

Benefits of Adjustable LED Task Lighting

Background

Ergonomics was defined by the late ergonomist, Stephen Pheasant, as the science of matching jobs to workers and products to users. In an office environment, this typically means matching chairs, keyboards, monitors, and input devices to employees. This task alone can require considerable human and financial resources. Consequently, attention to areas such as lighting, are typically an afterthought.

The US Census Bureau reports that workers over age 65 are increasing and will consist of 20% of the work force within 8 years. Yet the visual performance of a 60-year old is eight times worse than that of a 20-year old. Thus it is essential to address lighting as part of the total ergonomics “package”. Additionally, this change is needed to help facility planners realize that lighting is an important part of the “Triple Bottom Line”¹ (social, environmental, and economic aspects in balance) and should be considered an integral part of Indoor Environmental Quality (IEQ)².

At Duke University, an ergonomics program was created nearly 20 years ago to identify and address ergonomic hazards in the workplace. They also recommend ways of minimizing these hazards, enabling Duke employees to stay healthy, productive, and free of discomfort. They began seeing increased requests for lighting-related evaluations and also realized the apparent impact on the musculoskeletal system since the “body follows the eyes”. When the eyes move due to poor lighting situations, the result is the body is placed in very awkward and uncomfortable postures (figure 1).



Figure 1

¹ *Strategy and Alignment for Sustainable Facility Management* (IFMA Sustainability Facility Professional, Course 1), 6

² *Operating Sustainable Facilities* (IFMA Sustainability Facility Professional, Course 3), 155

This interest in the relationship between lighting and posture led to a study that was conducted among a group of Duke employees. Duke ergonomists worked with a lighting vendor and suggested there was a need to quantify the benefits of adjustable LED task lights due to their high cost. After an overview of previous lighting studies, it was found that there had never been an intervention/control field study on this subject. With assistance from a researcher at North Carolina State University, a clinical trial was designed. The aim of the study was to assess the ergonomic and/or calculated utility power consumption benefits of adjustable LED task lighting.

Study Details and Logistics

For the study to be effective, at least 100 subjects in interior (not adjacent to windows) computer, cubicle environment were needed (figure 2). The project required approval by Duke's Institutional Review Board and participants were required to sign an informed consent form. The site selected for this research was several floors of a building that houses employees of Duke Clinical Research Institute (DCRI). DCRI is the world's largest academic clinical research organization. They are known for their ability to combine the clinical expertise and academic leadership of a premier teaching hospital with the full-service operational capabilities of a major contract research organization. DCRI is a proponent of evidence-based medicine; participation in this trial would offer them a chance to participate in a study to help promote evidence-based design. Duke ergonomists engaged the support of the DCRI Facility Management group to assist in the logistics of installation and for access to employees.



Figure 2

Once 100 participants were recruited and informed consent was received, the first phase of the study was to assess and collect baseline and demographic data. A web-based survey was emailed to participants to obtain this information. Additionally, participants were randomly assigned to “intervention” and “control” groups with some balancing done to ensure a good distribution by age. The

intervention group was provided with adjustable LED task lights, all existing task lights were disabled or removed, and their ambient lighting levels were modified if needed so that all were in the range of 200-500 lux. The control group was asked to continue working with the pre-existing lighting scheme (no changes or alterations were made). As compensation for their (voluntary) participation, all participants received an adjustable LED task light (valued at \$300 USD).

Several unanticipated logistics issues arose which included:

- how to change ambient lighting for one cubicle without impacting adjacent cubicles;
- how and where to store 100 task lights;
- how to efficiently distribute install and train users of 100 task lights;
- how to schedule observations of intervention participants given an active, mobile, workforce; and
- how to address task light plugs not fitting in cubicle outlet receptacles without creating a fire hazard!

Once these issues were resolved, the study successfully got underway. In four phases over the course of six months, the participants performed their day-to-day work while the researchers collected data using various measures. This included on-site observation and surveys to assess the impact of lighting on the participants' posture, comfort levels and overall workday. Specifically, they collected participant data on discomfort, level of eye fatigue, perception of job control, workspace level of illumination, and posture during standardized tasks. By comparing the data for the intervention group to data for the control group, and by eliminating any outside effects that could skew the results, the researchers were able to identify several statistically significant findings.

Results

By comparing baseline data to follow-up data for the intervention group, the field study revealed that statistically significant benefits related to musculoskeletal comfort, posture, and visual comfort were documented when participants used the adjustable task lights. Specifically, not only were significant improvements in ratings of eye fatigue reported in 6 of 15 measures, but also significant reductions in discomfort ratings were found in the neck, right upper extremity (shoulder, upper arm, and wrist), lower back, hip/buttocks and lower extremities.

The improvements associated with the use of the adjustable LED task light went beyond physical and visual discomfort. Participants' assessments of the light's usability, usefulness and desirability were all positive as well. They rated the adjustable task light as being easy to use, not cumbersome, and better than the previous lighting. (See figure 3.) Compliance with using the task lights consistently was very high (87.8%) as compared to those who did not use the task lights consistently (12.2%). Overall, most participants indicated they would like to have the task light permanently in their workspace. Additionally, it was found that using the LED task lights resulted in a utility savings of 53 kWh per year for each employee.

		Average
Usable	This task light was easy to use.	5.59
	This task light was not cumbersome.	5.45
Useful	Compared to my lighting, this task light ...	
	is better.	4.86
	makes my work easier physically.	4.57
	helps me perform my work tasks more efficiently.	4.36
Desirable	reduces my visual fatigue at the end of each work day.	4.68
	I really benefited from the use of this type of task light.	4.82
	I think my co-workers will want to use this type of task light.	4.84
	I really want this task light in my workspace.	5.02

Verbal Anchors	
1	Strongly Disagree
2	
3	Disagree
4	Agree
5	
6	Strongly Agree

Figure 3

Conclusion

In summary, this field study on the benefits of adjustable task lighting documented positive results across the board, with nearly all participants reporting that the task light helped them in a number of ways. The DCRI Facility Management group reported that there were no employee complaints and that most employees appreciated the articulating, moveable features of the task lights. This gave the group evidence to be proactive in specifying this type of task light for future office workspaces. The results of this study underscore the importance of teamwork between Facilities Management and Health and Safety in identifying and solving common ergonomic issues, and the long term effect of evidence-based design on product specification in a “real world” situation.