

# THE IMPACT OF DAYLIGHT AVAILABILITY ON SEAT SELECTION

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## Abstract

Seating that meets students' needs and preferences could promote a longer stay in the libraries they use and keep students motivated, influencing their emotions and learning abilities. However, studies regarding seat preference in learning environments have mostly focused on interior elements, such as colours and furniture. Existing knowledge on the relationship between daylighting and seating preference is limited. This study aims to understand the contribution of daylight availability on seating preference.

In this study, participants were asked to select three best and three worst seat locations in a library and the most and least liked within those categories. Participants were also asked to indicate the reasons for their selection to examine whether the daylight in the selected desks (best and worst) coincides with those where daylight levels were high and low in order to understand whether the daylight component is an influential factor when deciding where to sit.

This study demonstrated that daylight is the most dominant reason when selecting desks, followed by privacy, outdoor view, and quietness. Although the reasons for seat selection varied, the majority of the participants agreed that satisfactory daylighting level, facing the least people, and a greenery outdoor view are particular reasons for seat selection. Future research is suggested where other reasons for seating selection are studied further; quietness, outdoor view, privacy, and their interaction with daylight.

**Keywords:** daylight; seat preference; library; students; seating behaviour.

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## 1. Introduction

Academic libraries play a significant role in the learning development of students [1]. They should provide a good learning environment that enhances students' learning ability and contributes to academic and intellectual development [2]. Although the framework for planning and designing learning spaces such as academic libraries exist [3] [4], there is still a need for a better understanding of the specific needs of students to provide environments that meet their needs and preferences [5].

The concept of learning environment preference has been explained in environmental psychology using the physical dimensions (comfort, aesthetics, information and communication technology facilities, and layout), social dimensions (privacy, interaction, and autonomy), and sociodemographic dimensions (gender, age, study year, and life conditions) [6]. In other words, the preference for a learning environment is defined by the specific physical conditions of the environment and by human, cultural, and psychological dimensions. These factors greatly impact the students' emotions, learning ability, and feelings of belonging to a space [7], hence, the students' behaviours and seat preferences in libraries [8] [9].

The seat selection process has been asserted as a result of the individuals' prior experiences in that space or deliberate choices among alternatives while entering the space [10], regardless of whether deciding consciously or unconsciously [11]. This assumption has also been supported, indicating that seating decisions could be different for individuals familiar and unfamiliar with the physical settings in the space [12] because the human response to the physical environment is strongly subject to prior experiences [13]. In that case, users of a library could choose the same seat repeatedly as developing preferences depending on previous experiences, against first comers who need to rely on external sources of information. The degree of freedom of choice could also influence the seating decision because individuals can choose only available seats or space. For instance, in the early morning hours, individuals could have more chances to select a space than those who arrive in the afternoon. Individual differences, namely arousal, motivation, and expectation, also matter in human behaviour [13], influencing the decision-making process.

Seating features that meet the students' needs and preferences could aid a longer stay in the library [14], keeping students happier and more motivated [15] [16]. Understanding occupant behaviour and their interaction with the indoor environment could help improve the occupants' satisfaction [17] and the energy efficiency of buildings [18] [19]. However, occupant behaviour is a complex subject, as are the many external and internal aspects influencing behaviour (e.g., external environmental conditions, building characteristics, and indoor environment conditions; and biological, psychological, and social aspects [20] [21]).

Studies regarding seat preference in the learning environment have mostly focused on interior elements, such as desk partition, colours, and furniture [14]. However, the existing knowledge of the association between daylighting and seating behaviour remains somewhat limited and needs further investigation [22]. This study aims to understand the relationship between daylight availability and seat preference and hence the spaces with higher demand in the context of the library. The research questions addressed in this paper are, therefore, as follows:

1. What are the underlying factors for choosing a seat in the library?
2. What is the importance of daylight on seat selection?

## 2. Methodology

### 2.1. Experiment

MSc students were asked to choose three best, and three worst seat locations from a library's seating plan and the most and least liked within those categories. They were also asked to indicate the reasons for their selection to examine whether the daylight in the selected desk (best and worst) coincides with those where daylight levels were high and low, respectively, hence if daylight component is an influential factor when deciding where to sit. The study took place on a sunny day in December 2019 between 13:00 and 14:00. In this study, the daylight availability of the selected desks was assumed to indicate the participant's daylight perception and expectation [23] [12].

### 2.2. Field site

The study was carried out in the UCL Bartlett library located in a six-storey building on the ground floor. The library comprises three main study areas (Figure 1). The *group study area* (Room 1) accommodates eight shared desks and four individual cubicles and has two side windows in the north-facing external wall; the *library collection area* (Room 2) has twelve shared desks and eleven individual desks and several side windows facing north and east orientations; the *quiet study room* (Room 3) is an open-plan space with a skylight, and thirty-two shared desks.



**Figure 1:** The plan of the Bartlett Library

### **2.3. Questionnaire design**

A questionnaire was designed using a mix of multiple-choice, Likert scale, and open-ended questions. The questionnaire contains four sections; the first two sections of the questionnaire were completed by participants before entering the library and considered information regarding (1) demographic; gender, and age, and (2) time spent in London (months). The following sections considered specific tasks to explore the influential reasons on students' seat selection and the role of daylight conditions; therefore, section (3) focused on the selection of the three best and three worst seating places in the library and the reasons for the selection, and section (4) the subjective evaluation of daylight availability at the best seats selected.

### **2.4. Quantification of daylight availability**

AutoCAD and Rhino were used to create parametric modelling, and an advanced level of Grasshopper was used to run lighting performance analysis with Ladybug and Honeybee plugins. Spot measurements were also used to validate the simulation results with real measurements.

### **2.5. Method of analysis**

All the statistical analyses were conducted using the software package SPSS 20.0.

*Analysis of seat preference of the participants:* Initially, influential reasons for the best and worst seat selections and the importance of daylight in the selections were considered. Secondly, daylight availability at the best seat selected was evaluated using ordinal regression. Lastly, the best and worst seat selections were assessed on the seating map considering other influential factors apart from the contribution of daylight.

*Analysis of daylight simulations:* Daylight availability at each seat was calculated using point-in-time climate-based calculations, which has been found to have a better association with predicting daylight availability than other daylight metrics [24].

### 3. Results and Discussion

#### 3.1. Seating preference in the Bartlett Library

##### Selection of best seats

The study findings show that daylight was the most dominant reason (36%) of all reasons given by participants when selecting the most liked desk, followed by privacy(18%), outdoor view(13%), and quietness(10%), respectively (Table 1). These results are in line with [23] and [12] findings that daylight was the most significant reason for seat selection. In this study, other specific features of the desk selected seem to be influential on seat selection (8%). Some of the specific features mentioned were wideness, proximity to the circulation route or entrance, enabling to study individually or with friends, being at the corner or the back of the room, and access to facilities such as a computer or plug socket. Participants also mentioned reasons related to indoor conditions (7%), such as temperature and air quality of the room. The proximity to windows was also mentioned (8%); however, it is unclear if it could be due to daylight or outdoor views.

**Table 1:** Participants' responses concerning the reasons for choosing the best seats in the library

<i>Reason for best seat selected</i>	<i>Total number of mentioned</i>	<i>A Best place</i>	<i>B Second-best</i>	<i>C Third-best</i>
<i>Quietness</i>	10% (22)	10% (8)	9% (7)	10% (7)
<i>Daylight</i>	<b>36% (81)</b>	<b>34% (28)</b>	<b>39% (29)</b>	<b>34% (24)</b>
<i>Proximity to window</i>	<b>8% (18)</b>	9% (7)	5% (4)	10% (7)
<i>Outdoor view</i>	13% (30)	13% (11)	15% (11)	11% (8)
<i>Privacy</i>	18% (42)	21% (17)	21% (16)	13% (9)
<i>Desk features</i>	8% (18)	6% (5)	7% (5)	11% (8)
<i>Indoor conditions</i>	7% (16)	7% (6)	4% (3)	10% (7)
<i>Total responses</i>	227	82	75	70

##### Selection of worst seats

Following the best seat selection, participants were also asked to state the three worst desks and the reasons for their selection. As seen in Table 2, the worst seats were also associated with unsatisfactory daylight conditions (33%), and with specific desk features (14%), nonprivate environment (12%), distractive noise (11%), and lack of or unpleasant outside views (6%). Although daylight remains the most dominant factor in seat selection, the order of importance in the worst seat selection is slightly different from those selected as best. Also, a group of people (11%) stated that some desks were the worst since they made them feel cramped or found some places claustrophobic (desks facing a wall). They also mentioned the lack of visual contact with other students or desks located in the corner of a room as reasons for their selection. These findings are interesting since most of those reasons were also considered positive features for some participants. For instance, the desk that made a student '*feel confined*' was suitable for another that considered it a place for '*easy to concentrate*'. Although seat preference varied from person to person depending on

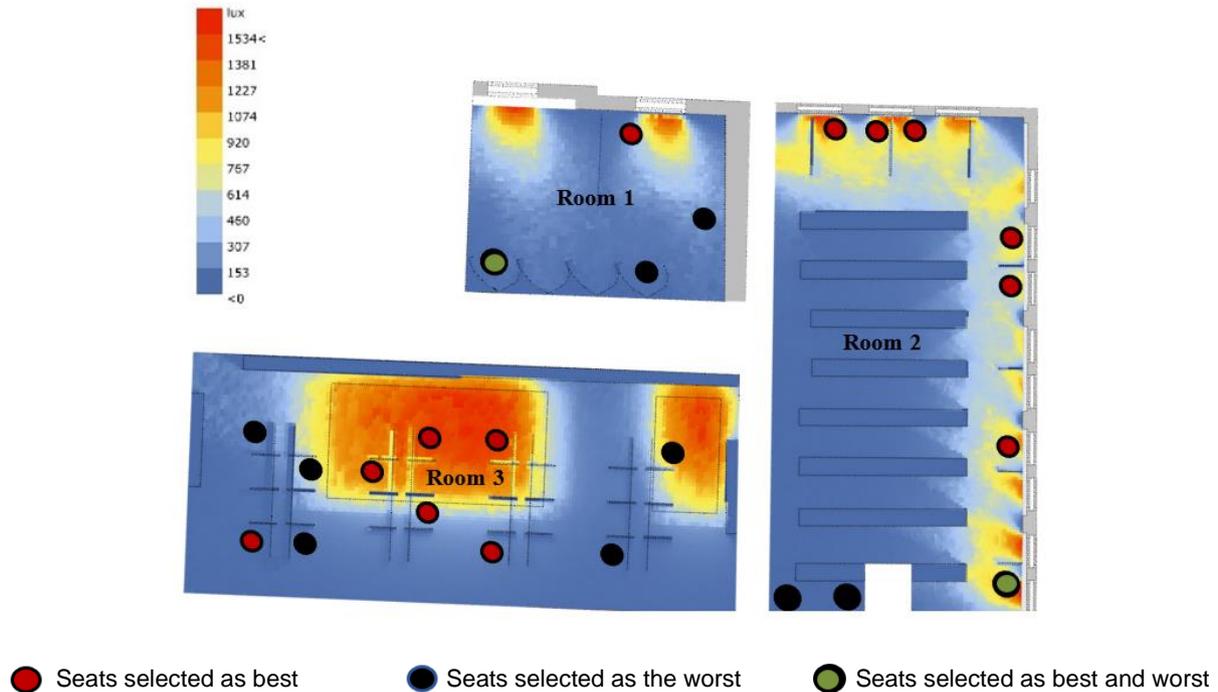
individual needs and expectations, most participants agreed that selecting a desk in the library is influenced by a satisfactory daylighting level, facing the least people, and a greenery outdoor view.

**Table 2:** Participants' responses concerning the reasons for choosing the worst seats in the library

<i>Reason for worst seat selected</i>	<i>Total number of mentioned</i>	<i>1 Worst place</i>	<i>2 Second-worst</i>	<i>3 Third-worst</i>
<i>Noise</i>	11% (21)	8% (6)	13% (8)	12% (7)
<i>Lack of /insufficient daylight</i>	<b>33% (62)</b>	34% (24)	32% (20)	32% (18)
<i>No window</i>	4% (7)	4% (3)	2% (1)	5% (3)
<i>Lack of/ unpleasant outdoor view</i>	6% (12)	6% (4)	6% (4)	7% (4)
<i>Privacy</i>	12% (23)	16% (11)	11% (7)	9% (5)
<i>Desk features</i>	14% (26)	13% (9)	16% (10)	12% (7)
<i>Indoor conditions</i>	9% (18)	8% (6)	9% (6)	10% (6)
<i>Feeling cramped</i>	11% (21)	10% (7)	11% (7)	12% (7)
<i>Total responses</i>	190	70	63	57

### 3.2. The role of daylight on seat selection

Figure 3 presents the seat preference configuration against the library's daylight availability when the experiment was conducted. It can be seen that most of the seats selected as the best are located in areas with high illumination, whereas most unpopular desks are located in places with poor or lack of daylight. The categorisation of lighting levels was done based on the recommended range for library reading rooms (between 300 and 500 lux) [12]. Interestingly, similar to previous findings, two desks were regarded as both best and worst by different participants. One of them, located in Room 1, corresponds to an individual cubicle that does not have access to outdoor view or acceptable daylight levels. The desk was selected as the worst seat by a participant because of the deficient daylight level; however, another participant preferred it because the desk was at the corner and provided a private environment. Another desk described as both best and worst by some participants is located near the window and in the corner of Room 2. The desk has a satisfactory daylight level and a greenery outdoor view, which some participants positively appraised. However, others were negatively affected, given its closeness to an emergency exit and people passing through circulation.



**Figure 2:** Best and worst seat selected by participants against daylight availability

Even though seat selection seems associated with daylight, its role may vary depending on the context, sample characteristics, and the activities participants are requested to undertake. For instance, this study's results could have been different if the participants were in real need of using the space for their specific academic tasks (e.g., reading and writing for an assignment). In that case, privacy and quietness would have been more important than natural environment components such as temperature, lighting, and outdoor view. Therefore, the study design might have affected the participants' natural environmental attention and evaluation of the space and desks. Nevertheless, although the importance of daylight varies from study to study, it always remains an essential factor for seat selection.

### 3.3. Assessment of daylight availability at the best seat selection

Following the best and worst seat selection, participants were required to describe the daylight conditions at their best seat desk. The daylight availability at the best desks selected by participants showed that 44% of the participants (N=22) described the amount of daylight on their best desk as very high, 42% (N=21) stated that the daylight conditions were high, and 6% (N=3) as above average. In contrast, only 8% characterised the conditions of the best-selected desks as low or very low. These results support the idea that most people prefer desks with a high amount of daylight, which could be with or without consciousness [11].

### 3.4. Combination of reasons for seat preference

Although daylight on its own seems to be a critical component for seat selection, its combination with other factors should also be considered. In this study, participants were required to state at least one and ideally three reasons for selecting a desk. Table 3 and 4 shows the combination of reasons for choosing the best and worst desks. As supported by previous findings, the combination of daylight and outdoor view and daylight and privacy are critical combined reasons for selecting seats. Also, people avoid selecting places with insufficient daylight and a cramped environment, followed by places with an unacceptable level of daylight and outdoor views.

**Table 3:** Frequency of mentioned reasons for the best seats selected

	<i>Desk features</i>	<i>Indoor conditions</i>	<i>Daylight</i>	<i>Outdoor views</i>	<i>Privacy</i>	<i>Quietness</i>
<i>Desk features</i>			2			
<i>Indoor conditions</i>						1
<i>Daylight</i>	1	1		7	4	2
<i>Outdoor views</i>					1	
<i>Privacy</i>	1	2	2	1		1
<i>Proximity to window</i>		1	1	1	1	
<i>Quietness</i>			1		1	

**Table 4:** Frequency of mentioned reasons for the worst seats selected

	<i>Insufficient Daylight</i>	<i>Desk features</i>	<i>Indoor conditions</i>	<i>No window</i>	<i>Noise</i>	<i>Unpleasant outdoor views</i>	<i>Privacy</i>
<i>Insufficient daylight</i>			1	1	2	4	
<i>Desk features</i>	2			1			1
<i>Indoor conditions</i>							1
<i>Feeling cramped</i>	6		1			1	
<i>Unpleasant outdoor views</i>	1						2
<i>Privacy</i>	2		1	1	1		

### 3.5. Seat preference in the different rooms

The Bartlett Library was selected due to the different configurations of rooms it provides. While two of the rooms (Room 1 and 2) have side windows allowing the students to access daylight and outdoor views, Room 3, an open plan space, is located under a skylight without outdoor views but sufficient daylight levels, especially at some desks. Therefore, is there any difference in the seating preference between rooms? If so, a difference in seat preference between spaces lit by the side windows and skylights?

Most students (54%) selected as best the desks located in Room 2, given the access to both daylight and outdoor views. However, the percentage of preferred desks in Room 2 in one of their three favourite seats is higher for individual desks than shared desks. Desks in Room 1 were also regarded as good by students (26%). Most of those students preferred to sit down near the window at the shared desks, while others preferred the individual cubicles

with no daylight and outdoor view access. On the other hand, only 20% of students selected the desks in Room 3 as the best, mainly the desks given access to excellent daylight availability. There was a tendency of students in Room 3 to select the desks with higher illumination. For instance, the desks getting a high amount of daylight under the skylight were preferable (16%) than the desks with inadequate or lack of daylight (4%). The preferred desks with low daylight levels are located in the corners of the room.

The room lit by skylight was less preferable than the rooms lit by the side windows despite the high amount of daylight. It could be argued that access to outdoor views and acceptable daylight levels makes the seating places more preferable than only daylight. However, outdoor views and daylight are not separate things to participants because people do not value each environmental variable equally for seat selection [11]. Also, privacy could be another important component because the place lit by skylight is an open plan space and comparatively less private than other rooms. These findings emphasised that although daylight is the most dominant seat selection factor, seat preference cannot be explained by daylight alone. It should be investigated together with other components such as privacy, outdoor views, and quietness because the seating configurations of the rooms were very different from each other.

### **3.6. Limitations**

The study was limited to a particular place and group of people at a given point in time. The activities participants were requested to undertake might have influenced the participants' seat selection. Since the order of importance in seat selection could have been different if the participants were in real need of using the space for their respective studies. In that case, privacy and quietness could have been more important than natural environment components such as temperature, lighting, and outdoor view, because a degree of privacy [25] and a quiet environment [26] are the most important components at especially exam periods helping students improve concentration.

## **4. Conclusion**

Linking the seating behaviour of individuals with a particular stimulus in the physical environment is quite difficult because individuals are exposed to multiple sources of information during seat selection. The factors influencing seating behaviour in the learning environment have been defined in various studies as ambient temperature, type of furniture, proximity to other occupants [23], quietness, outdoor view, privacy, social interactions such as close to friends, entrance or circulation [27], daylight [24] [28], students' degree of territoriality and seat arrangements [29]. It is also known that when choosing a space, individuals tend to value a few specific variables rather than evaluate each environmental variable equally [12]. Underlying processes of seating behaviour within a specific physical environment have not been completely understood yet. The impact of daylight on seating selection is also affected by the variations in other factors that influence the decision-making process.

In this study, we have shown that daylight was the most dominant reason given for selecting the best desks in the library, followed by privacy, outdoor view, and quietness, respectively. Although the reasons for seat selection varied, the majority of the participants agreed on; satisfactory daylighting level, facing the least people, and a greenery outdoor view.

The study also revealed that daylight conditions significantly influence seating preferences in places daylighted by side windows rather than a skylight. It could be explained that access to outdoor views and acceptable daylight levels makes certain areas more preferable. Another finding of the study was that the seats with a good combination of daylight and privacy are in more demand than the seats providing only an appropriate daylight level when all seats have access to similar outdoor views.

Although daylight has a vital role in seat selection, other factors, such as quietness, outdoor view, and privacy, need further consideration. Future research should be devoted to developing an analysis method to investigate seating selection with solely daylight and its interaction with other components.

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