisons (Table 5).

Gender comparisons. Gender comparisons were made because past research has looked into the connection among work environments, job satisfaction, and gender (Miller, 1980). Because the subcategory samples were unequal in the numbers of males and females, gender comparisons were made within each of the subcategories and included all males versus all females. There were statistically significant differences ($P = 0.028$) in ANOVA comparisons on scores of overall job satisfaction (Table 5) among males. The post hoc analyses (LSD) showed that male participants in offices with plants but no windows, and males in offices with plants and windows rated job satisfaction statements the highest (mean scores = 120.98 and 118.25; SD = 13.16 and

Table 4. Analysis of variance test comparing mean subcategory scores on the Job Satisfaction Inventory[z] of the four treatment groups in the study of the influence of live plants and window views of green spaces on employee perceptions of job satisfaction.

Subcategory and group	Sample size (no.)	Mean score[y]	SD	df	F	*P*
Pay						
No plants/no windows	264	9.36	3.53	3	2.577	0.053
No plants/windows	68	9.18	3.64			
Plants/no windows	95	9.81	3.53			
Plants/windows	95	10.43	3.58			
Promotion						
No plants/no windows	264	10.81	3.68	3	2.439	0.064
No plants/windows	68	11.25	3.74			
Plants/no windows	95	11.45	3.46			
Plants/windows	95	11.91	3.26			
Supervision						
No plants/no windows	264	13.53	4.37	3	3.031	0.029*
No plants/windows	68	12.99	4.52			
Plants/no windows	95	14.18	3.77			
Plants/windows	95	14.71	3.44			
Fringe benefits						
No plants/no windows	264	11.38	3.76	3	1.699	0.166
No plants/windows	68	10.76	3.87			
Plants/no windows	95	11.95	3.68			
Plants/windows	95	11.81	3.20			
Contingent rewards						
No plants/no windows	264	11.49	4.29	3	1.365	0.253
No plants/windows	68	11.65	4.35			
Plants/no windows	95	11.92	3.79			
Plants/windows	95	12.44	3.27			
Operating conditions						
No plants/no windows	264	12.20	3.63	3	0.981	0.401
No plants/windows	68	12.01	4.16			
Plants/no windows	95	12.81	3.67			
Plants/windows	95	12.57	3.078			
Coworkers						
No plants/no windows	264	13.22	4.11	3	2.78	0.041*
No plants/windows	68	13.00	4.45			
Plants/no windows	95	14.37	5.26			
Plants/windows	95	14.17	3.01			
Nature of work						
No plants/no windows	264	12.74	4.00	3	4.236	0.006*
No plants/windows	68	12.87	4.25			
Plants/no windows	95	13.57	3.73			
Plants/windows	95	14.27	3.03			
Communication						
No plants/no windows	264	11.74	4.73	3	1.672	0.172
No plants/windows	68	11.85	5.09			
Plants/no windows	95	12.46	4.41			
Plants/windows	95	12.85	3.84			

[z]Spector, P.E. 1985. Measurement of human service staff satisfaction: Development of the Job Satisfaction Survey. Amer. J. Community Psych. 13:693–713.
[y]Scores range from 1 to 20 with 4 being the lowest possible score and 20 being the highest possible score for each subcategory.
*Statistically significant at the 0.05 level.

Table 5. Analysis of variance test comparing mean job satisfaction scores of males and females on the Job Satisfaction Inventory[z] of the four treatment groups in the study of the influence of live plants and window views of green spaces on employee perceptions of job satisfaction.

Subcategory and group	Sample size (no.)	Mean score[y]	SD	df	F	*P*
Overall job satisfaction score						
Males						
No plants/no windows	117	114.98	15.10	3	3.077	0.028*
No plants/windows	26	112.12	15.97			
Plants/no windows	56	120.98	13.20			
Plants/windows	61	118.25	15.72			
Females						
No plants/no windows	105	112.60	19.37	3	0.623	0.601
No plants/windows	26	116.62	13.71			
Plants/no windows	19	114.95	20.35			
Plants/windows	25	116.88	13.52			

[z]Spector, P.E. 1985. Measurement of human service staff satisfaction: Development of the Job Satisfaction Survey. Amer. J. Community Psych. 13:693–713.
[y]Statements were rated on a 1- to 5-point scale with 5 being the most positive response and 1 being the most negative response.
*Statistically significant at the 0.05 level.

15.72). Male participants with windows but no plants and those without both windows and plants rated job satisfaction statements the lowest (mean scores = 112.12 and 114.98; SD = 15.97 and 15.10).

Descriptive statistics among female responses of overall job satisfaction indicated that there were no differences among female participants and that none of the groups seemed to benefit more than others in the terms of job satisfaction (Table 5). These findings did not support past studies that found no differences in sources of job satisfaction between males and females (Mason, 1995; Miller, 1980).

Conclusions

New trends in building design have included "the use of fresh air, daylight, plants, and window views and other design aspects to enhance employee perceptions about their job and to improve worker productivity" (Kozlowski, 2004). Previous research has found that "good working conditions" included such things as open and airy building design and architecture, bright colors and artwork, and plants and windows and that this variable ranked number five of 10 motivating factors for employees (Lindner, 1998). In general, findings from this study supported these past studies and indicated that individuals who worked in offices with plants and windows reported that they felt better about their job and the work they performed. This study also provided evidence that employees who worked in offices that had plants or windows reported higher overall quality-of-life scores. Other research has shown that knowing what factors contribute to employee job satisfaction can help prevent frustration, low morale, and decreased productivity (Beder, 1990; Grossnickle and Thiel, 1988). However, there were limitations to the study, and it should be replicated on a nationwide scale with a randomly selected sample.

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