

Providing exterior views for building occupants can improve moods, attitudes, and energy levels of office workers, which may indirectly impact employee effectiveness. Views of nature, in particular, are important contributors to the occupancy quality of employees, which is an important design principle. Haworth has developed a simple way to measure the quality of exterior view from within office environments. This paper reports the results from a case study that assessed the process for measuring percent optional exterior view (POEV). Digital photographs were taken from the participants' workstations and the percentage exterior view was calculated. A light meter also measured objective light levels (i.e., ambient, task, and daylight). Participants completed a survey, rating attributes of occupancy quality, job productivity, and job satisfaction. Findings revealed that POEV predicted subjective quality of exterior view and daylight better than objective measures obtained with a light meter. POEV is an easy, useful, and effective measure for exterior view in pragmatic situations such as the field research reported here. However, it may not influence perceived job satisfaction, group morale, job quality, or organizational quality.

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## An Easy, Effective, and Useful Measure of Exterior View

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## AN EASY, EFFECTIVE AND USEFUL MEASURE OF EXTERIOR VIEW: TOWARD A USER-CENTERED PERSPECTIVE FOR ASSESSING OCCUPANCY QUALITY

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An objective measure for external view—percent optional exterior view—was developed in a field study of two quite different office environments within the corporate headquarters of a large, manufacturing firm in the Midwest. As predicted, this measure correlated more highly with two subjective measures of environmental quality than objective, ambient light levels (ambient, task & daylight combined—measured photometrically in lux) or objective daylight levels; also as expected, neither percent exterior view nor daylight levels predicted job performance/productivity. Contrary to predictions, this measure did not correlate with subjective measures of job satisfaction, morale, job quality, or organizational quality.

### INTRODUCTION

Investigators have reported that exterior views through windows provide benefits to building occupants; even windows affording only an interior view have been shown to be positive (Hedge, 2000; Hildebrand, 1999; Leather, Pyrgas, Beale & Lawrence, 1998; Appleton, 1996; Mahnke, 1996; Biner, Butler & Winsted, 1991). Nonetheless, some confusion remains regarding the precise source of these benefits; e. g., whether direct sunlight, natural light (reflected sunlight), full-spectrum lighting, control over lighting/views (cf. Lee & Brand, 2005), exterior views, exterior views that include natural elements, exterior views that include a horizon line (cf. De Croon, Sluiter, Kuijer & Frings-Dresen, 2005). At least one investigator has claimed that exterior views of just the sky or weather do not provide any benefits to human occupants (Kaplan, 2001).

Although the physiological effects of the intensity, spectral and temporal aspects of natural light have been investigated (Guzowski, 2000), less is known about what aspects of natural light and exterior views benefit human occupants of buildings, and why. In an effort to spur further research in this area, a case study was conducted in the corporate office headquarters of a large, Midwestern manufacturing firm to demonstrate an easy, effective, useful, objective measure for exterior view. This measure could be included in any research project evaluating the occupancy quality of building interiors.

The measure was based on digital photographs (with the camera held at the occupant's seated eye-height) of the optional view (at least would be available by turning one's head) toward the window-wall from each office or workstation on areas of two floors (2<sup>nd</sup>-West & 3<sup>rd</sup> West) having identical floorplates (dimensions, glazing, building shell). However, the two floors differed in their interior architecture in a number of ways, including ceiling height, enclosure, layouts, privacy, ambient & task lighting, color scheme, group/team spaces, workstation size, occupant density, storage space and work surface space.

It was expected that percent exterior view would predict subjective quality of exterior view and subjective daylight quality—improving on objective total luminance levels and

even daylight-only luminance levels. Similarly, it was expected that percent exterior view would predict measures of workstation quality and perhaps even some measures of organizational quality and job quality—but not job performance/productivity.

### METHOD

*Subjects.* Fifty-two female and 43 male volunteers participated—of these, 46 were on the second floor, 49 on the third floor; 48 on the window-half, 47 on the wall-half of their floor. Participants' ages ranged from 26 to 56 with a median age of 41. Thirty participants reported they were clerical/administrative, 44 technical staff, and 21 supervisor/manager employees. The 2<sup>nd</sup>-West group included customer service, logistics and distribution areas. 3<sup>rd</sup>-West group employees held information technology and financial service jobs. On average, these participants spent 7.02 hours daily in and 1.65 hours away from their workstations; they had been in their present job an average of 5.56 years.

*Office environments compared.* The two environments chosen to develop this pragmatic measure of exterior view were identical in terms of their exterior building shells (e. g., dimensions, proportion/amount and type of glazing). They constituted the 2<sup>nd</sup>-West and 3<sup>rd</sup>-West floor areas of the corporate headquarters of a large, Midwest manufacturing firm. These areas were both open-office plans, but they differed in their interior design in a number of ways. The 2<sup>nd</sup>-West group sat in low-panel workstations (42-54 inches; with glazing above 42 inches), while the 3<sup>rd</sup>-West group sat in high-panel workstations (64-72 inches). Ceiling heights for 2<sup>nd</sup>-West and 3<sup>rd</sup>-West were 12'6" and 9', respectively.

*Materials & Procedure.* A Kodak Easy-share One digital camera was used to develop the objective measure of optional exterior view; photographs were taken from each workstation toward the window wall (as described above). Based on the arbitrary frame of these pictures, the percentage exterior view was calculated directly as the proportion of visible window in each photograph multiplied by 100. None of these exterior views included a horizon line, although some of them did include foliage (partial tree canopies).

A LSI light meter with a LSI System Control Module sampled objective light levels (in lux) approximately once every three seconds over two, 10-minute sampling periods; once with ambient, task & daylight combined, and once with only daylight present.

Additionally, a 227-item occupancy quality perceptual response survey/questionnaire was administered to all participants during the first of these 10-minute periods at another office location—although the average completion time was approximately 20 minutes. The survey asked respondents to rate: (1) attributes related to six major indicators of occupancy quality (overall employment, work environment, job, organization, compensation, and work station quality); (2) perceived levels of job productivity; and (3) the relative importance of different occupancy quality attributes for job satisfaction.

MANOVA/ANOVA, Pearson product-moment correlation coefficients and exploratory factor analysis using oblique rotation were used to analyze the data relevant for evaluating the objective exterior-view measure developed and described above.

## RESULTS

To confirm objective differences between the two office environments, a two-factor MANOVA of *group/floor* (2<sup>nd</sup>-West vs. 3<sup>rd</sup>-West) crossed with *location* (“window-half” vs. “wall-half”) using objective illumination levels (total luminance = ambient, task & daylight combined; as well as daylight only) and percent optional exterior view as dependent variables was conducted.

For *group/floor*:  $F(1,89) = 10.49$ ,  $p < .01$ , total luminance;  $F(1,89) = 8.73$ ,  $p < .01$ , daylight only;  $F(1,89) = 17.46$ ,  $p < .001$ , percent exterior view;

For *location/half*:  $F(1,89) = 0.56$ , n.s., total luminance;  $F(1,89) = 19.37$ ,  $p < .001$ , daylight only;  $F(1,89) = 38.79$ ,  $p < .001$ , percent exterior view;

For *group/floor X location/half*:  $F(1,89) = 0.001$ , n.s., total luminance;  $F(1,89) = 6.76$ ,  $p < .05$ , daylight only;  $F(1,89) = 9.35$ ,  $p < .01$ , percent exterior view (see Figures 1-3).

These results confirm differences in each of the objective measures of the physical environment as a function of the *group/floor* comparison based on interior design differences and the *location/half* comparison based on proximity to the window-wall.

The same two-factor MANOVA using the subjective measures of daylight quality and quality of exterior view as dependent variables yielded main effects for both *group/floor*:  $F(1,90) = 18.97$ ,  $p < .001$ , daylight quality;  $F(1,90) = 20.62$ , exterior view quality; and *location/half*:  $F(1,90) = 16.46$ ,  $p < .001$ , daylight quality;  $F(1,90) = 25.93$ ,  $p < .001$ , exterior view quality (see Figures 4,5).

However, when the objective measure of percent optional exterior view developed here was used as a co-variate, these results changed to the following for *group/floor*:  $F(1,90) = 7.30$ ,  $p < .01$ , daylight quality;  $F(1,90) = 9.42$ ,  $p < .01$ , exterior

view quality; and *location/half*:  $F(1,90) = 1.52$ , n.s., daylight quality;  $F(1,90) = 3.52$ ,  $p = .06$ , exterior view quality (see Figures 6,7).

Using the objective measure of daylight only as a covariate yielded the following results for *group/floor*:  $F(1,89) = 12.03$ ,  $p < .001$ , daylight quality;  $F(1,89) = 17.22$ ,  $p < .001$ , exterior view quality; and *location/half*:  $F(1,89) = 5.78$ ,  $p < .05$ , daylight quality;  $F(1,89) = 13.54$ ,  $p < .001$ , exterior view quality (see Figures 8,9).

Together, the results illustrated in Figures 4-7 suggest that the objective measure of percent optional exterior view accounts for some of the variance attributable to the 2<sup>nd</sup>-West and 3<sup>rd</sup>-West *floor/group* comparison, and perhaps for the majority of the variance attributable to the “window-side, wall-side” *location/half* comparison.

Integrating these conclusions with the additional results illustrated in Figures 8 & 9, one could even argue that the importance of sitting close to a window relates to the percent exterior view thus made available—certainly rather than to overall, objective luminance levels—perhaps rather than even objective daylight levels. This conclusion is based on the fact that percent exterior view accounts for more variance in subjective daylight quality and subjective exterior view quality as a covariate than do objective, daylight-only luminance levels.

Correlations between daylight-only luminance levels and daylight quality ( $r = .50$ ,  $p < .01$ ) & exterior view quality ( $r = .50$ ,  $p < .01$ ) compared to those same correlations with percent exterior view ( $r = .64$ ,  $p < .001$  &  $r = .71$ ,  $p < .001$ , respectively) supports this general conclusion—even given the fact that daylight-only luminance levels and percent exterior view are themselves correlated ( $r = .65$ ,  $p < .001$ )—as would be expected.

Neither percent exterior view nor daylight-only luminance levels related to subjective workstation quality, or to any of a number of different subjective estimates of organizational quality, job quality or job performance/productivity.

## DISCUSSION

In line with expectations, the objective, quantitative measure developed and described above for evaluating exterior view—percent optional exterior view—predicted subjective quality of exterior view and subjective quality of daylight better than total, objective luminance; in this regard, it also improved on objective, daylight-only luminance. However, percent exterior view was related to glare problems, although objective, daylight-only luminance was not. Contrary to predictions, neither percent exterior view nor daylight-only luminance was related to organizational quality, workstation quality or job quality, but as expected, these objective measures did not predict job performance/productivity.

It is suggested that the objective measure, percent optional exterior view as defined above, can function as an easy, useful and effective measure for exterior view within

pragmatic situations such as the field research reported here. As might be anticipated, more research is needed to validate these observations.

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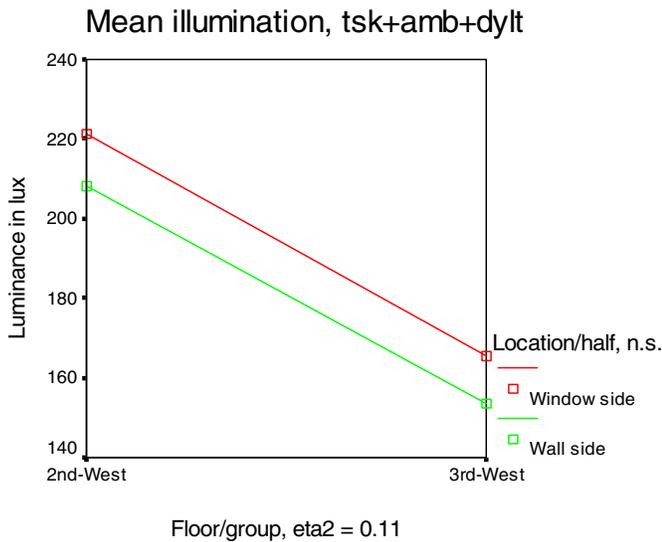


Figure 1: Objective, total luminance as a function of floor/group and location/half, with effect sizes.

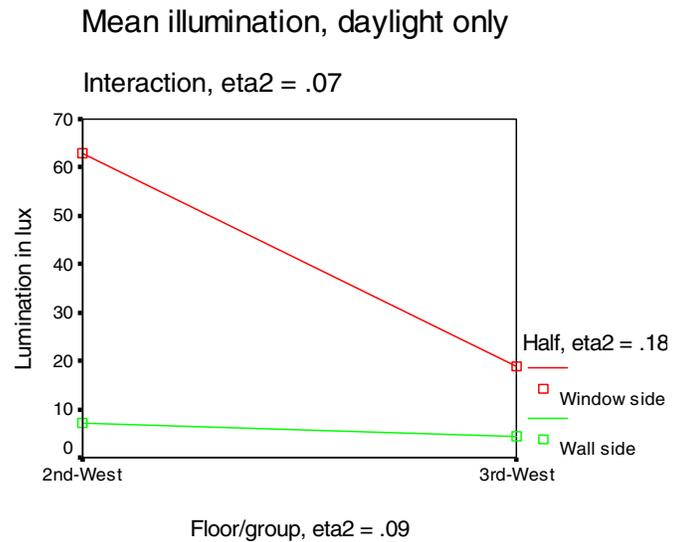


Figure 2: Daylight-only luminance as a function of floor/group and location/half, with effect sizes.

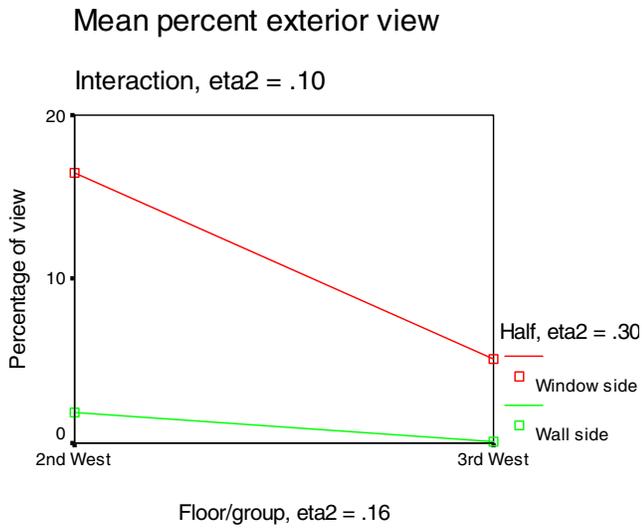


Figure 3: Mean percent optional exterior view as a function of floor/group and location/half, with effect sizes.

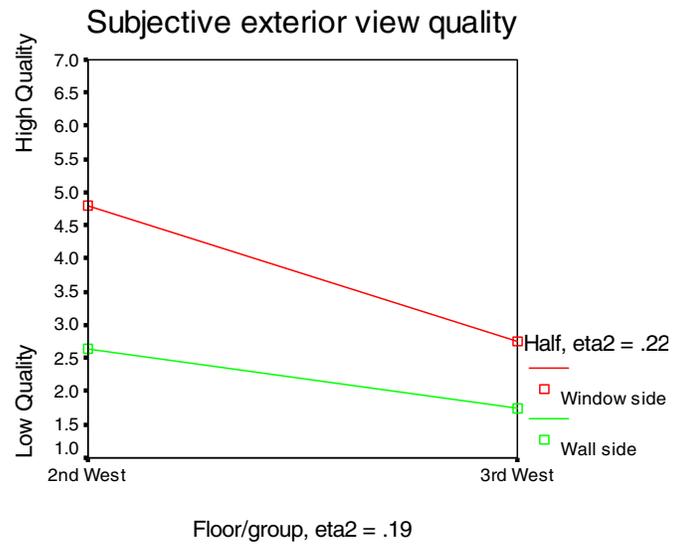


Figure 5: Mean subjective quality of exterior view as a function of floor/group and location/half, with effect sizes.

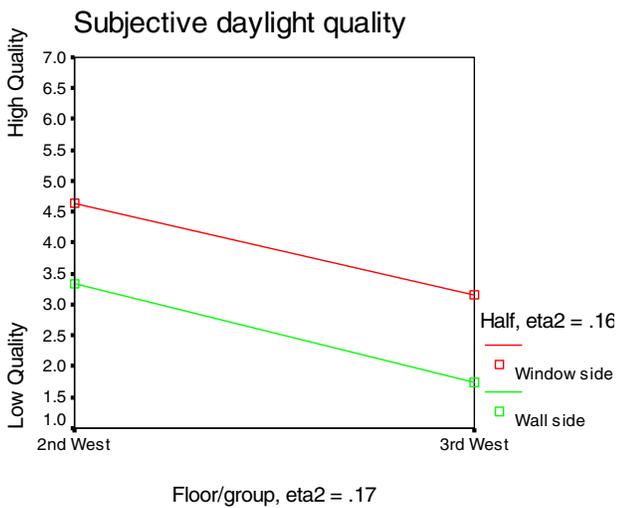


Figure 4: Mean subjective quality of daylight as a function of floor/group and location/half, with effect sizes.

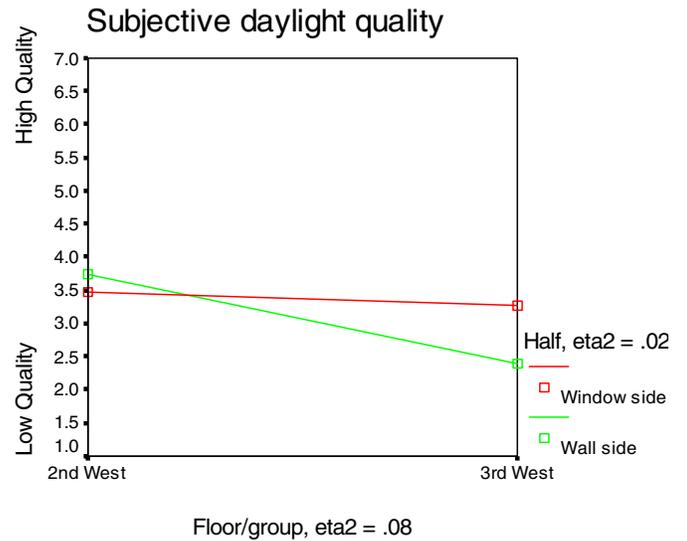


Figure 6: Mean subjective quality of daylight as a function of floor/group and location/half with percent optional exterior view as a covariate, with effect sizes.

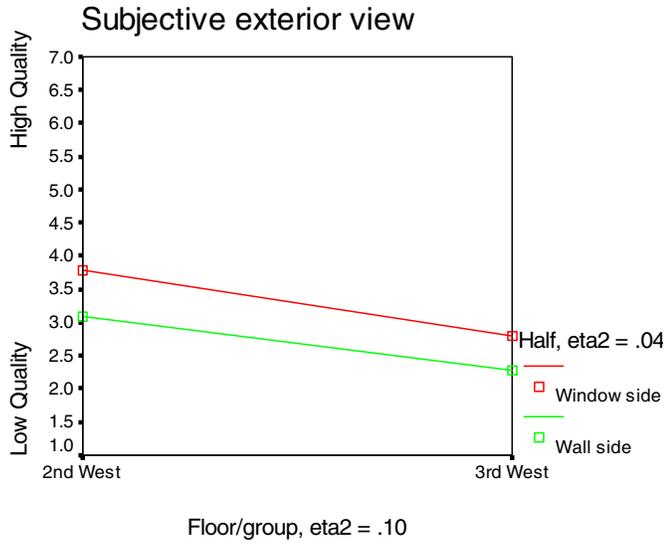


Figure 7: Mean subjective quality of exterior view as a function of floor/group and location/half with percent optional exterior view as a covariate, with effect sizes.

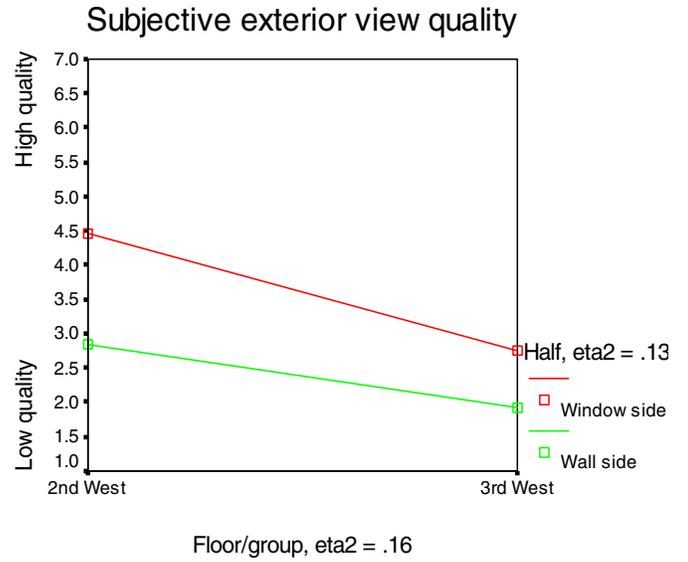


Figure 9: Mean subjective quality of exterior view as a function of floor/group and location/half, with effect sizes.

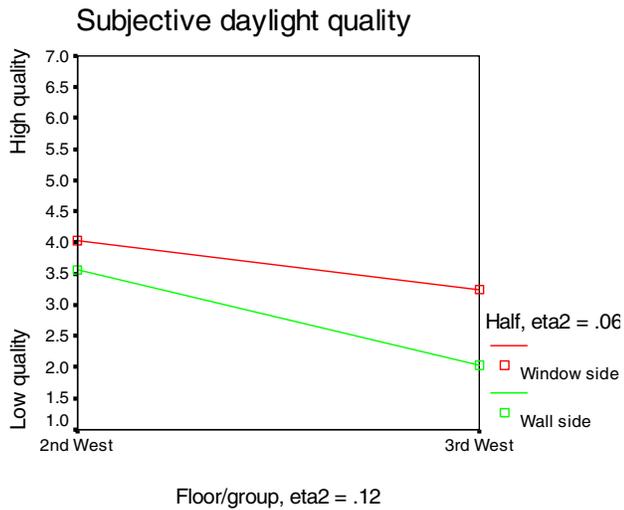


Figure 8: Mean subjective quality of daylight as a function of floor/group and location/half, with effect sizes.