A study on task lighting in shared residential kitchens highlighting the relation between multiple users, illuminance and task performances.

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Author
SANTHINI NAVANEETHKRISHNAN

Tutor
HARITA UNDURTY KARUNA

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Examiner
ISABEL DOMINGUEZ

MASTER'S PROGRAMME IN ARCHITECTURAL LIGHTING DESIGN,
SCHOOL OF ARCHITECTURE AND BUILT ENVIRONMENT,
KTH.

ABSTRACT

Shared spaces have proven to be the most sustainable solution in the midst of growing demand to implement sustainable lifestyles and at present, co-living is the most trending housing option. In these coliving spaces, the common shared spaces are very important among which kitchen is the most critical one as most of the tasks are carried out there. The main objective of this study is to find if a relationship exists between task lighting, illuminance and multiple users in shared residential kitchens. Limited research in this area has been the primary motivation for this study. Furthermore, during the course of the study, the importance of flexibility in the task lighting for shared residential kitchens was investigated.

Realizing the objectives, the study aims at answering the following main investigation questions:

- Is task lighting in a shared kitchen designed with the number of users in mind and does it consider the different ways in which they perform different tasks at the same time?
- Should the lighting design standards be reconsidered for shared residential kitchens?
- Would flexibility in the lighting devices be beneficial for shared kitchens ?

The main investigation questions are answered with the help of the following sub-investigation questions which mainly highlights the relation between the multiple users, illuminance and task performances.

- Do multiple users affect the various performances carried out in a shared kitchen?
- Are there any shadows cast by the multiple users in a shared kitchen? Do they affect the illuminance levels in the task areas and thereby affect the visual and task performances?

Case studies of two different shared residential kitchens were carried out. The methodology of the case study involved two stages, complete site analysis and an experiment.

The experimental set up is adapted from McGuiness, Boyce and Harker's investigation study "The effects of illuminance on task performance in domestic kitchens" and was modified to suit this study. The experiment was conducted in two different scenarios. Quantitative and qualitative analysis was carried out during the study.

The end results of the experiment proved that there is a strong influence of multiple users on the task performances without having any major impacts on the lighting conditions. This indicated that new lighting standards have to be framed for shared residential kitchens in the aspects of ergonomics and flexibility. The importance of flexibility in shared spaces and in shared residential kitchens was realised was considered just beneficial in terms of mood, comfortability and practicality.

Keywords: Flexibility, Individual lighting control, Shadows, Satisfaction, Effort made, Preparation zone, Reading recipes, Shared spaces, Coliving, Dorm

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Chapter 1. INTRODUCTION

1.1 Motivation

Lighting in living spaces serves both a practical and aesthetic purpose. The importance of lighting in indoor living spaces is usually not paid attention to. However, lighting is of utmost importance in residential spaces and for sustainable interiors. Common areas like kitchen, dining, living room, etc. are the most used and most important spaces in a co-living or shared space. In particular, the kitchen can be considered the heart of any home and an area that needs appropriate lighting since most of the visual and task performances are carried out there compared to all the other areas of a residence. Numerous studies have been carried out on the subject of residential lighting and kitchen lighting. However, detailed studies on shared residential kitchens and the lighting in such a space are few or non-existent. Moreover, the author's own experience of living in a student dormitory with shared kitchens revealed the importance of lighting in such spaces. This led to the decision to study the lighting in shared residential kitchens.

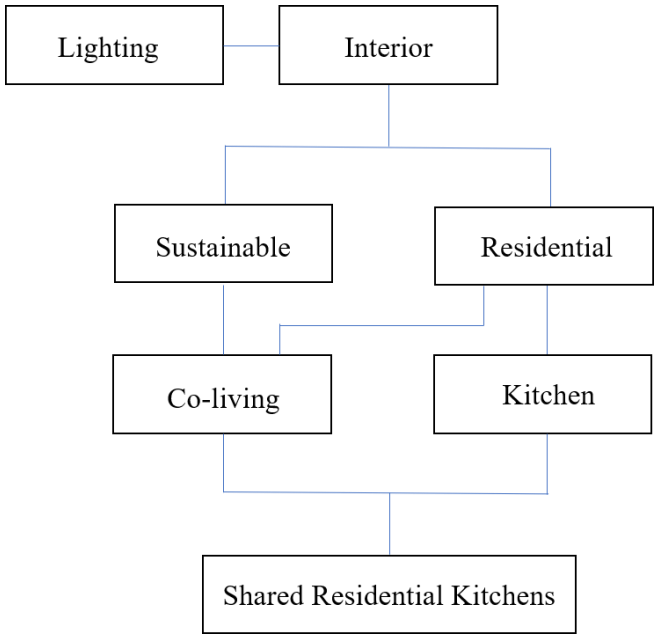


Figure 1. Motivation for choosing the space to study lighting

1.2 Background

1.2.1 Shared spaces

Shared interior spaces have become an integral part of living spaces in present society. A major reason for this development is the fact that such spaces tend to attain sustainability through the maximum use of available space and resources. Shared spaces have other benefits in the form of encouraging human interaction, which is very much necessary in the modern world where people are increasingly living solitary lives. Some of the most common shared spaces at present, other than public spaces, are co-working office spaces, shared corridor spaces, student housing or dormitories and currently trending co-living houses. Though these spaces have many advantages, they also tend to create an unpleasant or discomforting environment for some individuals. In spite of these, co-living spaces are generally beneficial for the society, human well-being, urban spaces, domestic resources, etc. For example, co-working spaces are a source of social support for independent professionals.[1]

Co-Living: Collective living or co-living is a new take on an old concept[2]. It is undoubtedly the most sustainable form of living in many aspects. The number of co-living houses are on the rise in many parts of the world and are highly trending in cities like New York and London, where housing prices are exorbitant. In such cities, there is a need to make residents to adapt to new ways to rent a space[3]. A co-living house is defined as housing with common spaces and shared facilities. In Sweden, the term kollektivhus (literally 'collective building') is the most frequently used term for housing with shared facilities. Originally, it referred to the collective organisation of housing, but not to neighbourly collaboration or to sense of community. When the term was launched in the 1930s, the aim was to reduce women's housework in order for them to be able to retain gainful employment even when they married and had children[4]. Hus 24, Scandinavia's first co-living house in Stockholm was founded in 2011 by Lisa Renandar, the CEO and Founder of Tech Farm in Stockholm, Sweden. The company and its co-living spaces have bloomed over the last few years[5]. One of its co-living house, K9, in Ostermalm, Stockholm, is bigger and can host up to 50 members. It is fully furnished and has well-equipped shared resources while providing a healthy social life for its members.

Dormitories/ Shared student housing / Shared corridor apartments: These spaces are also a form of co-living usually (at least in Europe) with private rooms and other common shared spaces like kitchens, etc. and are budget friendly for students. The only difference between co-living houses and student accommodations are the users. It is usually the case that students occupy these spaces while entrepreneurs, professionals, artists, etc. occupy co-living houses.

1.2.2 Kitchens

A kitchen is a room or part of a room used for cooking and food preparation in a dwelling or in a commercial establishment[6]. The kitchen work triangle consists of three areas that includes cooktop, sink and refrigerator. The three most important tasks carried out in a kitchen are preparation of food, cooking and cleaning. In a kitchen, the sink and meal preparation zones are the most frequently used spaces[7].

Private/Domestic/Residential kitchens: The kitchen is an important space in the home, serving many purposes, both functional and social. In addition, it is the busiest area where various tasks are carried out. Usually, private residences are designed for a single user or utmost for two users who carry out familiar tasks planned together. The residents have a usual routine of using the different zones too. Therefore, private kitchen lighting has limitations for multiple (more than two users) users' performance in the space.

Industrial/Commercial kitchens: The kitchen is the command central of any restaurant[8]. Unlike domestic kitchens, the major aspect of commercial kitchens is the various tasks performed by multiple cooks. Here again, the users are assigned to specific tasks and zones so that they do not interfere with each other. Hence, the limitations here are unplanned tasks, entirely different users, fixed zones and user interference.

Shared residential kitchens: A kitchen shared in a residence or apartment by at least more than two occupants (with similar or different backgrounds) is c alled a shared residential kitchen. Since the housemates perform their tasks individually with different needs, shared kitchen is the most critical area to be considered while designing its interiors in all aspects. The limitations mentioned above in private and commercial kitchens are the major considerations in these types of shared kitchens.

1.2.3 Lighting

Lighting or illumination is the deliberate use of light to achieve a practical or aesthetic effect[9]. Indoor lighting is usually achieved using light fixtures or by making use of daylight and is a vital part of interior design.

Lighting in shared spaces: Shared spaces always need to have mindful lighting design as the space experiences an ever-changing environment and has to cope with different users and usage of space. Moreover, lighting in shared interior spaces like co-working spaces, etc. has to be carefully designed while keeping in mind the safety and well-being of the users. Shadows, glare and reflectance are some of the important factors to be dealt with while lighting for spaces where multiple users perform many tasks, especially at the same time.

Lighting in kitchens: Lighting, once considered a second thought, is now an essential part of home decor, fulfilling aesthetics and function – particularly in a focal area like the kitchen. There are already numerous guidelines, standards and studies provided for kitchen lighting, for both domestic[10] and industrial[11] cases. In kitchen lighting, layering is considered important; it consists of ambient, task and accent lighting provided mainly for general illumination, on task surfaces mainly for performing tasks and for aesthetics respectively.

Task lighting: It ensures ample, focused light where needed for working. At present, the most common and best way to provide task lights is to fix it on the bottom of overhead-cabinets to illuminate the task surfaces. Though there are ways and standards provided for illuminating vertical task surfaces, it is mostly ignored. Task lighting is the key to performing different tasks concerning the visual comfortability, safety, hygiene etc. involved while performing the different tasks in the kitchen. Table 1.1 below shows the required standard illuminance for the task surfaces in a residential kitchen.

Table 1.1. IES recommended illuminance level values on the horizontal and vertical task areas for a residential kitchen.[12,13]

Task Surface Area	*Standard Illuminance Value (lux)*
Vertical work surface	*108*
Horizontal work surface	*300 - 538*

Lighting in shared kitchens: Standards for illumination or specific guidelines for lighting in shared kitchens are not available. The lighting is mostly designed with standards for domestic kitchens and is slightly modified (like the number fixtures, etc.) according to the kitchen zones. By bringing out the limitations in domestic and industrial kitchen designs, it is clear that their lighting standards would not suit shared residential kitchens.

1.2.4 Flexibility

Flexibility is the key to creating the optimum working environment and this is particularly true for the kitchen area. Incorporating flexibility ensures that there is full integration between users with different working levels as well as providing complete and safe access for those with limited mobility. There are already many flexible kitchen accessories existing, like the pull-out spray kitchen taps[14], etc. Efficient lighting in the kitchen does not necessarily mean more lights, but rather more lighting that is versatile. As an existing example, dimmer switches create more flexible lighting options for existing

lights. Since shared residential kitchens follow the domestic kitchen standards, options with flexibility for different users do not exist.

1.3 Objectives

Lighting in shared residential kitchens should be viewed in terms of multiple users and constantly changing situations/environment. Flexible lighting solutions to fulfil the needs of different users, with different abilities at different situations, need to be implemented. Hence, the following were considered as the main objectives of this study:

- To study the influence of multiple users on the performances of each other while carrying out important kitchen tasks in a shared kitchen in relation with the available task lighting.
- To investigate about the users' – multiple users' working efficiency, well-being, safety and mood level/quality in a shared kitchen space.
- To determine whether shadows affect the activities carried out in a shared kitchen. If yes, then to study how and why it affects performance.
- To determine factors other than shadows that affect the visual and task performances in a shared kitchen, if any.
- To highlight the importance of flexibility as one of the key elements in shared spaces.

In the process of realizing the objectives, the study aimed at answering the following main investigation questions:

- Is task lighting in a shared kitchen designed based on the number of users and considering the different ways in which they perform different tasks at the same time?
- Should standard lighting design be reconsidered in a shared residential kitchen?
- Would flexibility in the lighting devices be beneficial for shared kitchens?

The main investigation questions were answered with the help of the following sub-investigation questions that highlight the relationship between the multiple users, task lighting and task performances.

- Do multiple users affect various performances carried out in a shared kitchen?
- Are there any shadows cast by the multiple users in a shared kitchen? Do they affect the illuminance levels in the task areas and consequently affect the visual and task performances?

1.4 Limitations

- The study was conducted during the hours of darkness, which indicates that only artificial lighting is taken into consideration (no daylight present).
- Since this study focuses only on task lighting, the ambient and accent lighting in the space was not accommodated at this level of research.
- Only one selected task zone was studied, leaving out the other zones for further research.
- While the user group was studied during the qualitative analysis, the act that the case studies were done in different shared kitchens with different groups of users including students, working people, entrepreneurs, etc. was not take into account
- The number of case studies were limited for this initial study.
- Technical aspects of the lighting – colour temperature, energy usage, photometric data, etc. were not included in the study.
- Glare value or reflectance of materials used in the kitchen were not included in this study.

Chapter 2. METHODOLOGY

2.1 Overview

Case studies of two different shared residential kitchens [see appendix A], one in a dorm and the other in a co-living house, were done individually and compared to critically analyze the spaces. The case study was conducted in two different stages as can be seen from the work plan in fig. 2.1. Stage 1 dealt with complete site analysis while stage 2 consisted of the experimental part the study. Both the stages included quantitative and qualitative analysis to achieve a better understanding of the results.

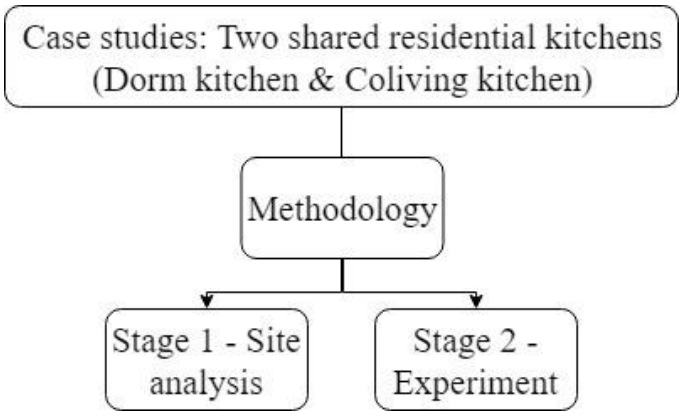


Figure 2.1 Methodology for this study

2.2 Stage 1: Site Analysis

Stage 1 involved analysing the kitchens to understand the existing conditions of the space, users and lighting (see fig. 2.2). To start with, a qualitative analysis consisting a set of questions [see appendix B-questionnaire 1] relating to the basic user background (including age range, health and kitchen skills), usage of the space and user evaluation of the space and lighting was carried out. This was followed by a quantitative analysis to study the existing illuminance levels on the task surfaces of the selected zone.

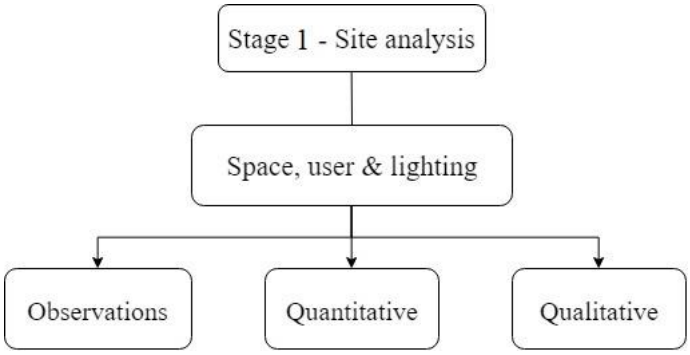


Figure 2.2 Site analysis – What is analysed and how

2.2.1 Space and user analysis

Responses to the questionnaire [see appendix B-questionnaire 1 responses] helped choosing residents with similar parameters. A total of eight subjects, four from each kitchen, participated in this study. The responses made it clear that the preparation zone is the most used zone in the kitchen (as discussed

in section 1.2.2). Hence, this task zone was chosen for the study. The most used preparation zone with task lighting was selected to conduct the study (see fig. 2.3 and fig. 2.4).

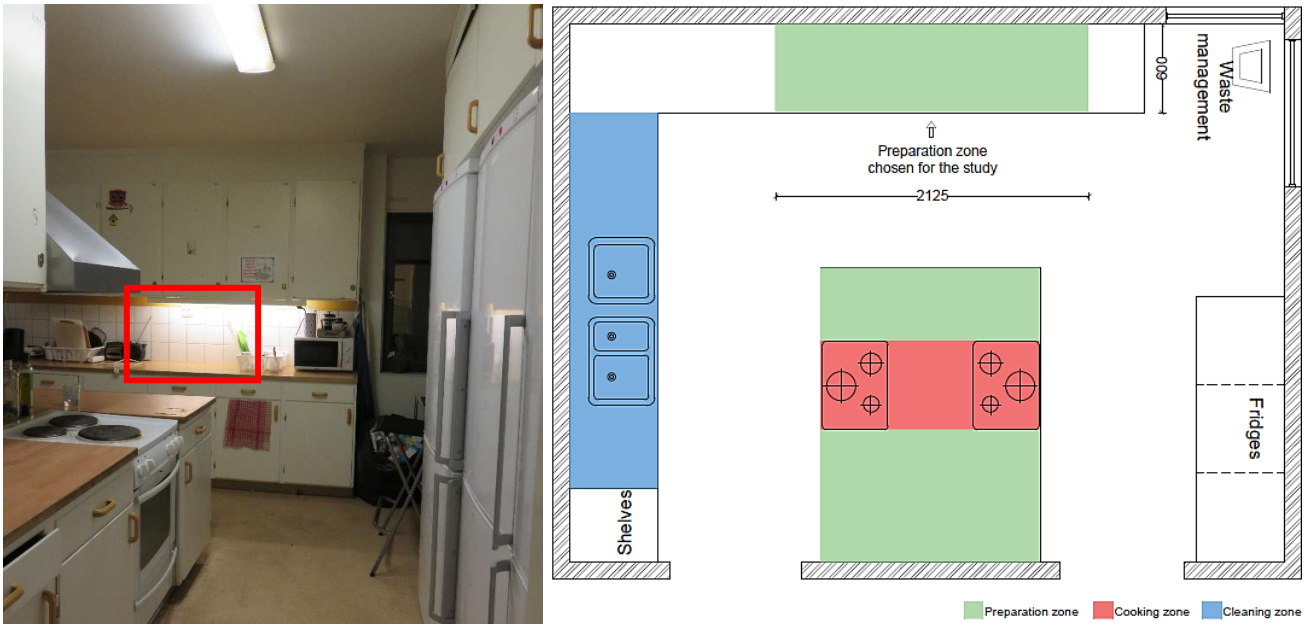


Figure 2.3 A view focusing on the preparation zone(left) and the zoning plan: work zones(right) of the Dorm kitchen

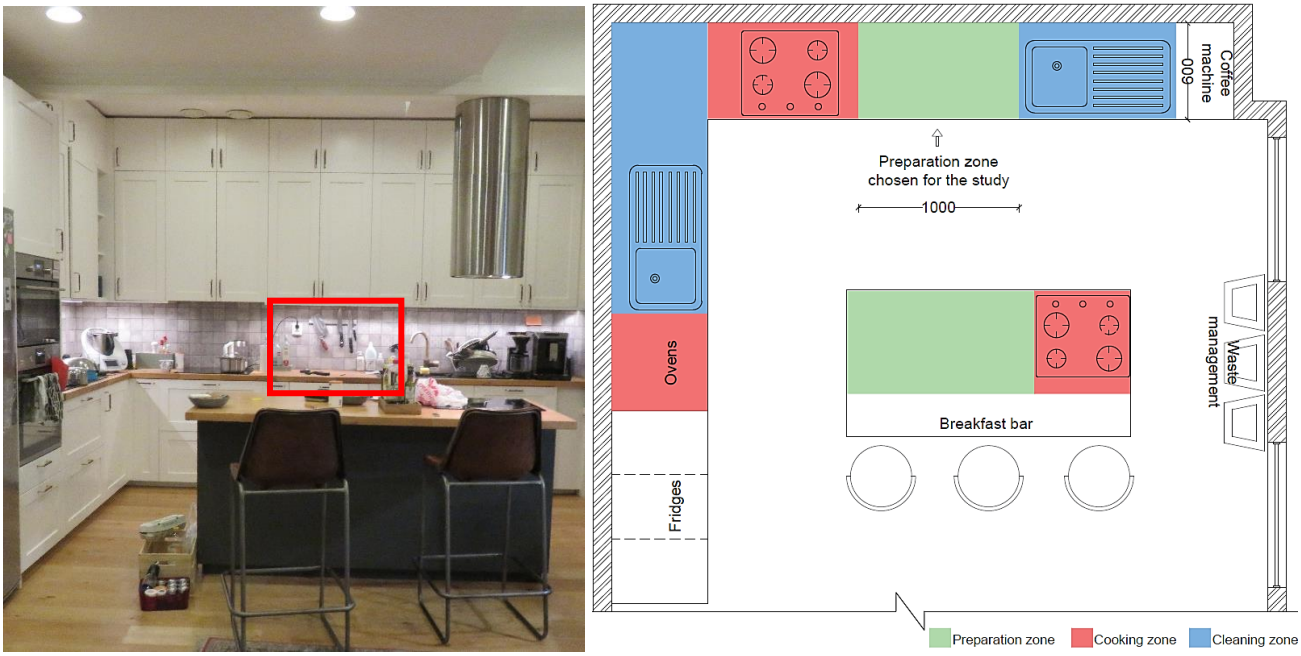


Figure 2.4 A view focusing on the preparation zone (left) and the zoning plan: work zones(right) of the Co-living kitchen

All the subjects except one were comfortable sharing the kitchen. The exception was due to the reason that the subject wanted more space for carrying out the task. Most subjects from both the kitchens reported that the presence of the other housemates affected the time they spent in the kitchen. The subjects concurred that the space created a pleasant, active environment and a focused mood. Domestic accidents rarely occurred in both the kitchens. When they did, the reasons were found to be carelessness or disturbances caused by fellow users.

2.2.2 Lighting analysis

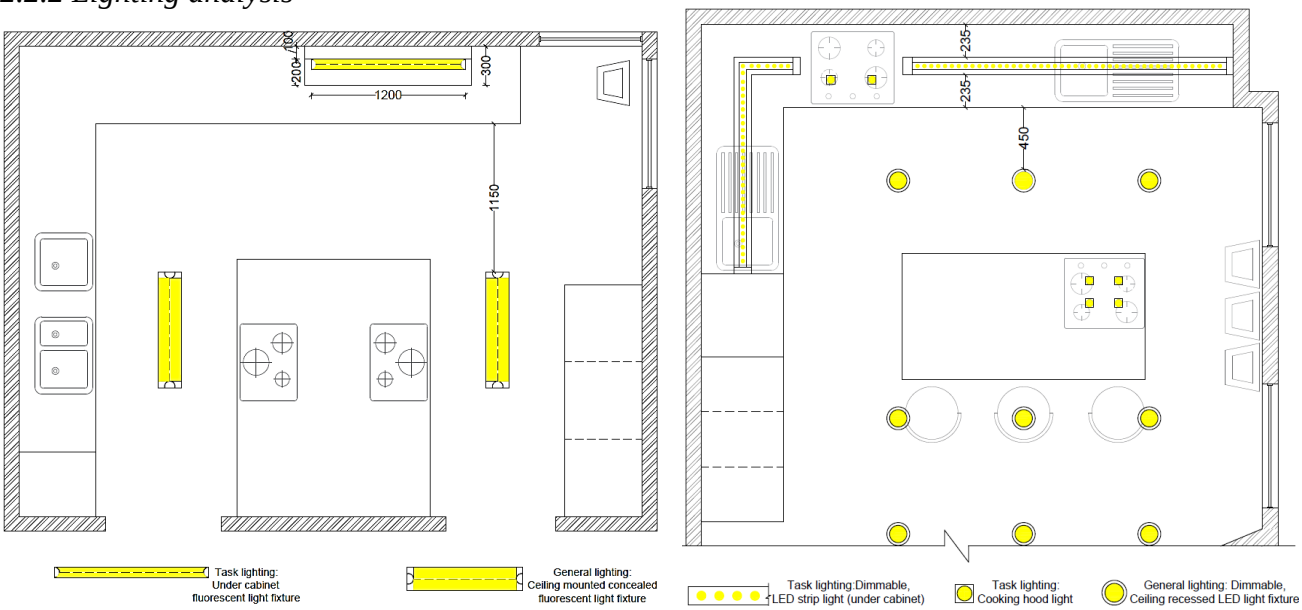


Figure 2.5 The existing lighting plan of Dorm kitchen (left) and Co-living kitchen(right)

Table 2.1. Existing illuminance values in the preparation zone of Dorm kitchen and Co-living kitchen

Task Surface Area	*Existing Illuminance Value (lux)*	
	Dorm Kitchen	Co-living Kitchen
Backsplash (for reading recipes) - vertical work surface	*644*	*133*
Countertop (for slicing cucumbers) - horizontal work surface	*885*	*199*

The illuminance levels of the vertical and horizontal task surfaces of the preparation zone which are the backsplash and the counter top respectively were measured [see appendix C] and are listed in table 2.1. It was observed that the Dorm kitchen provided more than required illuminance on both the task surfaces whereas the illuminance on the Co-living kitchen's countertop was less than the required standards (refer Table 1.1). Contradictory to the existing illuminance levels of the task areas, the subjects from the Dorm kitchen rated the artificial lighting quality in their kitchen as moderate while that in Co-living kitchen was rated good. Very few subjects who suffered from health repercussions chose lighting conditions can be the most likely reason for such issues.

2.3 Stage 2: Experiment

Experimental part of the study was adopted from *McGuiness, Boyce and Harker's investigation study "The effects of illuminance on task performance in domestic kitchens"*[15]. The setup and observations were modified to suit this study. Additionally, quantitative analysis [see appendix C] like measuring illuminance levels and qualitative analysis consisting a set of questionnaires [see appendix B] were included (see fig. 2.6).

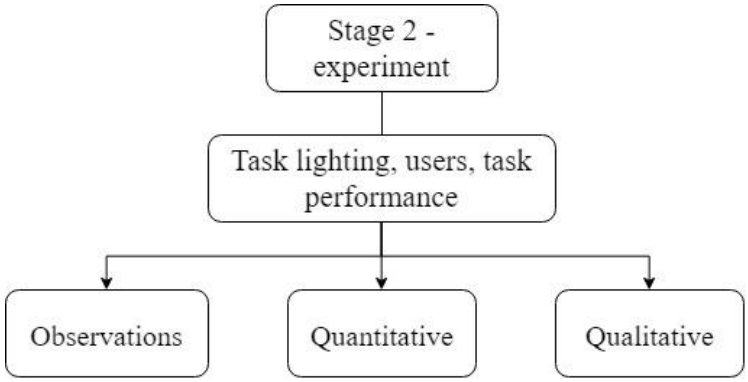


Figure 2.6 Experiment – What is studied and how

2.3.1 The setting and the tasks

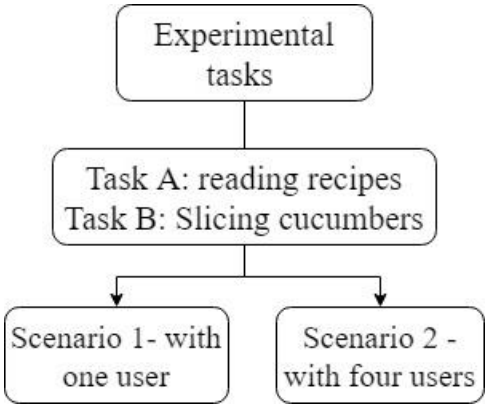


Figure 2.7 Experimental tasks performed in different scenarios

An experiment consisting of two different tasks performed in the preparation zone was conducted in the two different scenarios (see fig. 2.7). In task A, subjects were asked to read a recipe from a mobile phone (phone was chosen as it was the most commonly used device by the subjects) and write the answers for the questions asked from the given recipe. Two different recipes were provided in the two scenarios respectively. For task B, the subjects were instructed to slice a portion of a cucumber into as many complete thin slices as possible with any one of the knives provided to them (see fig. 2.8).

Figure 2.8 Materials used and their initial setup for the experimental tasks in Dorm kitchen(left) and Co-living kitchen(right)

Set-up of the scenarios – In Scenario 1, the subject performed the tasks alone in the kitchen. In Scenario 2, the subject performed the tasks in the kitchen occupied by three other users at three different points doing various activities. Figures 2.9 and 2.10 illustrate the setup of the scenarios while Tables 2.2 and 2.3 list the various activities performed by the users during the experiment in Dorm kitchen and Co-living kitchen respectively.

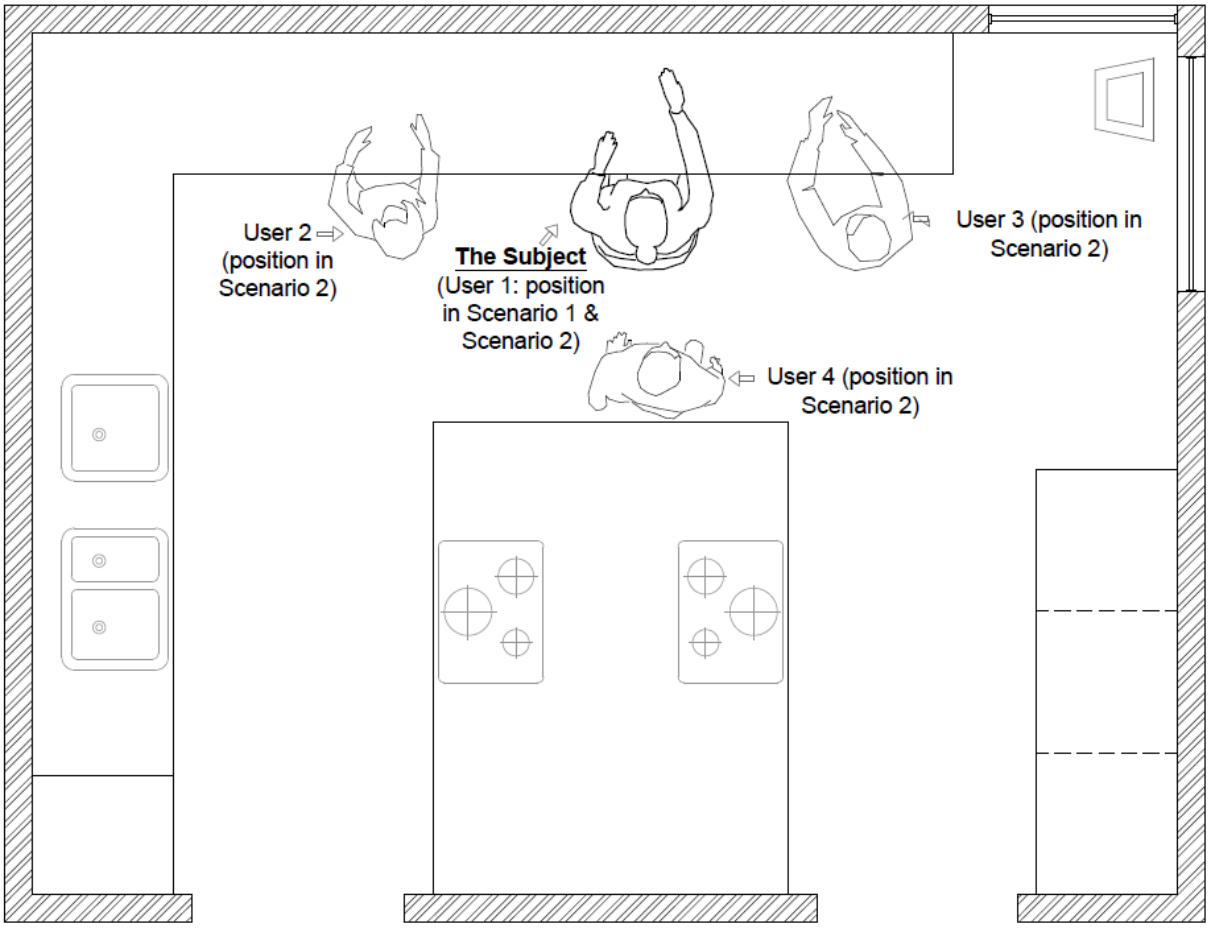


Figure 2.9 Plan showing the position of the users for the experiment in Dorm kitchen

Table 2.2. Various activities performed by the users during the experiment in Dorm kitchen

Dorm kitchen		
Subjects / Users	Activities	
	Scenario 1	Scenario 2
The Subject (User 1)	Performing the experimental tasks in the kitchen alone.	Performing the experimental tasks in the kitchen occupied by three other users.
User 2	Not present in the kitchen	Chopping vegetables
User 3	Not present in the kitchen	Cleaning utensils and talking with user 4
User 4	Not present in the kitchen	Talking with user 3 and/or user 2

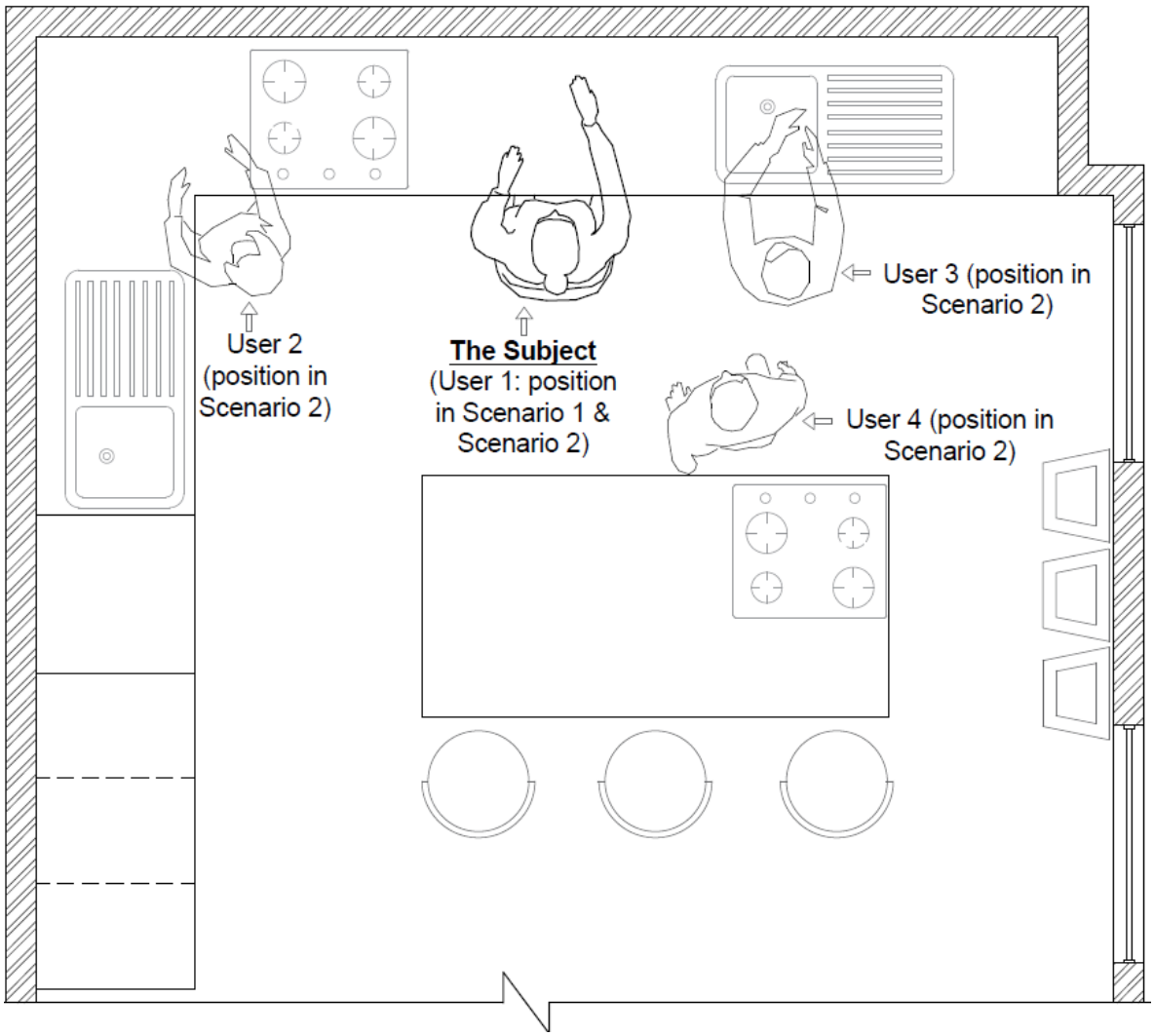


Figure 2.10 Plan showing the positions of the users for the experiment in Co-living kitchen

Table 2.3. Various activities performed by the users during the experiment in Co-living kitchen

Co-living kitchen		
Subjects / Users	Activities	
	Scenario 1	Scenario 2
The Subject (User 1)	Performing the experimental tasks in the kitchen alone.	Performing the experimental tasks in the kitchen occupied by three other users.
User 2	Not present in the kitchen	Chopping vegetables
User 3	Not present in the kitchen	Washing dishes and talking with user 4
User 4	Not present in the kitchen	Talking with user 3 and/or user 2

2.3.2 Procedure

Each subject was explained about the experimental tasks and the questionnaire that followed in both the scenarios. In addition, each subject was instructed about the positions and activities to be performed in scenario 2. The procedure of the experiment is shown in fig. 2.11.

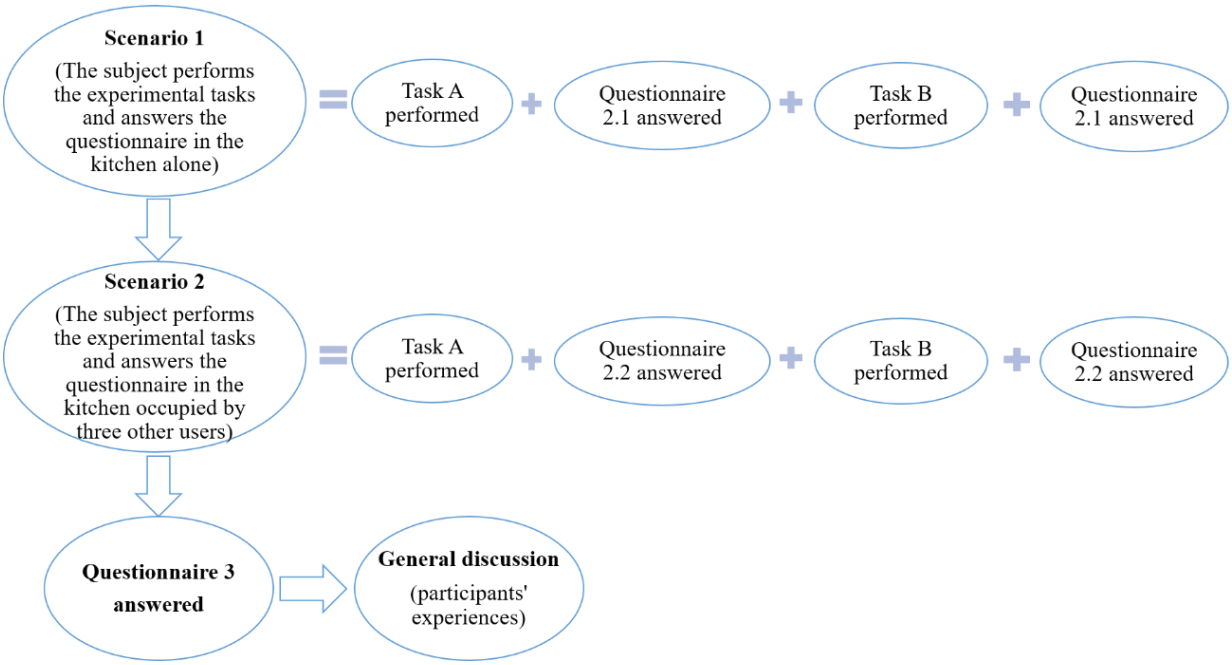


Figure 2.11 Procedure for stage 2:Experiment

Figure 2.12 A view of scenario 1 in Dorm kitchen(left) and scenario 2 in Co-living kitchen(right)

2.3.3 Measurements

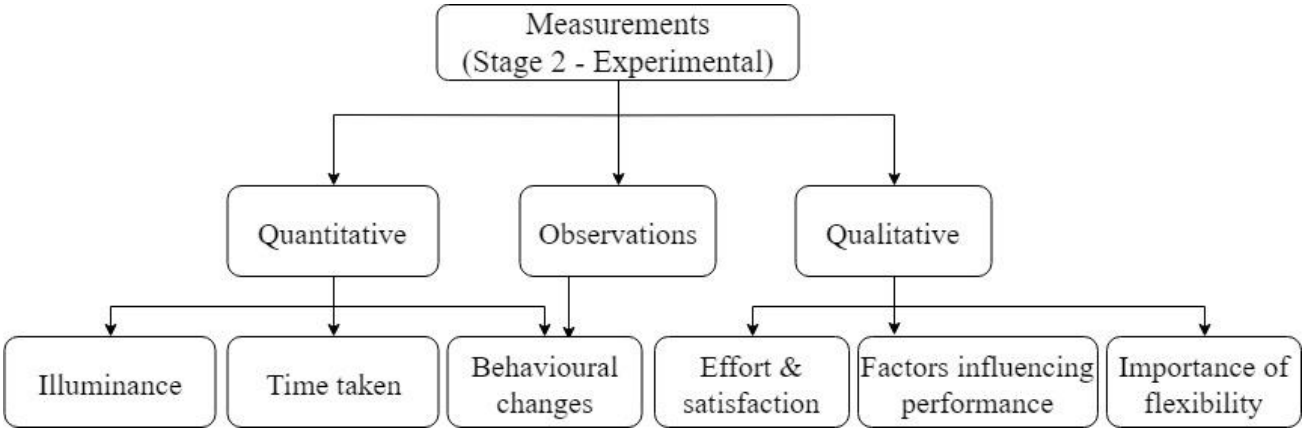


Figure 2.13 Measurements and analysis of the experiment

Work plan in fig. 2.13 illustrates the entire measurements and analysis process of the experiment. The total time taken to complete the tasks along with other additional information was recorded. For task A, any mistake in the answer given was noted. For task B, the number of complete slices was recorded. In addition to these measurements of task performance, the opinion of the subjects on the effort made to perform the task and the satisfaction level with the lighting conditions were quantified by asking them to answer the following two questions after performing each task in both the scenarios: i)how much effort did you require to perform the task and ii) how suitable do you consider the kitchen lighting for the performance of this task? The answers were given on seven-point rating scales with the ends labelled 'virtually none/a great deal'; and 'entirely satisfactory/entirely unsatisfactory' respectively.

Also, during the performance of each task, actions of the subjects were carefully observed and any differences in behaviour while performing the same tasks during scenario 2 were noted.

Illuminance levels on the vertical and horizontal task surfaces were noted during both the scenarios to determine if there were changes in the lighting conditions due to the presence of multiple users in the kitchen. The subjects were questioned regarding factors that influenced the performances and the importance of flexibility. A quick discussion with the subjects regarding their experience as a participant was carried out before concluding the study.

Chapter 3. RESULTS AND ANALYSIS

3.1 Illuminance

It was observed [see appendix C] that the illuminance value on both the task surfaces of the two kitchens reduced while the users occupied the kitchen to perform the tasks. Though the illuminance levels were reduced at the beginning, they attained a constant value during both the scenarios in the dorm kitchen. However, in the case of the co-living kitchen, the illuminance levels further reduced during scenario 2 on the horizontal work surface alone. Table 3.1 lists the illuminance values on the task surface at both the scenarios for both kitchens.

Table 3.1 Illuminance values on the task surfaces at the two scenarios in both the kitchens

Task Surface Area	*Illuminance Value (lux)*			
	Dorm Kitchen		Co-living Kitchen	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
Backsplash (for reading recipes) - vertical work surface	*588*	*588*	*128*	*128*
Countertop (for slicing cucumbers) - horizontal work surface	*863*	*863*	*166*	*158*

3.2 Performance

The mean time taken was calculated from the total time taken by each of the subjects [see appendix C] in both the kitchens to perform each of the two tasks in the two scenarios and is listed in table 3.2. No significant difference was found in the time taken to perform the tasks in the two different scenarios. There was an increase of few seconds for the slicing cucumber task at scenario 2 in both the kitchens while for the reading recipes task it remained almost the same at both the scenarios in dorm kitchen. However, against expectations, it was observed in the co-living kitchen that the time taken to perform the reading task reduced at scenario 2 and had a noticeable difference.

Table 3.2 Mean time taken to perform the tasks during the two scenarios in both the kitchens

Tasks	*Mean time taken*			
	Dorm Kitchen		Co-living Kitchen	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
A: Reading recipes	*1.28*	*1.27*	*2.07*	*1.27*
B: Slicing cucumbers	*0.44*	*0.57*	*1.00*	*1.22*

As for possible errors, almost all the subjects from both the kitchens did not make any while only one subject from the co-living kitchen made two errors whilst performing the reading task in scenario 1 [see appendix C]. And, the number complete cucumber slices cut also remained almost the same at both scenarios in the kitchens for each of the subjects [see appendix C].

3.3 Subjective Assessments

3.3.1 Effort and Satisfaction

From the ratings(see fig. 3.1 to 3.4), it was observed that all the subjects felt more effort was required to perform task A: reading recipes in scenario 2 in both the kitchens. Whereas for task B: slicing cucumbers, the effort required was considered almost the same at both the scenarios in the two kitchens. Regarding the lighting conditions, the satisfaction level remained relatively the same throughout the experiment. Though the subjects from the dorm were highly satisfied with the lighting conditions to perform the tasks in their kitchen, none were entirely satisfied at any point . Whereas, the subjects from the co-living kitchen predominantly found the lighting conditions to perform the tasks in their kitchen entirely satisfying.

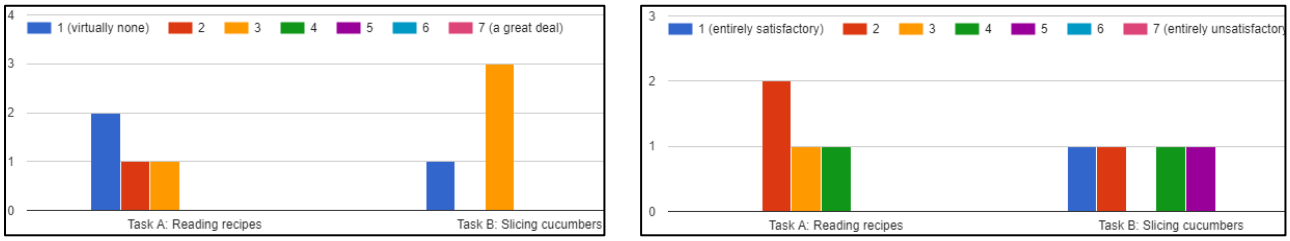


Figure 3.1 Effort made(left) and satisfaction with the lighting(right)to perform task A and task B at scenario 1 by the subjects in dorm kitchen

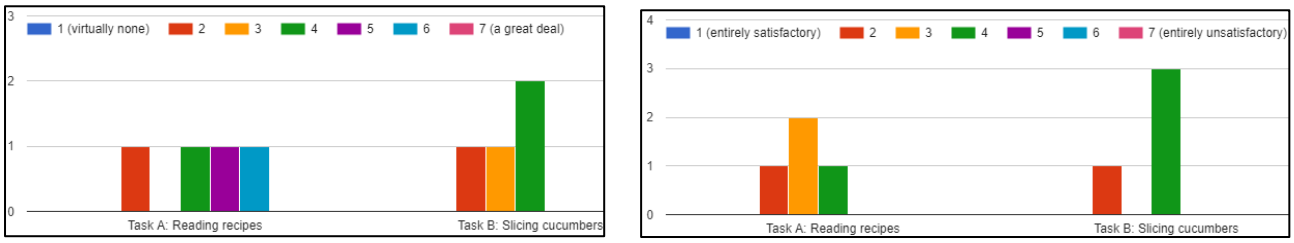


Figure 3.2 Effort made(left) and satisfaction with the lighting(right)to perform task A and task B at scenario 2 by the subjects in dorm kitchen

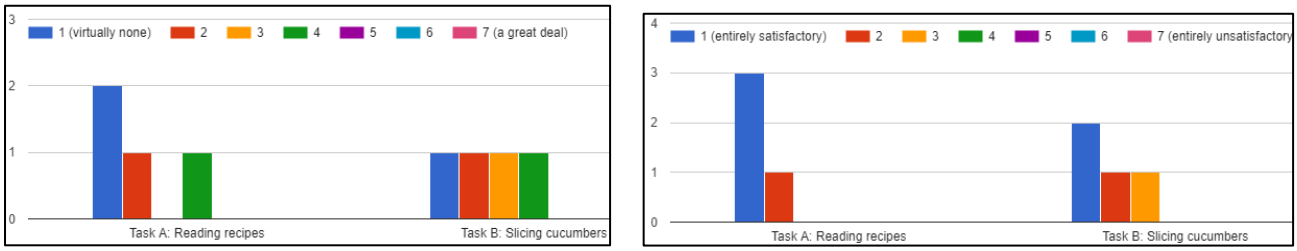


Figure 3.3 Effort made(left) and satisfaction with the lighting(right)to perform task A and task B at scenario 1 by the subjects in co-living kitchen

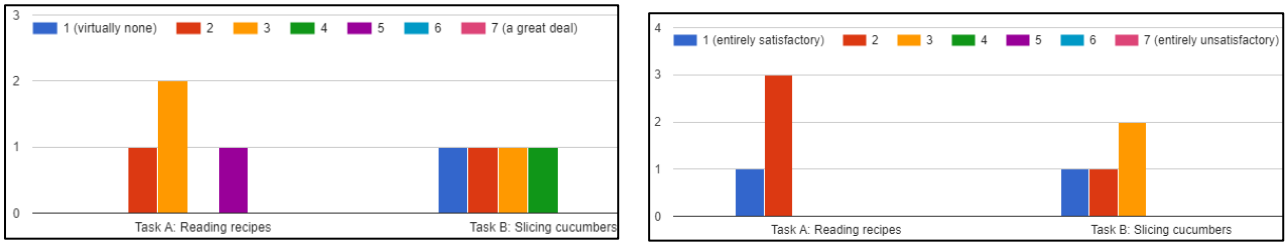


Figure 3.4 Effort made(left) and satisfaction with the lighting(right)to perform task A and task B at scenario 2 by the subjects in co-living kitchen

3.3.2 Factors influencing performance

The subjects from both the kitchens reported [see appendix C] that either the noise caused or the activities of other users in the kitchen distracted them from performing the tasks properly (see fig 3.5).

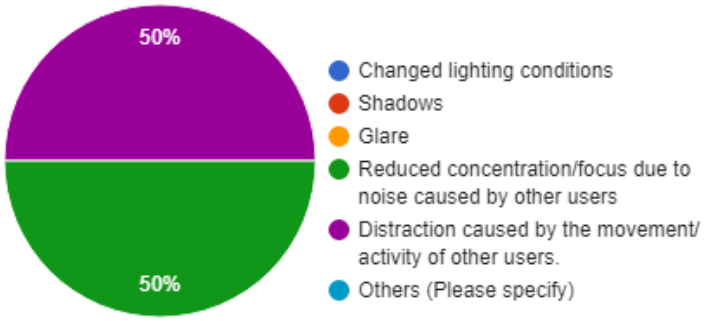


Figure 3.5 Factors that influenced the performance of the tasks by the subjects in dorm kitchen and co-living kitchen

3.3.3 Importance of flexibility

To understand the importance of flexibility in such shared spaces, the subjects were asked if they had any complaints with the kitchen space and/or task lighting.

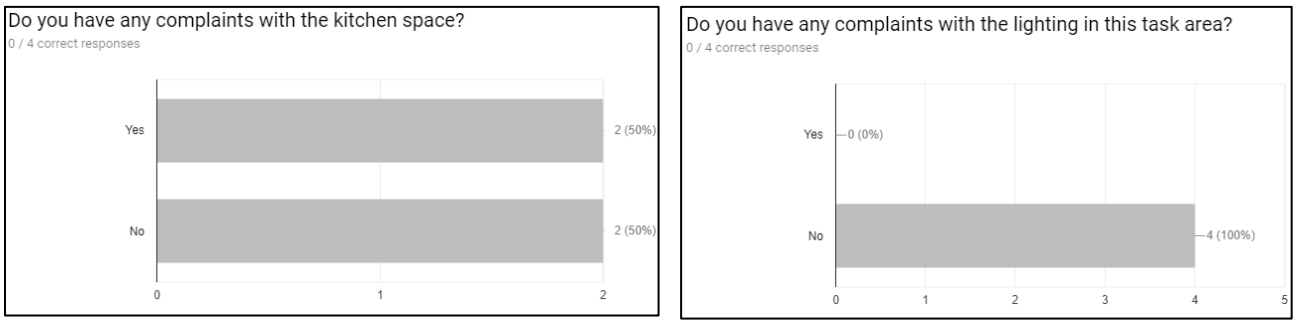


Figure 3.6 Survey results of complaints with the kitchen space and lighting from both kitchens.

At least half of the subjects from both the kitchens [see appendix B] had complaints about their kitchen space, but none had any complaints about the task lighting (see fig 3.6). Two subjects from the dorm complained about lack of personal space in the kitchen and lack of ventilation when more individuals occupied the kitchen. Similarly, two from the co-living kitchen complained about the inadequate design flow in the space for multiple tasks and/or users. Then, the subjects were asked about their preferences regarding individual controls in task lighting. As we can see from fig. 3.7, most of the subjects preferred task lighting with individual controls and were most interested in controlling the intensity of the light [see appendix C].

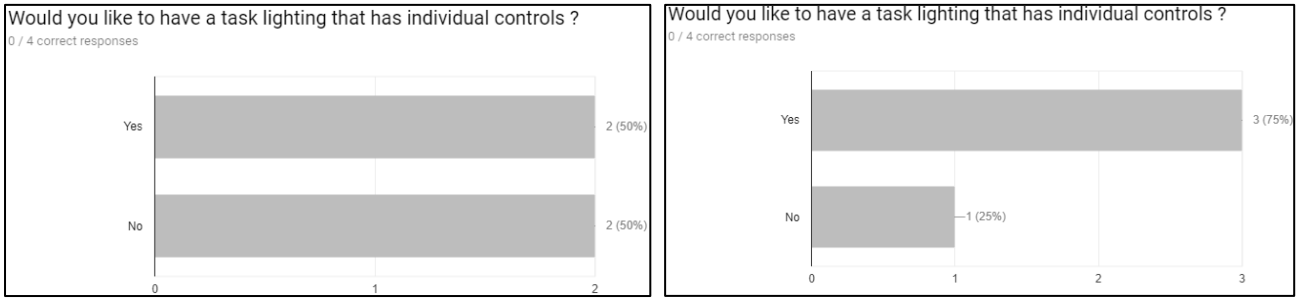


Figure 3.7 Preference of task lighting with individual controls in dorm kitchen (left) and co-living kitchen (right).

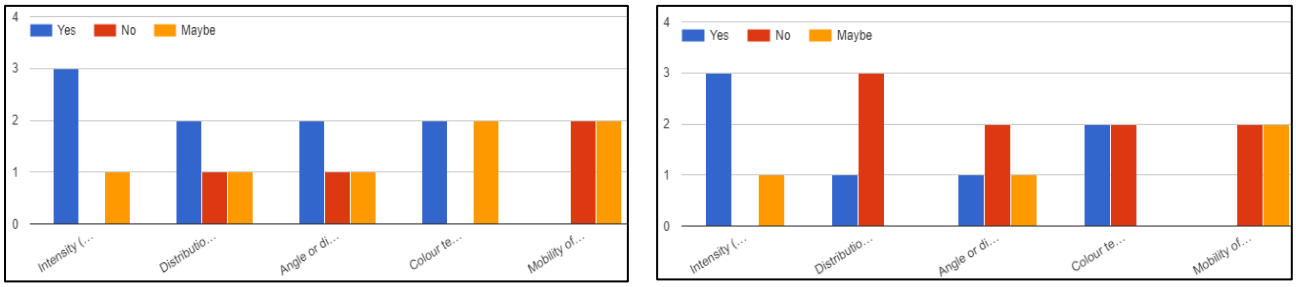


Figure 3.8 Preferred individual control with flexible options for the task lighting by subjects in dorm kitchen(left) and co-living kitchen(right).

It was noted that the subjects were also interested in controlling the distribution, direction and colour temperature of the task lighting (see fig. 3.8).

3.4 Behaviour

When performing the tasks in the different scenarios, the subjects were allowed to modify their own posture or position of the task freely. Most modifications included bending and some turning while performing the tasks (see Table 3.3). The effect of multiple users on the subjects' behaviour was quantified by assuming that the behaviour adopted by each subject in scenario 1 was their normal behaviour and identifying any changes in behaviour relative to that as modified behaviour in scenario 2 [see appendix C]. By doing this, the number of subjects in each kitchen who modified their behaviour in scenario 2 was determined (see Table 3.4). Both the frequency of behavioural changes and the no. of subjects with those changes from the co-living house was more compared to the dorm in scenario 2.

Table 3.3 Frequency of behavioral changes while performing the tasks during scenario 2 relative to behaviour at scenario 1, in both the kitchens

Behavioral changes	Dorm kitchen		Co-living kitchen	
	Task A	Task B	Task A	Task B
Turning	*0*	*0*	*1*	*1*
Bending slightly	*1*	*0*	*1*	*2*
Bending too much	*1*	*1*	*2*	*0*

Table 3.4 Number of subjects with behavioral changes while performing the tasks during scenario 2 relative to behaviour at scenario 1, in both the kitchens

Tasks	*No. of subjects with changes in behaviour*	
	Dorm Kitchen	Co-living Kitchen
A: Reading recipes	*2*	*3*
B: Slicing cucumbers	*1*	*3*

Chapter 4. DISCUSSION

The main objective of this site analysis and experiment was to establish the effect of multiple users on the illuminance and task performances in a shared residential kitchen. In the case studies conducted, it was found that the existing illuminance levels reduced when the subjects occupied the kitchen. The changed illuminance remained constant in the dorm kitchen, the reason for the change being the vague shadows of the subject cast on the task surfaces (see fig.4.1). However, in the co-living kitchen, the reduced illuminance on the countertop occurred only during scenario 2. This could possibly be due to the interference of other users or their shadows, though the shadows were not visible until carefully observed.

Overall, shadows were vaguely noticeable on the task surfaces of both the kitchens and did not create any significant impact on the task performances. Therefore, they were not considered as a factor that influenced the performance of the subjects. Moreover, shadows can be the reflection of the user interference with the ambient lighting in the kitchen. Though this is not investigated in this study, observing other lighting in the space would be important to determine why and how exactly the shadows were cast.

Out of the two tasks, the time taken for the reading task reduced in scenario 2 in both the kitchens. However, the subjects rated that the reading task required more effort in scenario 2. Nevertheless, zero errors in carrying out the tasks and almost the same amount of completely cut cucumber slices in both the scenarios show that the tasks were performed properly despite the space being crowded. This shows that the subjects tend to have increased focus while working outside their comfort zone, which would usually involve being more relaxed, or concentrating easily when alone. Thus, it can be inferred that the users tend to perform the tasks faster and want to complete it sooner when influenced by noise or other distractions caused by fellow users in the kitchen (which they have mentioned as the major factors influencing their performances).

While observing the behavioural changes, it was noticed that some of the subjects took the phone away from the given position [see appendix C] and held it under the cabinet, closer to the task light and in a slightly vertical position. This turned out to be an interesting and unplanned observation to measure the illuminance value at the same position to know if the illuminance level is higher than the vertical illuminance at the backsplash (which was the location of the given position for the phone to read the recipes). However, the illuminance level at those specific positions as shown in fig.4.1 was lower (521 lux in dorm kitchen and 103 lux in co-living kitchen) than that on the vertical (backsplash) surface (refer Table 3.1). This indicates that the subjects were comfortable with the available lighting levels but the comfortability in standing, viewing, holding things, etc. differed for each individual. It is also understood that the minor difference in the illuminance levels is not the users' concern and does not influence their performances.

Figure 4.1 Measuring illuminance at dorm kitchen (left) and co-living kitchen (right) at the positions adapted by some of the subjects holding the phone to read the recipes.

Another commonly observed behavioural change was bending in posture to perform the tasks. Some of the users assumed a bent posture during both the scenarios (as explained above, it might be their usual comfortable position). However, most of them had a bent posture in scenario 2. This can be attributed to the reason that they wanted to focus more (as discussed earlier) and to get closer to the task. However, in case of the users who were short, it was observed that they bent to avoid the task lighting at some point (while disturbed by the other users around) at the eye level. This highlights that the differences in the anthropometric measures between different users plays an important role in planning and designing the lights as well. More changes that are behavioural were observed on the co-living's users compared to the dorm's. This can be due to the difference in the user backgrounds (all users from the dorm were students whereas those from the co-living had varied backgrounds). All these observations stress the importance of studying the user groups thoroughly.

During the observations, it was noticed that one of the subjects in the co-living kitchen made two errors in task A: reading recipe at scenario 1 and took 2.40 minutes to complete the task. However, during scenario 2, the subject performed the same task (albeit with a different recipe and set of questions) and completed it in less than half of the initial time taken, in 1.01 minutes without any errors. In addition, the user rated that this task required more effort to perform in scenario 2. The user mentioned during the discussion after the experiment that he had got acquainted to the reading task by then and adapted himself to the new scenario 2 before his turn while others where already performing the task.

This again proves that though the subjects have complaints about the space, noise, users, etc., they still adapt to the changes rapidly. This is can be considered as one of the traits of individuals living in a shared accommodation. In addition, it was understood that when a person is well experienced or well adapted in doing a certain task, he/she could do it with less effort in any difficult situation during the process. Thus, these can be the reasons why there have not been many complaints or discussion about shared kitchens till date as the users get accustomed to such environments but lose or give up on comfortability in most of the things.

This study was carried out having flexibility as the vision for lighting design in shared residential kitchens. Therefore, as shown in the study, its importance, necessity and function, were analysed qualitatively. It was noticed from direct observations and from the users' feedback [refer 3.3.3, see appendix B] that shared residential kitchens lack flexible design flow and do not cater to the needs of different users. However, there were no complaints regarding the task lighting (of the preparation zone)

in the kitchens. Still, the users preferred to have individual controls with flexible options for the task lighting as they predicted that it might serve to cater their personal needs, especially concerning the mood and comfortability at different situations [see appendix B].

During the final discussion with the subjects in the co-living house, they were asked why they did not prefer to change the brightness of the available (dimmable) control of the task light. All of them responded that they just did not feel like changing it as it depends entirely on the mood, situation and the tasks performed. They also mentioned that they usually prefer to dim the light when alone, after waking up or while reading a book, etc. This clearly demonstrates that mood plays an important role in the preferred lighting conditions, which again differs with every individual.

Even though the experimental set up in this case study tried to adapt natural kitchen scenarios, it was still scripted. So, task performances, behaviour and results were not achieved completely in a natural workflow. The study did have an influence in the behavioural pattern of some subjects in the manner that they became more conscious at least during the scenario 2.

Chapter 5. CONCLUSIONS AND FUTURE WORK

5.1 Conclusions

It was found that the multiple users affected the various performances carried out in a shared residential kitchen. There were shadows cast by multiple users, which alter the illuminance levels in the task areas to a certain extent. However, this change in illuminance levels is not sufficient to affect the visual and task performances carried out. Hence, it is clear that the multiple users have extreme influences on the performances (most directly) without having any major impact on the lighting conditions.

To conclude, the study shows that task lighting in shared residential kitchens is not entirely designed keeping in mind the number of users or that fact that different tasks are performed in different ways at the same time. Therefore, it is recommended to reconsider the lighting design standards for shared residential kitchens and in particular, the ergonomics and flexibility of the design.

In addition, it was inferred that flexibility plays a major role in designing shared residential kitchens catering to the needs of different users. Flexibility in lighting design, especially in task lighting, is not considered a necessity but still would help achieving better lighting conditions. From the investigations, it was established that mood, situation and flexibility are highly correlated when lighting is concerned. Hence, flexible solutions in lighting would add to the comfortability and well-being of the space and the users, as well as create more practical lighting conditions mainly for shared spaces. Thus, flexibility in lighting devices would definitely be beneficial for shared residential kitchens.

This study serves as a stepping-stone for further investigations and explorations on lighting in shared kitchen spaces and is of assistance to ongoing or future research studies on shared living spaces. For example, IKEA's external innovation lab Space10 has created an online platform for researching and developing concepts for future shared living spaces. One Shared House 2030 is a collaboration between Space10 and Brooklyn design studio Anton & Irene. The project aims to get insights on the future of co-living[16]. In such projects, this thesis can throw more light on the most important shared area, the kitchen in the co-living space or it can also serve as an inspiration to study lighting in any other shared areas of the co-living spaces.

5.2 Future work

This thesis can be considered as an initial step to look into shared spaces and their lighting design. Many improvements can be made in it during further studies.

- As stated in the discussion, the other lighting in the kitchen space – accent and ambient, should also be considered to get definite results.
- The technical aspects including the colour temperature and light distribution have to be studied as they greatly affect the mood and well-being of the users and the task surfaces of the space respectively.
- The other important zones; cooking and cleaning zones can also provide better findings for the investigation questions of this study.
- Though it was not intentional, the shared residential kitchens in this study happened to be island kitchens. On a broader perspective, other kitchen types should also be explored to know the

limitations and differences between the various types of shared residential kitchens to analyse the space and its lighting conditions better.

- A detailed user background should also be considered to make the observations and analysis more accurately.
- It was observed that some of the users had different and varied responses during the discussion after the experiment, especially on general opinions about the shared environment, multiple users, etc. which were asked at the beginning of the study. In future, it would be interesting to ask the same set of questions at both the beginning and the end of the study.
- The entire experiment can be observed in a more natural situation with the help of video recorder or CCTVs for observations without making the users conscious about the study, as it changes their behavioural pattern into a more artificial one.

REFERENCES

*Online references were last accessed on 25.05.2018

[1] Cornelia Gerdenitsch - Tabea E.Scheel - Julia Andorfer - Christian Korunka https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4843169/

[2] http://www.kollektivhus.nu/pdf/SwedishCohousing14.pdf

[3] https://www.archdaily.com/tag/co-living

[4] http://www.kollektivhus.nu/pdf/SwedishCohousing14.pdf

[5] https://www.techfarm.life/k9

[6] https://en.wikipedia.org/wiki/Kitchen

[7] https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1470-6431.1987.tb00138.x

[8] https://www.thebalancesmb.com/everything-you-need-to-know-about-restaurant-kitchens-2888800

[9] https://en.wikipedia.org/wiki/Lighting#Indoor_lighting

[10] Kitchen and Bath Lighting: Concept, Design, Light, Dan Blitzer, Tammy Mackay, NKBA (National Kitchen and Bath Association) ISBN: 978-1-118-45454-1

[11] http://www.alulinegms.com/sitedata/files/kitchen_design_guide.pdf

[12] http://www.lrc.rpi.edu/programs/solidstate/assist/pdf/LED-lighting-apps-guide-2002.pdf

[13] http://www.lrc.rpi.edu/programs/solidstate/assist/pdf/undercabinet1.pdf

[14] https://www.tapwarehouse.com/blog/pull-out-tap-kitchen-accessory

[15] The effect of illuminance on the performance of domestic kitchen work by two age groups . P.J. McGuiness, MSc, and P.R. Boyce, PhD, MCIBS

[16] http://onesharedhouse2030.com/about/

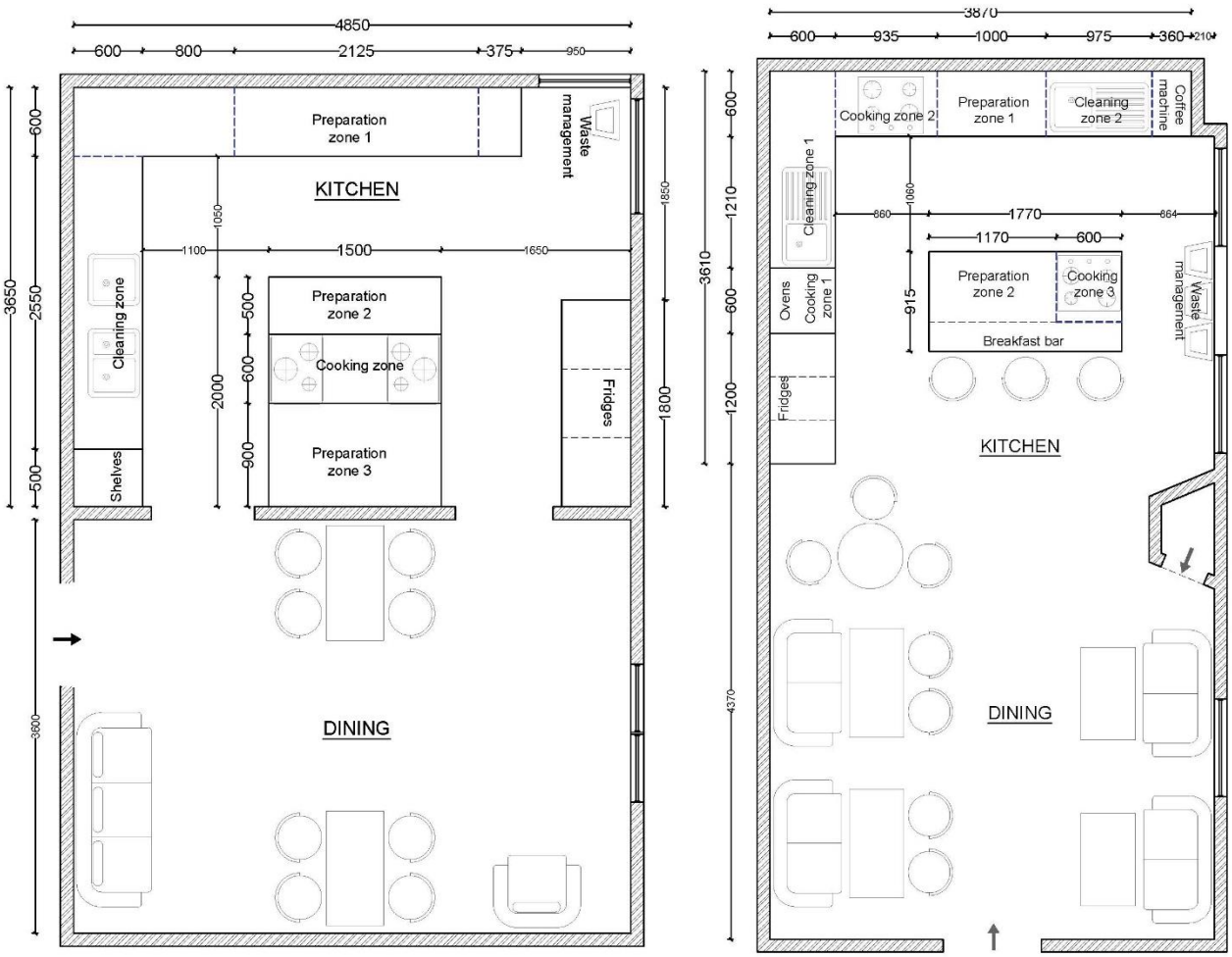
APPENDICES

APPENDIX A

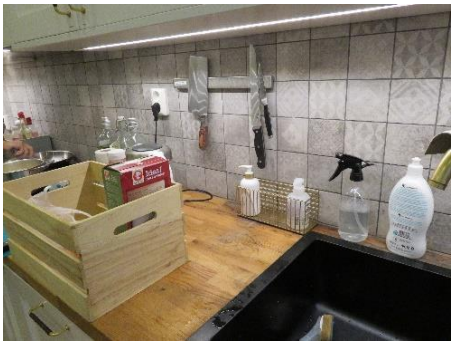
Case study – Site and Experiment details

Plan (left): Dorm kitchen, Lappis, Stockholm

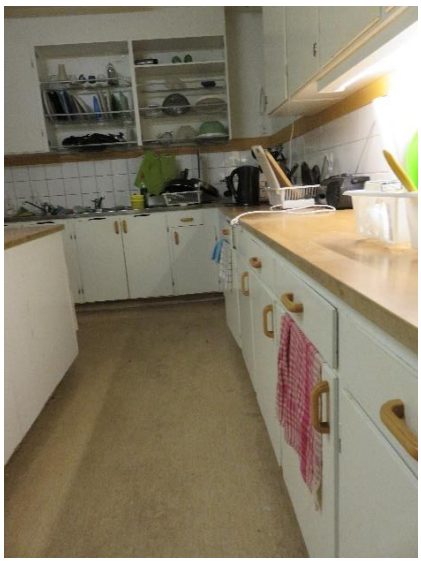
Plan (right): Co-living kitchen, K9, Kommendörsgatan, Stockholm



Site pictures: Co-living kitchen, K9, Kommendörsgatan, Stockholm



Site pictures: Dorm kitchen, Lappis, Stockholm



APPENDIX B

Questionnaires and Survey Responses

Generated with google forms

Questionnaire 1

Stage 1 - Analysis of the existing space,users and lighting.

These set of questions are asked at the beginning of the case study as a part of the site and subject analysis. This also serves as a basis for shaping the methodology for the experiment and further investigation.

Subject Analysis

1. **Gender**
   Mark only one oval.
   - ◯ Male
   - ◯ Female

2. **Age**
   Mark only one oval.
   - ◯ Below 21
   - ◯ 21 - 30
   - ◯ 30 - 35
   - ◯ Above 35

3. **How often do you cook in this kitchen?**
   Mark only one oval.
   - ◯ 1) less than once a week
   - ◯ 2) 1-3 times in a week
   - ◯ 3) 3-5 times in a week
   - ◯ 4) more than 5 times a week

4. **How skilled are you with performing the kitchen tasks ?**
   Mark only one oval.
   - ◯ Poor
   - ◯ Moderate
   - ◯ Good

Space and Situation Analysis

5. **How comfortable are you sharing a kitchen?**
   Mark only one oval.

	0	1	2	3	4	5	
Very uncomfortable	◯	◯	◯	◯	◯	◯	Very comfortable

6. **How do you prefer working in the kitchen?**
Mark only one oval.

- 1) Alone
- 2) With 1 other person
- 3) With more than 1 person
- 4) No preference

7. **Do you prefer to change your working area in the kitchen when someone else is working next to you?**
Mark only one oval.

- Yes
- No

8. **If yes, choose the reason?**
Mark only one oval.

- You want to avoid disturbing the other person
- You feel disturbed by the other person
- You need more space during the cooking procedure
- It interferes with the lighting required for your tasks
- Other reasons (Please specify)

9. **Which is the most used area by you in this kitchen?**
Mark only one oval.

- Cooking area
- Prep area
- Sink area

10. **Where do you usually prepare for your recipes?**
Mark only one oval.

- Prep area - under the cabinets
- Counter space near the cook-top
- Both , depending on the availability

Lighting and situation analysis . Safety, Health and Well-being

11. **How do you find the lighting quality (artificial lighting) in the kitchen during hours of darkness?**
Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

12. **Rate the mood or feeling you experience in the space, especially when the kitchen is occupied by multiple users (on a scale of 1 to 5 in the following categories)**
Mark only one oval per row.

	0	1	2	3	4	5
Unpleasant(0) - Very pleasant(5)	◯	◯	◯	◯	◯	◯
Dull(0) - Energetic(5)	◯	◯	◯	◯	◯	◯
Tensed(0) - Relaxed(5)	◯	◯	◯	◯	◯	◯
Distracted(0) - Focused(5)	◯	◯	◯	◯	◯	◯

13. **What affects your duration of time spent in the kitchen?**
Mark only one oval.

- ◯ The other housemates working in the kitchen (Either a good company or a disturbance)
- ◯ Noise
- ◯ Existing lighting conditions
- ◯ Nothing specific
- ◯ Other reasons(Please specify)

14. **Do you get distracted easily in the kitchen?**
Mark only one oval.

- ◯ Yes
- ◯ No

15. **How often did you experience domestic accidents in the kitchen ? (For e.g. cutting your finger or any other form of injuries?)**
Mark only one oval.

- ◯ Rarely
- ◯ Often
- ◯ Regularly
- ◯ Never

16. **Could any of the following be reasons for such accidents? Please choose the most likely reason.**
Mark only one oval.

- ◯ Lighting conditions
- ◯ Disturbances/ distractions caused by fellow users
- ◯ Other reasons (Please specify)

17. **Do you suffer from any health repercussions (for e.g. minor issues viz. headaches, eye strain or any major issues) due to working for a longer period of time in the kitchen with more than one user?**
Mark only one oval.

- ◯ Rarely
- ◯ Often
- ◯ Never

18. **If yes, could any of the following be the reasons for such issues? Please choose the most likely reason.**

Mark only one oval.

- ◯ Lighting conditions
- ◯ Noise
- ◯ Crowded space with multiple users
- ◯ All of the above
- ◯ Others (Please specify)

Questionnaire 2.1

Stage 2 - Scenario 1

These set of questions are asked at the end of each task in Scenario 1 (questions explained).

Scenario 1 - Answer the following two questions after performing each of the tasks respectively.

Effort and Satisfaction

1. **How much effort did you require to perform the task (on a scale of 1 to 7 from virtually none to a great deal)?**
   Mark only one oval per row.

	1 (virtually none)	2	3	4	5	6	7 (a great deal)
Task A: Reading recipes	◯	◯	◯	◯	◯	◯	◯
Task B: Slicing cucumbers	◯	◯	◯	◯	◯	◯	◯

2. **How suitable do you consider the kitchen lighting for the performance of the task (on a scale of 1 to 7 from entirely satisfactory to entirely unsatisfactory)?**
   Mark only one oval per row.

	1 (entirely satisfactory)	2	3	4	5	6	7 (entirely unsatisfactory)
Task A: Reading recipes	◯	◯	◯	◯	◯	◯	◯
Task B: Slicing cucumbers	◯	◯	◯	◯	◯	◯	◯

Questionnaire 2.2

Stage 2 - Scenario 2

These set of questions are asked at the end of each task in Scenario 2 (questions explained).

Scenario 2 - Answer the following two questions after performing each of the tasks respectively.

Effort and Satisfaction

1. **How much effort did you require to perform the task (on a scale of 1 to 7 from virtually none to a great deal)?**
   Mark only one oval per row.

	1 (virtually none)	2	3	4	5	6	7 (a great deal)
Task A: Reading recipes	◯	◯	◯	◯	◯	◯	◯
Task B: Slicing cucumbers	◯	◯	◯	◯	◯	◯	◯

2. **How suitable do you consider the kitchen lighting for the performance of the task (on a scale of 1 to 7 from entirely satisfactory to entirely unsatisfactory)?**
   Mark only one oval per row.

	1 (entirely satisfactory)	2	3	4	5	6	7 (entirely unsatisfactory)
Task A: Reading recipes	◯	◯	◯	◯	◯	◯	◯
Task B: Slicing cucumbers	◯	◯	◯	◯	◯	◯	◯

Questionnaire 3

Stage 2 - These set of questions are asked after the experiment is completed (questions explained).

Factors influencing performance

1. **What do you think were the factors that influenced your performance (can choose more than one factor if required)?**
   Mark only one oval.

   - ◯ Changed lighting conditions
   - ◯ Shadows
   - ◯ Glare
   - ◯ Reduced concentration/focus due to noise caused by other users
   - ◯ Distraction caused by the movement/ activity of other users.
   - ◯ Others (Please specify)

Flexibility

2. **Do you have any complaints with the kitchen space?**
   Mark only one oval.

   - ◯ Yes
   - ◯ No

3. **If yes, what is it ?**

   _____

4. **Do you have any complaints with the lighting in this task area?**
   Mark only one oval.

   - ◯ Yes
   - ◯ No

5. **If yes, what is it ?**

   _____

6. **Would you like to have a task lighting that has individual controls ?**
   Mark only one oval.

   - ◯ Yes
   - ◯ No

7. **If yes, (1) Why would you like an individual control?(2) What would you like to control?(3) When do you want to control?**

   _____

8. **Choose if you would prefer to have an individual control of the following flexible options for the task lighting.**

Mark only one oval per row.

	Yes	No	Maybe
Intensity (brightness/dimming options)	◯	◯	◯
Distribution (to focus on the spot or spread over the surface)	◯	◯	◯
Angle or direction of light/luminaire	◯	◯	◯
Colour temperature of the light (bright white,soft white/yellow, blue or any other colour of choice)	◯	◯	◯
Mobility of the luminaire (for ex., pulling it out or moving/dragging it to some other area)	◯	◯	◯

Dorm kitchen – Survey Results

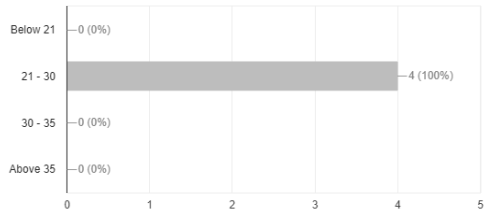
Questionnaire 1 - Responses

Gender

0 / 4 correct responses

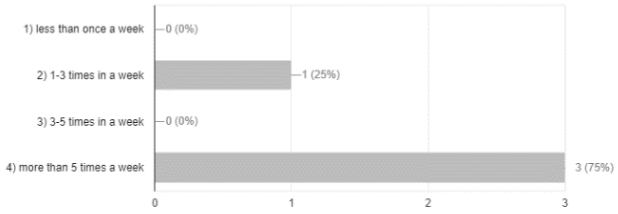
Age

0 / 4 correct responses



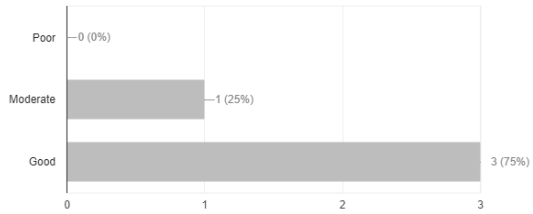
How often do you cook in this kitchen?

0 / 4 correct responses



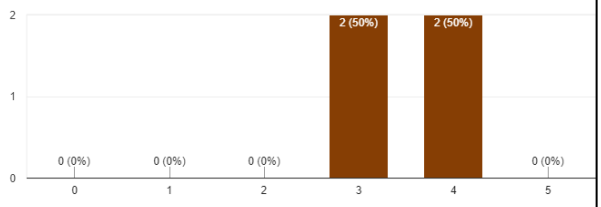
How skilled are you with performing the kitchen tasks ?

0 / 4 correct responses



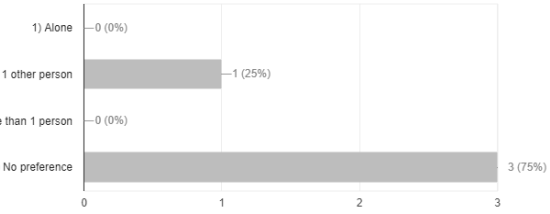
How comfortable are you sharing a kitchen?

4 responses



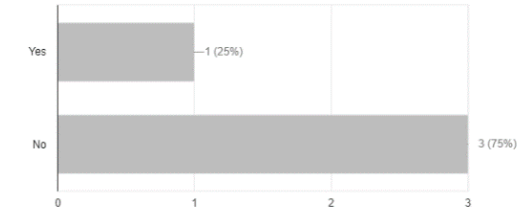
How do you prefer working in the kitchen?

0 / 4 correct responses



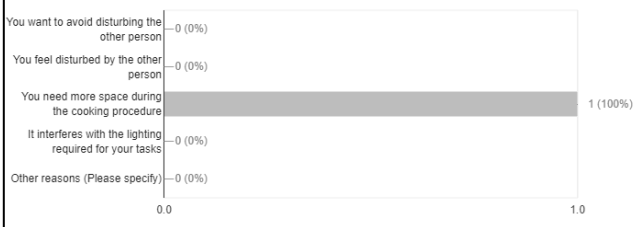
Do you prefer to change your working area in the kitchen when someone else is working next to you?

0 / 4 correct responses



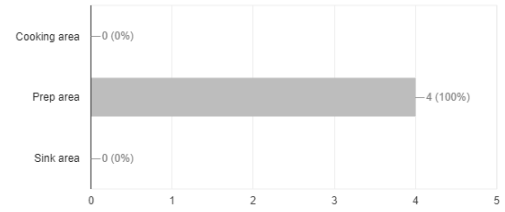
If yes, choose the reason?

0 / 1 correct response



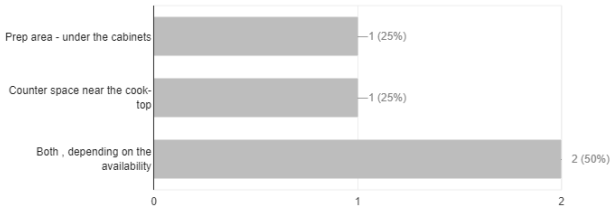
Which is the most used area by you in this kitchen?

0 / 4 correct responses



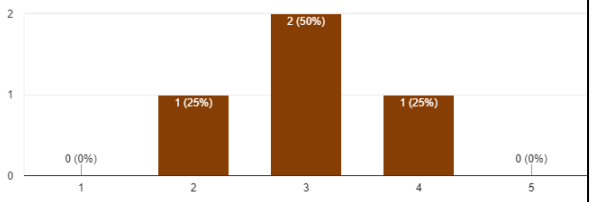
Where do you usually prepare for your recipes?

0 / 4 correct responses

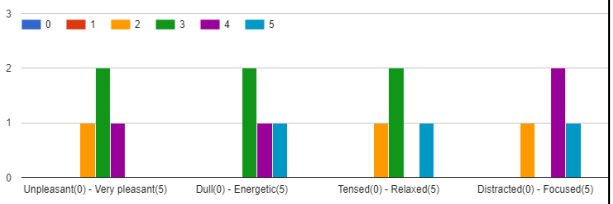


How do you find the lighting quality (artificial lighting) in the kitchen during hours of darkness?

4 responses

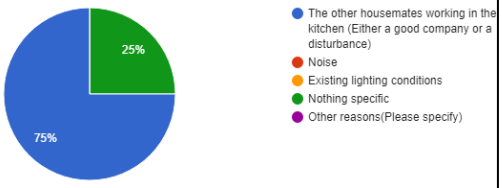


Rate the mood or feeling you experience in the space, especially when the kitchen is occupied by multiple users (on a scale of 1 to 5 in the following categories)



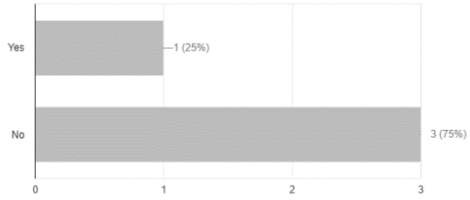
What affects your duration of time spent in the kitchen?

4 responses



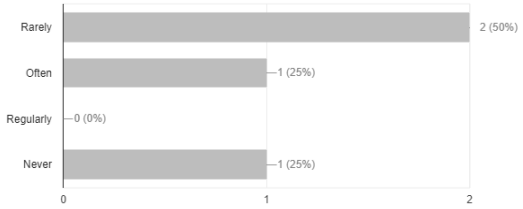
Do you get distracted easily in the kitchen?

0 / 4 correct responses



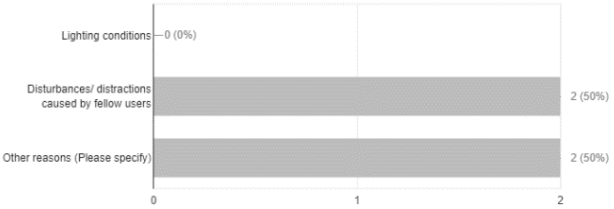
How often did you experience domestic accidents in the kitchen ? (For e.g. cutting your finger or any other form of injuries?)

0 / 4 correct responses



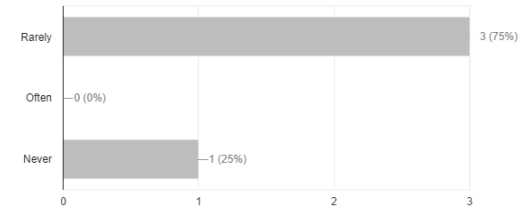
Could any of the following be reasons for such accidents? Please choose the most likely reason.

0 / 4 correct responses



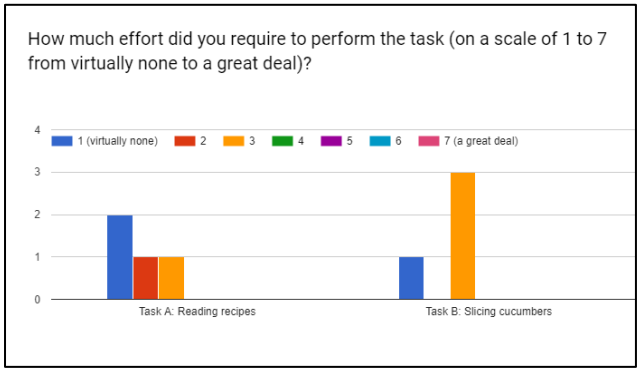
Do you suffer from any health repercussions (for e.g. minor issues viz. headaches, eye strain or any major iss... the kitchen with more than one user?

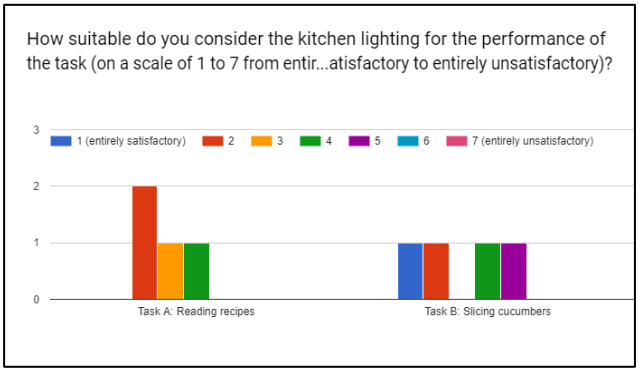
0 / 4 correct responses



Dorm kitchen – Survey Results

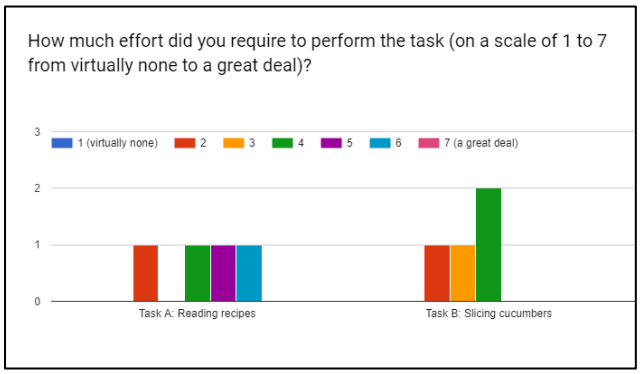
Questionnaire 2.1 - Responses

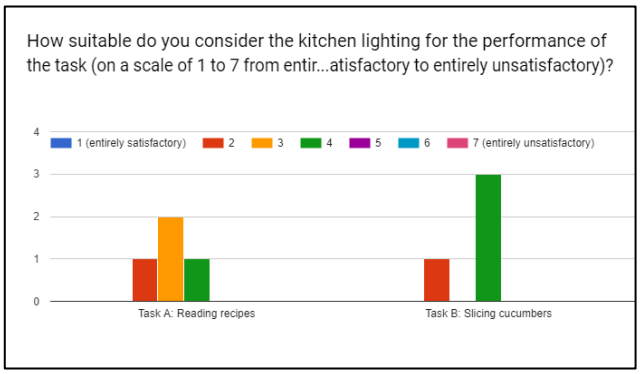




Dorm kitchen – Survey Results

Questionnaire 2.2 - Responses



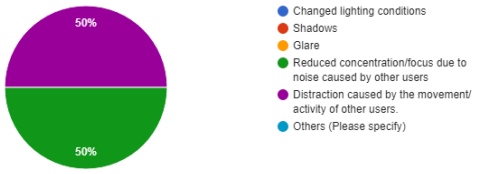


Dorm kitchen – Survey Results

Questionnaire 3 - Responses

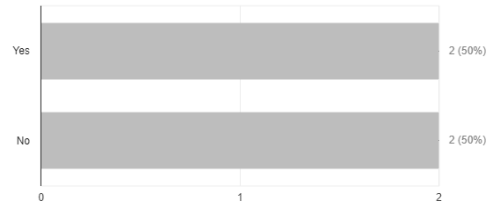
What do you think were the factors that influenced your performance (can choose more than one factor if required)?

4 responses



Do you have any complaints with the kitchen space?

0 / 4 correct responses



If yes, what is it ?

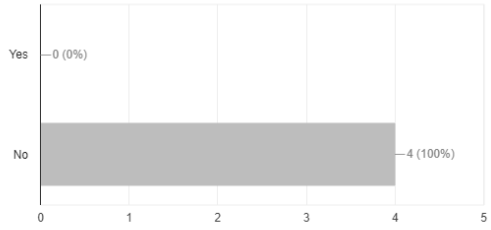
2 responses

A little tight for personal space.

Lack of proper ventilation especially when many cooks.

Do you have any complaints with the lighting in this task area?

0 / 4 correct responses



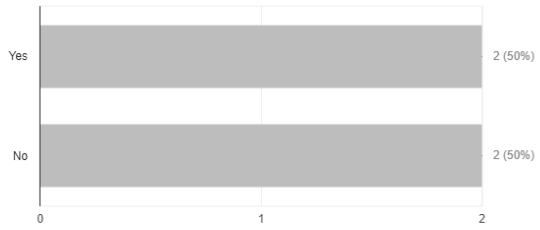
If yes, what is it ?

0 responses

No responses yet for this question.

Would you like to have a task lighting that has individual controls ?

0 / 4 correct responses



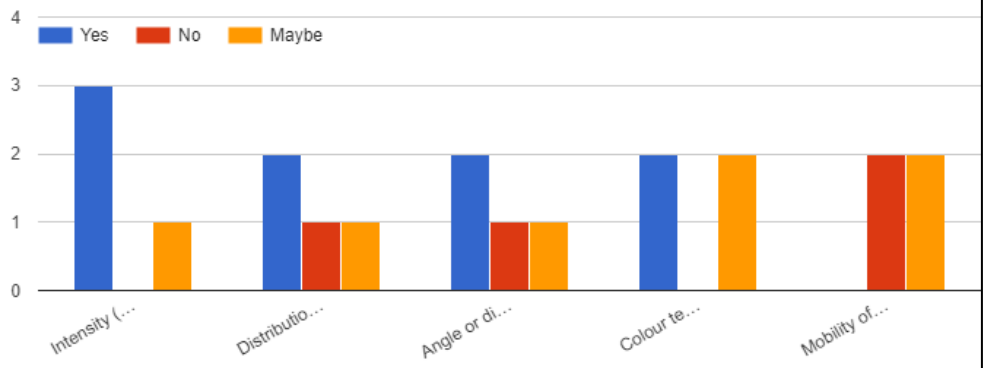
If yes, (1) Why would you like an individual control?(2) What would you like to control?(3) When do you want to control?

2 responses

Light intensity whenever I wanted to change.

Control the intensity of the light at different times of the day

Choose if you would prefer to have an individual control of the following flexible options for the task lighting.

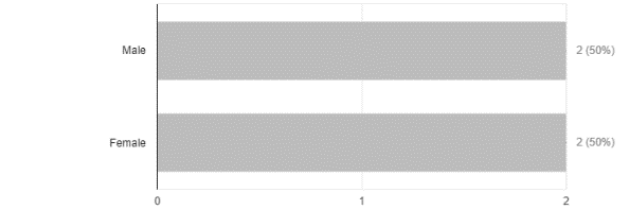


Co-living kitchen – Survey Results

Questionnaire 1 - Responses

Gender

0 / 4 correct responses

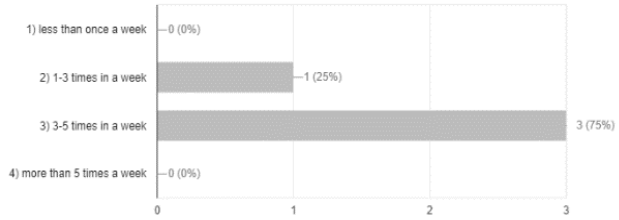


Age

0 / 4 correct responses

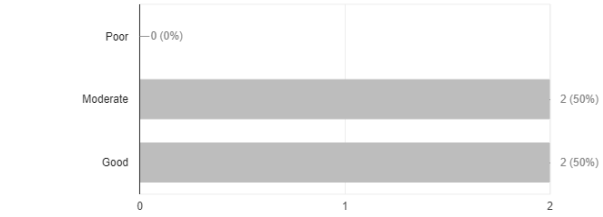
How often do you cook in this kitchen?

0 / 4 correct responses



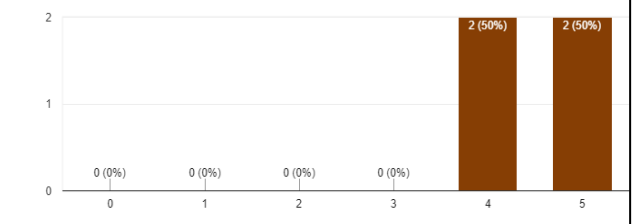
How skilled are you with performing the kitchen tasks ?

0 / 4 correct responses



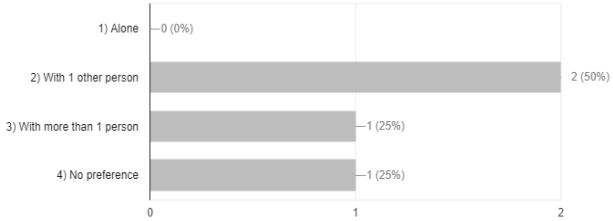
How comfortable are you sharing a kitchen?

4 responses



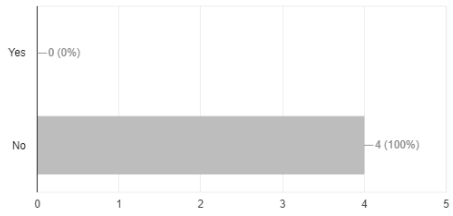
How do you prefer working in the kitchen?

0 / 4 correct responses



Do you prefer to change your working area in the kitchen when someone else is working next to you?

0 / 4 correct responses



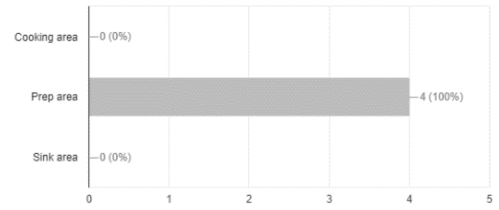
If yes, choose the reason?

0 / 0 correct responses

No responses yet for this question.

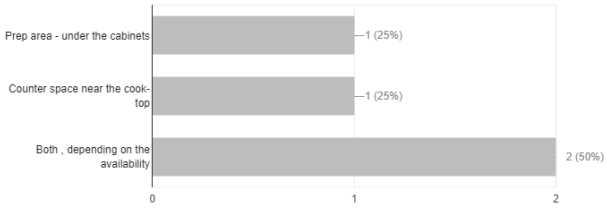
Which is the most used area by you in this kitchen?

0 / 4 correct responses



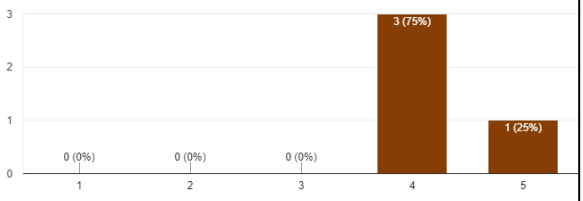
Where do you usually prepare for your recipes?

0 / 4 correct responses

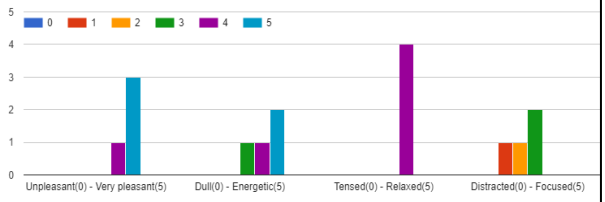


How do you find the lighting quality (artificial lighting) in the kitchen during hours of darkness?

4 responses

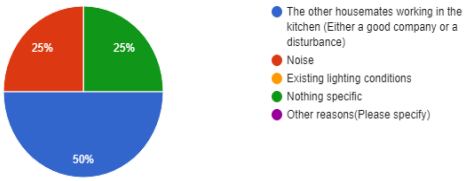


Rate the mood or feeling you experience in the space, especially when the kitchen is occupied by multiple users (on a scale of 1 to 5 in the following categories)



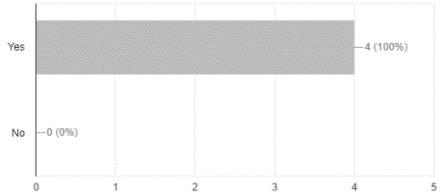
What affects your duration of time spent in the kitchen?

4 responses



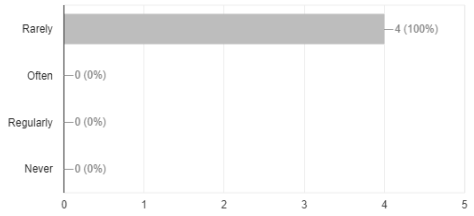
Do you get distracted easily in the kitchen?

0 / 4 correct responses



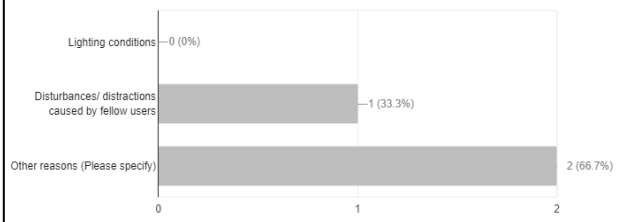
How often did you experience domestic accidents in the kitchen ? (For e.g. cutting your finger or any other form of injuries?)

0 / 4 correct responses



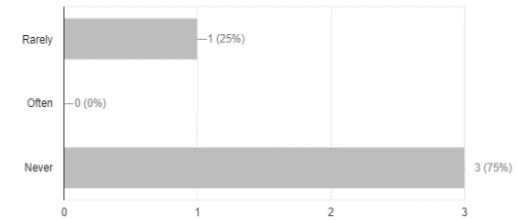
Could any of the following be reasons for such accidents? Please choose the most likely reason.

0 / 3 correct responses



Do you suffer from any health repercussions (for e.g. minor issues viz. headaches, eye strain or any major iss... the kitchen with more than one user?

0 / 4 correct responses

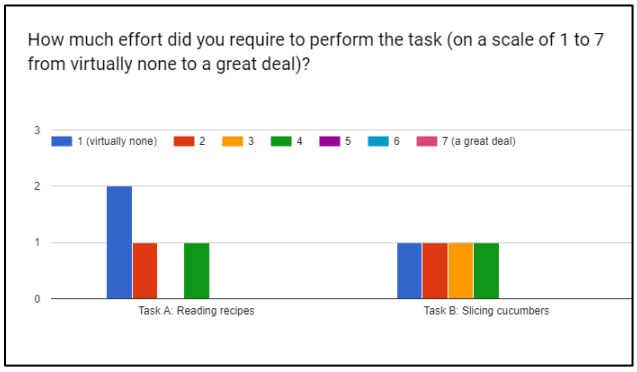


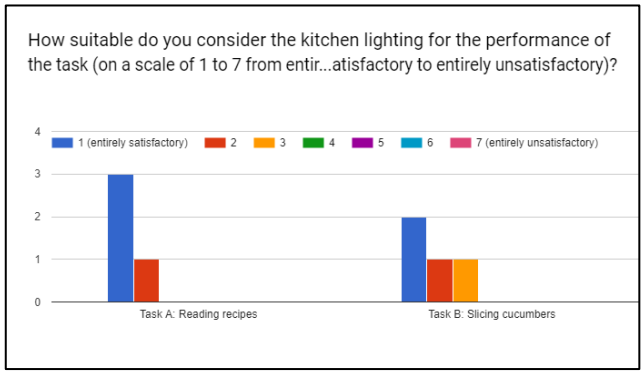
If yes, could any of the following be the reasons for such issues? Please choose the most likely reason.

0 / 1 correct response

Co-living kitchen – Survey Results

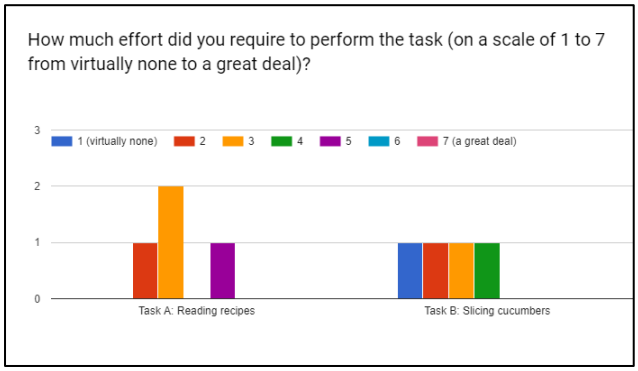
Questionnaire 2.1 - Responses

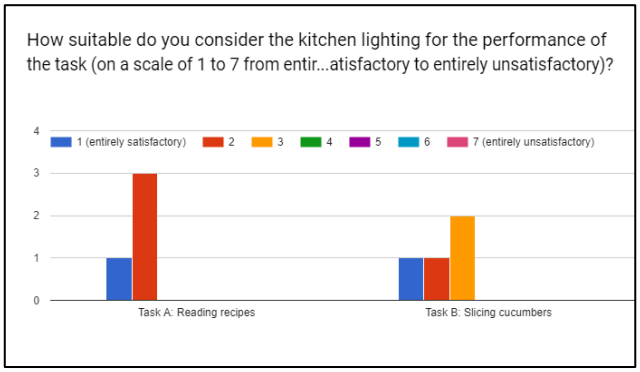




Co-living kitchen – Survey Results

Questionnaire 2.2 - Responses



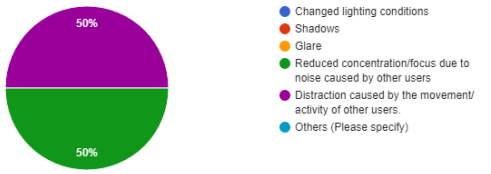


Co-living kitchen – Survey Results

Questionnaire 3 - Responses

What do you think were the factors that influenced your performance (can choose more than one factor if required)?

4 responses



Do you have any complaints with the kitchen space?

0 / 4 correct responses

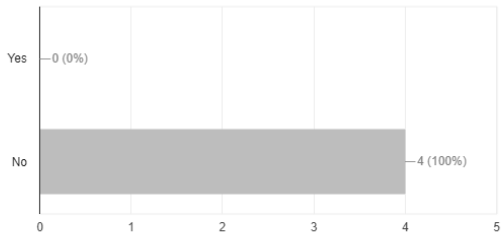
If yes, what is it ?

4 responses

x
Note sure if this is a complaint, but I feel, maybe I'm a bit too tall for it and I have to for example, bend more.
xx
Inadequate design flow for multiple works/users.

Do you have any complaints with the lighting in this task area?

0 / 4 correct responses



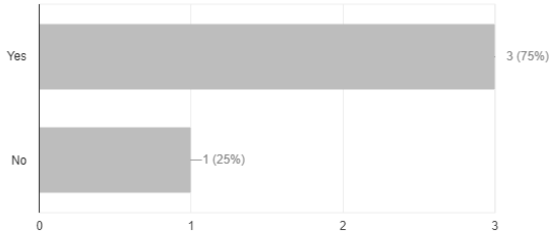
If yes, what is it ?

0 responses

No responses yet for this question.

Would you like to have a task lighting that has individual controls ?

0 / 4 correct responses



If yes, (1) Why would you like an individual control?(2) What would you like to control?(3) When do you want to control?

4 responses

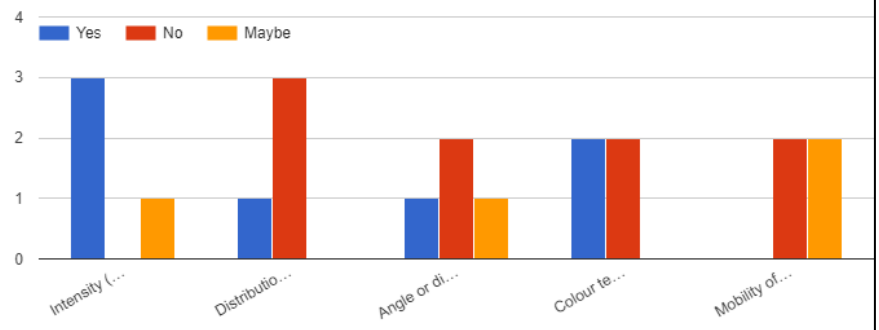
I don't necessarily need the same light if I'm reading, cutting or doing something else. No or more light when I need.

Individual controls may not make the kitchen look nice. But it makes it more practical.

Can be more comfortable . Like controlling the brightness maybe. I would control it depending on what I'm doing in the kitchen.

xx

Choose if you would prefer to have an individual control of the following flexible options for the task lighting.



APPENDIX C

Observations and measurements

Time taken

Tasks	*Time taken by each subject*							
	Co-living Kitchen							
	Scenario 1				Scenario 2			
	Subject 1	Subject 2	Subject 3	Subject 4	Subject 1	Subject 2	Subject 3	Subject 4
A: Reading recipes	*1.21*	*3.52*	*1.13*	*2.40*	*1.29*	*2.27*	*0.49*	*1.01*
B: Slicing cucumbers	*0.51*	*0.49*	*1.22*	*0.20*	*0.55*	*1.15*	*1.26*	*0.30*

Tasks	*Time taken by each subject*							
	Dorm Kitchen							
	Scenario 1				Scenario 2			
	Subject 1	Subject 2	Subject 3	Subject 4	Subject 1	Subject 2	Subject 3	Subject 4
A: Reading recipes	*1.08*	*1.20*	*1.56*	*1.29*	*1.22*	*1.05*	*2.20*	*0.59*
B: Slicing cucumbers	*0.36*	*0.54*	*0.53*	*0.34*	*1.09*	*0.40*	*0.43*	*0.35*

Means of time taken to perform the tasks				
Tasks	Dorm Kitchen		Co-living Kitchen	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
A: Reading recipes	*1.28*	*1.27*	*2.07*	*1.27*
B: Slicing cucumbers	*0.44*	*0.57*	*(0.60=)1.00*	*(0.82=)1.22*

Errors made and cucumber slices

No. of errors made							
Co-living Kitchen							
Scenario 1				Scenario 2			
Subject 1	Subject 2	Subject 3	Subject 4	Subject 1	Subject 2	Subject 3	Subject 4
0	*0*	*0*	*2*	*0*	*0*	*0*	*0*

No. of errors made							
Dorm Kitchen							
Scenario 1				Scenario 2			
Subject 1	Subject 2	Subject 3	Subject 4	Subject 1	Subject 2	Subject 3	Subject 4
0	*0*	*0*	*0*	*0*	*0*	*0*	*0*

No. of complete thin cucmber slices							
Co-living Kitchen							
Scenario 1				Scenario 2			
Subject 1	Subject 2	Subject 3	Subject 4	Subject 1	Subject 2	Subject 3	Subject 4
12	*16*	*22*	*16*	*18*	*20*	*19*	*19*

No. of complete thin cucmber slices							
Dorm Kitchen							
Scenario 1				Scenario 2			
Subject 1	Subject 2	Subject 3	Subject 4	Subject 1	Subject 2	Subject 3	Subject 4
10	*9*	*6*	*12*	*9*	*11*	*7*	*12*

Behavioural observations

Behavioral observations during **task A** performances								
Dorm Kitchen								
Behaviour	Subject 1		Subject 2		Subject 3		Subject 4	
	At Scenarios							
	1	2	1	2	1	2	1	2
Reading keeping the phone at the given position	*	*	*	*			*	*
Reading keeping the phone on countertop								
Lifting the phone and reading					*	*		
Bending slightly			*	*	*			*
Bending too much	*	*				*		
Turning to read								
Turning along with the phone								

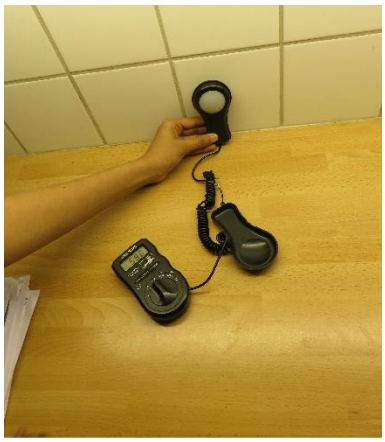
Behavioral observations during **task A** performances								
Co-living Kitchen								
Behaviour	Subject 1		Subject 2		Subject 3		Subject 4	
	At Scenarios							
	1	2	1	2	1	2	1	2
Reading keeping the phone at the given position	*	*		*				
Reading keeping the phone on countertop								
Lifting the phone and reading			*		*	*	*	*
Bending slightly	*					*	*	*
Bending too much		*		*				
Turning to read				*				

Turning along with the phone								
Behavioral observations during **task B** performances								
Dorm Kitchen								
Behaviour	Subject 1		Subject 2		Subject 3		Subject 4	
	At Scenarios							
	1	2	1	2	1	2	1	2
Standing straight	*	*					*	
Turning								
Bending slightly			*	*	*	*		
Bending too much								*

Behavioral observations during **task B** performances								
Co-living Kitchen								
Behaviour	Subject 1		Subject 2		Subject 3		Subject 4	
	At Scenarios							
	1	2	1	2	1	2	1	2
Standing straight	*						*	
Turning			*	*		*		
Bending slightly		*	*	*	*	*		*
Bending too much								

Frequency of behavioral changes during scenario 2 relative to behaviour at scenario 1

Behaviour changes	Dorm kitchen		Co-living kitchen	
	Task A	Task B	Task A	Task B
Turning	*0*	*0*	*1*	*1*
Bending slightly	*1*	*0*	*1*	*2*
Bending too much	*1*	*1*	*2*	*0*

Illuminances values (as registered in the thesis) – Co-living kitchen

Illuminances values (as registered in the thesis) – Dorm kitchen