Original research article

Reflections on a retrofit: Organizational commitment, perceived productivity and controllability in a building lighting project in the United States

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A B S T R A C T

The luminous environment affects how office workers perceive their work setting. However, research on how the lighting commissioning process associates with psychosocial variables relevant to office settings is lacking. This case study explored the extent to which employees working on a recently retrofitted floor of an administrative office building believed they could control the new lighting system. It also measured their levels of perceived productivity and affective organizational commitment to examine correlations between these variables and levels of satisfaction with the lighting commissioning process. Satisfaction with the commissioning process did not significantly correlate with perceived productivity, controllability, affective organizational commitment, or the average number of productive work hours reported after the retrofit. However, perceived productivity significantly and positively associated with perceived controllability and affective organizational commitment. Also, controllability and affective organizational commitment both significantly correlated with the number of productive work hours perceived. Results support interdisciplinary studies emphasizing the importance of lighting controllability in improving employees' perceived performance and satisfaction at work. Results also offer practical suggestions concerning the commissioning process used in the case study.

1. Introduction

Research in the fields of environmental and industrial/organizational psychology, environmental engineering, interior design, and business has explored associations between building occupants' preferences for, and perceptions of, environmental attributes at work and a number of psychosocial outcomes at various stages of the design cycle (e.g., [1–6]). While engineers and designers are becoming intent on creating high-performance buildings that offer occupants a sense of comfort and satisfaction [7,8], researchers and practitioners are understanding that the luminous environment significantly affects how employees perceive their work setting and their attitudes and behaviors within it.

While field research on how the lighting commissioning process associates with psychosocial variables is lacking (e.g., [2]), engineers and facility managers do commonly gather data from office workers about how the indoor environment affects their energy consumption, comfort, productivity, and efficiency [9–11,7,12,13]. Environmental

psychologists are also interested in researching the ways in which building users perceive and utilize alterations in lighting environments. For example, the effects of different lighting designs on office workers' performance, wellbeing, and health have been investigated, and changes have been found with respect to peoples' performance associated with task visibility, practice, and fatigue (e.g., [2]). Bordass and Leaman [14] found that stable thermal conditions, usability of ventilation and lighting controls, operable windows, and views out of the building helped office workers feel satisfied and comfortable. Another study conducted after a lighting retrofit was done in a post office setting, as well as in a large manufacturing building, found that workers perceived themselves to be more productive after design changes [15]. Thus, an interdisciplinary approach to researching the effects of luminous environments on office workers, and how the lighting commissioning process plays a role in this relationship, is timely and prudent.

Indeed, after the construction or retrofit stage, the commissioning stage is arguably the most important in ensuring a buildings' proper function. Commissioning is often when a building's controls can be

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optimized, and when lingering or new issues can be identified and addressed [8]. The more effective the commissioning process is (or appears to be from an occupant's perspective), the better the outcomes will be with respect to building performance, as well as occupant wellbeing. Recent studies suggesting that daylighting, electric lighting, and glare are significant factors of occupant satisfaction with work settings (e.g., [16,7,17,18]) bolster the need to measure different psychosocial constructs experienced by office workers.

Although sector-specific studies on barriers to energy innovation, as well as integrated studies of influences on businesses' energy behaviors at the individual, organizational, and institutional levels, are underrepresented in the body of literature [19], we know that occupant behavior can impact a retrofit program's success [20] and that large organizations appear to be are responsible for a significant amount of greenhouse gas emissions—and this trend is on the rise [21]. Andrews and Johnson [19] state that both quantitative and qualitative methodologies should be utilized to address gaps in research, and that "several of the most informative [studies] to date include detailed case studies of particular organizations" (pg. 205). The present case study approaches some of these gaps with a mixed-methodology approach as it takes advantage of an opportunity to augment interdisciplinary knowledge about LED projects in the commercial building sector by investigating a number of variables concerning user experience during a lighting retrofit and commissioning process.

Others have investigated similar variables with respect to changes in lighting design. One case study formalized usability metrics in a post-occupancy evaluation (POE) of several buildings retrofitted with newer lighting technologies and advanced HVAC control strategies [22]. However, while this POE evaluated the effectiveness and efficiency of advanced energy retrofits, along with user satisfaction and related objectives, it did not formally consider occupant reactions to the commissioning process, or ask occupants about their perceived productivity or levels of commitment toward the organization for which they worked. Moreover, studies that address various user preferences for LED lighting (e.g., [23]; Perino et al., 2005; [24]), advantages and drivers of LED projects in the commercial building market (e.g., [25,26]), as well as barriers to successfully implementing LED projects (e.g., [27,28]), do not often combine all of the variables accounted for in the present case study.

Despite a growing body of literature, more work is needed to understand the complex determinants of human satisfaction and comfort in indoor spaces. The present case study tests whether three psychosocial variables meaningfully associate with each other, and with office workers' impressions of a recently completed lighting commissioning process, so that designers, engineers, and researchers alike can better understand how to incorporate occupant perceptions of a lighting retrofit into change management models. Given existing research findings, perceived productivity, perceived environmental controllability, and affective (emotional) organizational commitment ought to play more important roles in design and decision-making processes for architects, managers, developers, and other stakeholders interested in maintaining a luminous environment that employees feel is contributing to their success at work— this case study aims to explore this argument.

1.1. Perceptions of organizational commitment

Studies addressing the luminous environment in office settings can offer reliable data about employees' feelings, behaviors, and performance concerning the workplace, or organization in general [2]. In the context of physical changes made to a work environment, particularly after a lighting retrofit, investigating the psychological construct of organizational commitment may afford a better understanding about the relations between people and their place of work – especially because satisfaction with the physical environment often predicts job satisfaction and organizational commitment [29,30,4,31].

Organizational commitment is understood in organizational/industrial psychology literature as an attitude based on the degree of identification with, or attachment to, the organization for which one works [32–34] and often correlates strongly with job satisfaction [35,80,30]. Organizational commitment correlates reliably with employee motivation and satisfaction at work (e.g., [83–85]) when conceptualized as three key experiences: (1) acceptance of the values and goals of an organization, (2) willingness to exert effort for an organization, and (3) having a strong desire to remain affiliated with an organization [36].

To further delineate organizational commitment in workplace settings, Allen and Meyer [37] developed a three-component model composed of affective, continuance, and normative commitment, respectively. Briefly, they define affective organizational commitment as one's personal, emotive characteristics and experiences at work. Work experiences provide the strongest contribution to an individual's development of affective organizational commitment because they often fulfill a psychological need for comfort and competence in a professional social role [37]. Whereas, continuance organizational commitment is based on the magnitude and number of investments an employee has in his or her organization, together with a perceived lack of alternatives [38–40]. Finally, normative organizational commitment develops through experiences prior to, and following, entry into an organization [82]. Allen and Meyer [32] provide an example in which an individual with strong normative organizational commitment has a family member employed by the same organization that emphasizes the importance of organizational loyalty.

The three dimensions of organizational commitment appear to be experienced somewhat differently by employees (and an individual may experience each dimension to varying degrees; [32]. Essentially, employees with strong affective organizational commitment remain working for an organization because they *want* to, whereas those with strong continuance organizational commitment remain because they feel they *need* to, and employees with strong normative organizational commitment stay because they feel they *ought* to [32].

Relevant to understanding the extent to which employees feel organizational commitment in an office setting, especially after a design change, is the link between strong self-reporting of organizational commitment and organizational citizenship behaviors (OCBs; [41,42]). OCBs are characterized as discretionary actions that promote effective functioning of the organization but are not directly recognized by a formal award system [41]. Significant links have been revealed between employees' organizational commitment, their level of effort, and their performance at work (e.g., [43]) whereby the higher an individual's organizational commitment, the greater the effort the individual is willing to invest on behalf of the organization, and the better their performance. OCBs seem to become more likely as organizational commitment increases because employees identify with the organization's values and goals. This identification can manifest as a willingness to exert effort for the organization (or a certain floor, unit, or team within it) because of a feeling of investment and affiliation.

Because organizational commitment appears to predict more instances of organizational citizenship behavior in the workplace [41], measuring it in the present case study may provide insight for future research concerning pro-social attitudes and behaviors in settings where recent changes to the lighting design have been made – changes that are known to significantly affect employee satisfaction. For example, employees that are highly organizationally committed are better able to cope with stress [44], and those who feel organizationally committed at work are less likely to search for alternative positions [45]. Thus, if organizational commitment is strong among office workers surveyed after a lighting retrofit has occurred, and if levels of organizational commitment correlate with perceptions of productivity, and controllability of the new lighting scheme, it may be argued that the lighting commissioning process has been a success.

A reliable and standardized organizational commitment scale (the OCS) has been developed by Allen and Meyer [32] and used in studies