Lighting at home is clearly one of the most crucial issues for people with sight loss. Yet little research has been published which examines the extent of the issue, and there is a lack of guidance for artificial lighting within private dwellings in the UK.

In 2001 Thomas Pocklington Trust commissioned a one year scoping study from the Research Group for Inclusive Environments (RGIE) at the University of Reading to undertake initial survey work and a small practical trial. This paper summarises the content and output of this study. The output from this project is the initial stage in the development of lighting guidance and recommendations for visually impaired people, community care professionals and designers.

The results from the home surveys carried out in this study show that surface and task illuminances were found to be varied between homes with very low levels found in some properties.

An earlier assessment of office task lighting for visually impaired people showed that 600 lux was considered by participants to be too dim for reading and the average light level selected by participants for reading was 2400 lux. This study found that in their own homes many participants were, on average, reading under much lower conditions and that these illuminances were generally accepted by participants.

The study also found low readings of illuminance levels in hazardous areas such as stairs, which were cause for concern. Many participants in the study reported awareness of the importance of lighting but finding information was perceived to be difficult. Transport and travel difficulties also prevent people gaining access to the range of lighting available.

A lack of support from health care professionals was reported, with only a small percentage of questionnaire respondents having received advice on lighting. This lack of support may reflect a lack
of specialist knowledge on lighting available to these professions, and highlights a need to inform these groups.

In the small trial of lighting in individual homes, solutions were seen to be very useful and in most cases favourably rated, though some task lights were more suitable than others depending on the task in hand.

**Introduction**

**The rationale for the study**

This report summarises the content and output of a one-year scoping study concerned with the artificial lighting requirements of visually impaired people in their own homes. The output from this project is the initial stage in the development of light guidance and recommendations for visually impaired people, community care professionals and designers. The work has been carried out by the Research Group for Inclusive Environments (RGIE) at the University of Reading and funded by Thomas Pocklington Trust. Throughout the project the research team consulted an advisory panel whose members represented a wide range of disciplines.

An inevitable outcome of the ageing population is an increase in the total number of visually impaired people. However, little research has been carried out on how artificial lighting in a domestic environment may be optimised for visually impaired people. This study is aimed at addressing this lack of evidence-based data. As well as a literature search, the project has involved the distribution of over 600 questionnaires that covered a range of issues associated with lighting in the home, a total of 206 of those returned were used in analysis. In addition, lighting surveys in the homes of 24 people with visual impairments have been carried out. In order to assess their performance and acceptability 25 different lighting solutions were installed in nine of these homes. An extensive range of results has been obtained from this study and these results are summarised in this paper.

**Visual impairment and the ageing population**

At the population is growing and ageing, the proportion of older people is expected to increase. One of the effects that growing older has on vision is that, on average, less light falls on the retina, and there is less tolerance to glare. Statistics from the Department of Health (Department of Health 2000) clearly show that a large percentage of people both blind and partially sighted people are 75 and over.\(^1\) Of the 157,820 people registered blind in England, as at 31 March 2000, 108,360 were 75 or over. Patmore, (2002) reports that ‘it is well established that disability and isolation are linked to depression in older people’.\(^2\) However, the ongoing increase in assistive technology, ‘smart’ housing and home care means that more people can stay at home for longer. This independence has been shown to be cost effective, as well as delaying both mental and physical decline.

Information from the RNIB suggests that the most common eye pathologies are: macular degeneration, cataract, glaucoma, retinitis pigmentosa and diabetic retinopathy. Previous research has used categories to group these, and the wide range of other pathologies, based on the type of vision loss resulting from the eye condition. That is, loss in the fovea which affects visual acuity and colour perception, loss in the periphery which affects sensitivity to movement and general loss of vision across the whole visual field. Project Rainbow, a project on colour, contrast and perception funded under the LINK Construction Maintenance and Refurbishment Programme, used these resulting effects to propose three categories: central, peripheral and general visual field loss (Bright et al 1997).\(^3\)

Macular degeneration, one of the most common causes of visual impairment, makes up close tasks such as reading more difficult. This can, in some cases, be helped by the use of optical aids. Impairment of peripheral vision can result in ‘tunnel vision’, which can make it difficult to spot potential hazards. Retinitis pigmentosa, macular degeneration and cataracts can result in problems or discomfort with glare and bright lights.

Another effect of some types of visual impairment is the need for longer adaptation times for the eye to adjust to different light levels. While it is generally agreed that in many cases increased light levels may allow some visually impaired people better vision, there are also some people for whom their eye condition means that even normal levels of light can be uncomfortable or even disabling (CIE 1997).\(^4\) However, there is much anecdotal evidence to suggest that the older eye, and many visually impaired people, benefit from increased light levels. As well as helping to improve visual

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in homes. Mounting positions for lights include ceiling mounted; floor standing; table standing; and under unit lights.

Many different types of switch are also commonly available including manual switches; automatic sensors; remote switches; dimmer switches; and ‘touch’ lights which activate on contact with the base of the light and may be particularly useful for people with mobility problems and arthritis sufferers.

**Lighting research and visual impairment**

Some studies have been carried out to examine the effects of illumination on visual performance. A study by Cornelissen et al (1994) indicated that while there is a preference for a certain light level and an improvement in visual performance obtained by adapting lighting, not all subjects in their study adjusted light levels to the point of achieving maximal performance.10

This study also found that people chose their preferred level of illumination to optimise their vision of detail. These self adjusted light levels for use during close up tasks would not be ideal for distance vision, such as when the person needed to move around. It may therefore be concluded that self-adjusted lighting levels are not always the most advantageous.

Another finding was that improving illumination has an effect on visual capacities of visually impaired people. While they note that this is also true for people with no visual impairment, they report that improvement of visual performance may occur at light levels at which non-visually impaired people show little improvement. As even people with similar eye conditions have been shown to prefer different sets of levels of illumination it may not be realistic to expect to find a single general lighting solution based on type of visual impairment alone. However, this does not exclude finding a group of solutions that are popular across visual impairments, or that fit a common need.

Another study found that in older visually impaired people their level of visual acuity measured in the home was lower than in the clinic (Silver et al 1978).11 Cullinan et al (1979) also reported that as many as 60% of people attending an eye clinic see better there.

**Range of lighting available and their characteristics**

There is a wide range of styles of lighting for the home that are readily available. There are different types of light sources. These are tungsten halogen, fluorescent and incandescent. Light sources are often described in terms of their colour temperature, such as how ‘warm’ or ‘cool’ the appearance of the light is. These lamps can also be differentiated by their colour rendering performance. A variety of luminaires (light fittings) are available in the shops. These include down and up lighters; wall sconces; pendant lights; table lights; track lighting; and recessed lighting.

There are also different lighting styles including wall washing; spotlighting; and floodlighting, although the latter is not common performance, it may also increase general well-being and health.

**Accidents in the home**

The Consumer Affairs Directorate (1999) reports that the numbers of falls that occur in the home are concentrated in the very young and the very old, and the most common place in the home for an accident to take place is the kitchen.5 It is reported that 36% of over 65 year olds attending Accident and Emergency departments after a fall have a visual impairment that could be improved by wearing glasses (RNIB & Health Promotion England 2001).6

There is some anecdotal evidence to show that low light levels on stairs can increase the risk of falls (Hill et al 2000).7 Also, the study funded by the DTI showed that 61% of older people’s homes have a lighting level of 50 lux or less on the stairs, and 18% of people had no lights on the stairs at night (Hill et al 2000).8 The DTI provide some basic recommendations to improve safety in this area. These simple steps include: using the highest wattage possible; having pale walls; fitting lampshades that let as much light through as possible; fitting light switches at both ends of the stairs; using lights in this area at night; and using energy efficient lamps. However, energy efficient lamps are not always popular, as it is reported (Hill et al 2000) that they do not fit within shades very well and they take some time to reach their maximum output.9


8 Ibid.

9 Hill et al (2000) op.cit


than at home. They concluded that this may be due to a difference in testing conditions between the home and clinic and they believed lighting levels were the key. Indeed, they even postulate that the results from their study, if generalised to the population at large, suggest that an improvement in lighting alone may reduce the numbers of people judged to be visually impaired at home (Cullinan et al 1979).

There is evidence that an increase in quality of life is linked to improved lighting conditions (Sorensen & Brunstrom 1994). There is also evidence linking light deprivation with sleep disorders and depression (IESNA 1998). Cullinan (1978) concluded from his survey on visually impaired people in their homes that there are many older people who accept poor sight as a consequence of the ageing process and have done little to change it. Cullinan suggests that improvements could be made with help either from ophthalmologists / opticians or by adjusting their home lighting. Tinetti and Speechley (1989) also link poor lighting with falls among older people. Van Dijck (1994) from the Visual Advice Centre in Eindhoven produced a paper about the advice given on lighting during home visits. This suggested that specific advice to individuals to meet their personal lighting needs would be the preferred approach.

In a study of task lights in an office environment by the RGIE (Cook et al 1999), Anglepoise light structure and supports were found to be the most acceptable task lights, while the hardest to use was an angled illuminance source. Other findings from this study included:

- Hobby lights and ceiling mounted spotlights were found by participants to be awkward to set up, while an uplighter and a short task light with a swan neck were reported to be difficult to use.
- The task light that produced the most even illuminance was the uplighter, followed by the ceiling mounted spotlights.
- The lighting system that caused the least glare was the general office lighting in the test room, while the two task lights that produced the least glare were the uplighter and the ceiling mounted spotlights.
- The swan neck task light was thought to cause the worst glare problem.
- The three important factors concerning light performance in this study were range of movement, size and heat output – issues that may also be expected to be important for a task light for use in a home environment.
- For reading, the group of visually impaired people who took part in this study set their task lights up to produce, on average, 2400 lux. Task lights producing less than 600 lux, as well as general office lighting of less than 300 lux, were considered to be too dim.
- However, participants liked a wide range of illuminances on a task. The range of illuminances produced by one task light for twenty-three test subjects was from 350 to 6500 lux.

While much research has been done on lighting in office and public buildings, there has been little recent research on lighting in private dwellings. Recommendations for lighting in residential homes (Boyce 1986) states that they should be uniformly lit and meet the recommended illuminances for the current lighting codes. However, a study in daytime and darkness of the lighting levels for both general and specific tasks in domestic dwellings was carried out by Merz (1982). This showed low levels of illuminance generally and many rooms with only a single light source in the centre of the room.

Current lighting standards, codes of practice, and lighting design recommendations

Codes of practice for the provision of artificial lighting are provided in the Code of Lighting (from The Society of Light and Lighting) in the UK, the Illuminating Engineering Society of North America in

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13 ibid.
17 ibid.
the USA, and the Commission Internationale de l’Eclairage internationally. These recommendations usually specify a minimum illuminance for different building types or tasks. However, the recommendations do not currently cover private dwellings or those of visually impaired people. Lighting companies (Philips, etc), the Partially Sighted Society, IESNA (1998), and publications by the London Electricity Company such as Making the most of lighting, do offer some basic practical advice. In the UK there are currently no recommendations for illuminance levels of artificial lighting in private dwellings, only for residential homes. There is therefore a need to move forward the design recommendations to cover domestic lighting.

The study’s methodology
This study comprised a questionnaire and a series of home surveys. The aim of the questionnaire was to find out what types of lighting people had in their homes, its influence on tasks and its acceptability. A secondary aim was to find out if any alterations had been made to the lighting, and, if so, by whom.

The questionnaire was designed to be user friendly and was written in plain English. For this reason no technical terms were required when participants were asked to describe light fittings. A booklet of ‘useful information’ was also provided. The questionnaires were distributed via occupational therapists, rehabilitation workers and other sensory team workers and local societies. Some individuals contacted the research team directly, having read the project flyer or publicity in publications such as Side View and Modern Eyes magazine.

Participants in the home surveys were people who had previously assisted in RGIE research projects. Other volunteers also contacted the research team after reading the project publicity.

The home surveys consisted of three phases. Firstly, data gathering. Secondly, examining current lighting conditions of the person and which fittings were present, general illuminance measurements in each room for general and thirdly, task lighting and carrying out an interview based on key themes.

In total, twenty-four people volunteered to take part and were sent the questionnaire before the home surveys took place. The questions about light fittings, which they received after the surveys had taken place, allowed the research team to test the accuracy of the reporting of fittings in the questionnaire. Completion of the questionnaire before the home surveys allowed the research team to identify key issues for the semi-structured interview.

The final phase of the study involved the implementation of lighting solutions. Lighting solutions were installed in nine of the participants’ homes. There were five categories of solution. These included:

- the addition or altering of under unit lights and inside cupboard lights
- the addition or altering of floor standing fitting using a floor standing uplighter with a dimmer switch;
- the addition or altering of task lights for when local lighting could be improved;
- the addition or altering of a lamp in its fitting; and
- the addition or alteration of lighting where an unusual solution was used.

Participants were given a week to trial the solutions, then the alterations were assessed using photometric measurements and satisfaction ratings from the participant.

Research findings
Results from the questionnaire survey
The return rate for the questionnaire was encouraging. The research team was initially concerned about the size and complexity of the questionnaire, but a large percentage of respondents reported that they had not required assistance to complete it.

Respondent profile
Over half of the respondents were over 65, with only 26.7% under 54. There were more female respondents (68.6%) than male (31.4%). The region most represented was the South East (33.8%), followed by the South West (13.2%), East of England (12.7%), and the North West (11.3%). The remainder of the regions were each represented by less than 10% of the respondents.

Most respondents had first noticed difficulties with their vision between one and 21 years ago, with general and central vision being the most affected. Just 25% stated problems with peripheral vision. There were a range of visual impairments reported, and, in keeping with the population statistics, many respondents had macular degeneration (34.3%). Half of the respondents were registered blind, with 37.6% partially sighted and 11.7% neither.

23 ISENA (1998), op.cit.
Most respondents reported being able to see windows and shapes of furniture in a room. As an indication of distance vision, 82.5% of respondents reported being able to recognise a friend’s face up close, with only 8.5% being able to recognise a friend’s face across a road, although most reported that a person’s face appeared hazy when talking to them.

A residual vision score was calculated for each respondent using the method tried and tested in Project Rainbow (Bright & Cook 1999), from a method adopted in the 1984 RNIB needs survey (OPCS). A score of 12 indicated insufficient residual vision for navigation and colour/luminance identification, while a score of 6 indicated good residual vision. Most respondents had a score of between 7 and 9, with none having a score of 12. The results were split into three groups:

- Those with good residual vision who had scores between 6 and 8 (59.2% of respondents).
- Those with worse but still useful residual vision who had scores of between 9 and 11 (40.8%).
- Those with no light perception who had a score of 12 (0% of respondents).

In response to Question 15, 68.2% of respondents reported that objects in their peripheral vision were hard to see. Only 59.2% reported in response to Question 16 that objects could not be seen better if they looked slightly to one side, above or below. This result is surprising. With such a high response for Question 15 suggesting low peripheral vision for so many respondents, a higher response of ‘no’ for question 16 was expected. This may affect the reliability of the respondents’ reports of their visual ability and question the validity of using statistical analysis using vision as a factor.

Over half of respondents reported having another factor or disability that affected their ability to get around, with 49.7% having difficulty walking and 21.2% reporting hearing loss. Arthritis was the most common ‘other factor’ reported by respondents in this category.

Most people (85.5%) reported problems going from bright to dim areas, and 74.2% had problems going from dim to bright, indicating a general problem with adaptation to different light levels.


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House profile

In the questionnaire survey 97.1% of respondents lived in accommodation with between one and four bedrooms, and the most common types of housing were semi-detached, bungalow and terraced houses. The outside entrance to the homes was lit using street lighting and porch lighting (74.1% and 66% of replies respectively) with lighting on the side of the building (42%) and garden lighting (15%) following.

The majority of respondents described the lighting on the path, steps or ramp, and while opening the door, as being ‘good’ or ‘very good’, with a quarter saying it was ‘poor’ or ‘very poor’. However, more people judged the lighting to be ‘fair’ than ‘poor’ or ‘very poor’.

Most people who shared their building with other homes reported that light levels in the communal areas, such as in the corridor, on the stairs, and when opening their own front door, was ‘good’ or ‘very good’. This seemed to suggest that most respondents found lighting in communal areas acceptable. However, more were dissatisfied (‘poor’ or ‘very poor’) with light levels in these areas than thought it was adequate (‘fair’), except for opening their own door where more people reported it as adequate than as ‘poor’ or ‘very poor’.

Light fittings and bulb usage

Using the home survey data and participant responses to the light fitting questions, the respondents’ categorisation of their light fittings were seen to be sometimes unreliable. Despite instructions in the accompanying booklet and the questionnaire itself, some people still gave the number of bulbs and not the number of fittings. As some people also misinterpreted the direction of light from a fitting (‘up’, ‘down’ and ‘up and down’), these categories were grouped together for analysis purposes.

It was found that ceiling lighting was the most frequent type and was most common in the halls, the stairs and the bathroom. The lounge, dining room, bedroom and kitchen all had a wider range of mounting styles. The most common fittings present in the lounge were table lights, floor standing and wall lighting. In the dining room table, wall and floor lighting were the most common fittings. The kitchen had a high incidence of under unit lighting.

Taking the data on ceiling mounted lighting, suspended lights were the most common, except in the kitchen which had a larger amount of fluorescent ceiling lighting. In the bathroom, suspended lighting accounted for 52.3% of ceiling mounted lighting, and was...
followed with surface mounted, then fluorescent lighting. Wall lighting accounted for less than 20% of the total mounting styles for every room. Table mounted lighting was most common in the lounge, dining room and bedroom, with non-adjustable table lights being more prevalent, except in the kitchen and dining room. The prevalence of non-adjustable table lights in these rooms may be due to the light having a mainly decorative rather than functional purpose. On stairs, the only type of table light was non-adjustable. Overall, floor mounted styles were most frequently reported in the lounge.

A variability score was calculated for each respondent to indicate the variety of lighting styles in the home. Over half the respondents had a total variability score for their house of nine to 12, with most of the rest being above 12. This indicated that, on average, more than one fitting style was present in most people’s rooms. The hall was the room with the lowest variability score – 77.8% of respondents had a variability score of one, an average of only one fitting style, while most rooms had an average of two fitting styles. Typically, the lounge had the highest variability scores with most people being able to choose between two, three or four different fitting styles.

The ‘ordinary’ lamp was the most common bulb reported in all types of fitting – except under unit lighting fittings, where the most common was fluorescent. Fluorescent bulbs were also present in ceiling fittings (15%), wall fittings (12.6%), floor fittings (10%) and table fittings (8.9%). This may be due to the increased use of Anglepoise lights with fluorescent bulbs. Energy saving bulbs were also reported frequently (17.7% in floor fittings, 13% in ceiling fittings and 12% in table fittings). In the questionnaire, respondents indicated the bulb type in each fitting, so trends in bulb combination could also be studied. It was found that there were few combinations of multiple type of bulb, with the exception of ordinary and energy saving bulbs being used in combination in ceiling, wall, table, and floor fittings.

**Subjective ratings for light levels to perform tasks**

Respondents were asked to rate the light levels for a range of up close and general tasks in each room, some of which were specific to that room, (for example, making tea). Lighting for most of the tasks was rated ‘good’ or ‘very good’, although ‘fair’ was reported quite frequently.

Task lighting in the hall was rated mostly ‘good’ or ‘very good’, apart from the task of reading the post where over half (54.3%) the respondents gave the light levels a rating of ‘poor’ or ‘very poor’. A quarter (25.6%) found light levels for finding keys ‘poor’ or ‘very poor’, and the few who used a computer in the hall said lighting was ‘poor’ or worse. Just under a quarter (23.1%) found the light levels for housework ‘poor’ or ‘very poor’.

In the lounge over a third of respondents (36.1%) said the light level for reading was ‘poor’ or worse, with only a slightly smaller percentage giving the same rating to writing. The lowest frequency of ‘good’ or better for this room was with the task of writing (41.8%). All except three of the tasks reported in the lounge had a rating of ‘good’ or better of over 50%, although approximately a third or more of the respondents reported light levels of ‘poor’ or worse for reading and writing (36.1% and 32.8% respectively) and 25.2% of respondents who reported carrying out hobby activities in the lounge rated the light levels as ‘poor’ or ‘very poor’.

In the kitchen, ratings for light levels were mostly ‘good’ or ‘very good’, with around half the respondents giving this rating to levels for reading and writing (49.1% and 50.5% respectively), showing some variation in usefulness of lighting in the kitchen to perform these complex visual tasks. However, over a quarter (27.6% and 25.3% respectively) of respondents gave a rating of ‘poor’ or worse for these tasks. Just less than half (47.1%) gave a rating of ‘good’ or better for watching TV, while there were high instances of ‘good’ or ‘very good’ for moving around (83.9%). Positive ratings for visually demanding tasks dropped with 66.9% rated ‘good’ or better for cooking, 66.5% for laundry and 68.7% for making tea. Of those who reported preparing food and cooking in the kitchen, 11.1% of respondents for each task reported the light level as being ‘poor’ or worse.

In the dining room, light levels for moving around, talking, using the telephone, having a meal and watching TV were all rated ‘good’ or better by over 50% of respondents. Hobby activities, taking medication, using the computer, housework and other tasks had ‘good’ or ‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split between ‘good’/‘very good’ ratings from between 25% and 47.1% of respondents. For the tasks of reading and writing results were evenly split
was a higher percentage of people giving a rating of ‘poor’ or ‘very poor’ for finding the stair edge (31.5%), going downstairs (25.8%) and going upstairs (28.6%). The light levels for going up and down stairs were generally rated more negatively than for moving around.

In the bedroom the tasks of choosing clothes, reading, writing, putting on makeup, shaving and housework all had ratings of ‘good’ or better from fewer than half of the respondents. For many tasks in this room, ratings of ‘poor’ and ‘very poor’ were almost as high, or higher. In the bathroom however, all tasks, except the task of ‘other’, had light level ratings of ‘good’ or ‘very good’ at over 50%, with high positive ratings for moving around, getting dressed and bathing. The highest incidence of ratings of ‘poor’ or worse was for putting on makeup.

Ratings for tasks compared across all rooms
The research team compared ratings for tasks that were repeated across the majority of rooms. Over 69% of respondents rated the light levels for the task of moving around as ‘good’ or ‘very good’, except on the stairs and landing where this dropped to 56.8%. Less than 6% rated this task as ‘poor’ or worse across all the rooms, except the stairs and landing. The light levels for doing housework were rated for all rooms, except the bathroom and the kitchen.

Only the lounge had ratings of ‘good’ or better from over 50% of respondents for this task, while all the other rooms had positive ratings between 40% and 50%. The hall had the highest ratings of ‘poor’ and ‘very poor’ for housework, while all other rooms had incidences of this rating of less than 20%, with the stairs and landing having the lowest percentage. Many respondents reported that the light levels for doing housework were adequate, with the frequency of ‘fair’ ratings ranging from 28.3% in the hall to 39.8% on the stairs and landing.

The light levels for the tasks of reading and writing were rated in the lounge, kitchen, dining room and bedroom. For these tasks the kitchen had the highest number of ratings of ‘good’ or ‘very good’ (49.1% for reading, 50.5% for writing), while the highest incidence of ratings of ‘poor’ or worse for writing was in the bedroom (43.9%). An equal number rated reading in the bedroom as ‘poor/very poor’ as rated it ‘good/very good’ (40%). In the dining room the ratings were evenly split between ‘good/very good’ (33.9% for reading, 34.7% for writing), ‘fair’ (34% for reading, 36.7% for writing) and ‘poor/very poor’ (32.1% for reading, 28% for writing). In all the rooms over a quarter of respondents rated the light levels for these two tasks as ‘poor’ or ‘very poor’.

Subjective ratings for light levels on surfaces
Light levels on certain surfaces throughout the house were also asked to be rated. The most frequent rating for every surface across all rooms was ‘good’. Only on the stairs and landing were there a higher number of people rating the light level as ‘fair’. The surface with the highest frequency of ‘poor’ ratings was the floor, although this may be due to this area being very critical as it is the surface that is most looked at during movement (Bright & Cook, 1999).25 Between the stairs and landing the highest frequency of ‘poor’ for light levels was on the stairs themselves. This is a matter for special concern, as the stairs are a high hazard area.

Glare was most commonly reported from ceiling light fittings, but it must be noted that ceiling light fittings were the most common, so this is not surprising. The majority of respondents reported never suffering glare from light fittings, except for ceiling fittings in the lounge, where as many reported glare as did not. One third (33%) said they suffered glare from under unit lights in the kitchen, which may result from the poor fitting or unsuitable design of the light.

Over a quarter of respondents (29.5%) reported glare from shiny surfaces in the kitchen, and 22% in the bathroom.

Results from the general questions: on trips, bumps, advice and changes to lighting
More people reported bumping rather than tripping or falling in each room. The highest incidences of bumps were in the dining room and the lounge. This may be due to the amount of time spent in these rooms, or the amount of furniture in these rooms. The stairs had the highest reported percentage of trips and falls, although the lounge and bedroom also had high percentages.

Although trips and falls on the stairs were reported as occurring much less frequently than bumps, the stairs are a hazard area, so these reports are still a cause for concern, as are the low light levels reported on the stairs. A quarter of respondents (25.2%) used dimmer switches, with the majority putting them in the lounge, the bedroom or in more than one room in the house.

Over half of the respondents had received a visit from social services to assess their needs. A high percentage (90.7%) had received advice from social services or another qualified professional, but only 46.7% had been given advice that covered lighting. Only 18.3% of respondents said that social services had actually been

involved in altering their lighting, although this may be because the respondents did not want their lighting to be changed.

Where social services had been involved in altering lighting the majority of changes had taken place between one month and five years ago. Changes made included changing lighting in specific rooms, changes in mounting style, changing the direction of light and changing the bulbs in fittings. One fifth of respondents whose lighting had been altered by social services said that they had made multiple changes. Of the 125 respondents who reported changes had been made by the respondent, or their friends or families, 25.6% had been made one to six months ago, 15.2% had been made between six months and a year ago and 38.4% were made between one and five years ago. Changes made more than five years ago constituted 20.8%. This shows that more changes were made more than one year ago than in the last year. For this reason there may be a need to reassess lighting needs given that eyesight deteriorates in many people.

Changes made include those to general illuminance, mounting style, direction of light and to the bulbs in fittings (the majority of which were spotlights). The changes made by respondents showed a similar trend to those changes made by social services, although more respondents reported having changed the electrics or switching than reported these changes as made by social services. This may be related to the extent to which social services can get involved with this magnitude of change due to their spending budgets.

It was found that more than half of people would consider altering their lighting if money were no object. Forty of the 116 people who said they would be willing to change, reported that they would make multiple alterations, 59 said they would alter the mounting style (to wall lighting, under unit lighting and floor standing lighting), while 35 would make changes to general illuminance.

It was anticipated that respondents would want to make light changes that would reduce glare, but this was not cited as a reason. Reasons for this may be that people accept glare as a side effect of lighting, or they may not know that direct glare can be reduced without reducing the power of the light source.

Reasons given for not wanting to alter lighting included reports that there was no need; that current lighting was adequate; the issue of expense; and the feeling that changes were unnecessary until the person’s sight got worse.

Of the respondents, 67.2% used adjustable lights for close up work, while 88.6% used a magnifier or other aid. Over half of the respondents shared their homes with others, with 53.1% saying that their lighting was a compromise between their needs and the people they shared with, 30.1% saying it was set up for the needs of the visually impaired person, while only 8% said lighting was set up to meet the needs of the other person. Saving money was reported as a factor that would encourage almost a third (31.7%) of people to change their lighting. Half the respondents said they would be encouraged to change their lighting if it would increase brightness, with only 10.4% saying the same for decreasing brightness. Reducing glare was an incentive for 30.7%, although this was not seen from the open ended responses to what respondents would be willing to alter. Over a quarter (26.2%) reported environmental reasons would be a factor while ‘other’ responses included: if the current lighting became insufficient; to alter the power and distribution of light; to allow independence; and for aesthetic reasons.

Trends and relationships investigated

To investigate relationships within the results several different statistical tests were used. With small numbers of responses it was sometimes not possible to apply any statistical test with any reliability, but occasionally it was possible to group some of these together in order to compare broader categories of responses.

Relationships involving the home and social services

It had been anticipated that respondents with walking difficulties might tend to live in single storey flats or bungalows. However, the Pearson’s Chi squared test showed that there was no significant relationship between respondents with walking difficulties and the type of home they lived in.

The longer ago the respondent reported first noticing difficulties with vision, the less likely they were to report having a visit from social services. This significant relationship may reflect an increase in the service provision to visually impaired people. The data also indicated that visits by social services or other qualified professionals were not biased towards any particular certification status of the respondents, (i.e. whether they were registered blind, partially sighted or not registered at all).

There were no significant differences in respondents reporting a visit, advice or advice on lighting from social services depending on their location. This indicates no evidence to support the concern that the level of advice and style of service provision alters...
significantly across regions. There was, however, a trend in frequencies of reported alterations made to lighting by social services teams when the regions were grouped into four larger areas. Analysis of the data for the South, East and West regions showed some significance. These differences between the regions may be due to budget constraints imposed on the regions or may relate to the procedure for providing alterations. There was no significant relationship found between the respondents’ willingness to alter lighting and advice given by social services.

There was also no significant relationship between advice from social services and the length of time since respondents last altered their lighting. There was, however, a significant relationship between advice on lighting from social services and the length of time since respondents last altered their lighting: the more recently respondents reported change, the more likely they were to report having had advice on lighting from social services or a qualified professional.

Relationships involving variability or flexibility of lighting
No significant differences were found when comparing the average glare scores with the variability scores within each room. This suggests that the number of styles of fitting present, the variability score, is not related to the frequency of glare.

Comparing average scores for ratings of surfaces against the variability score using analysis of variance showed a significant difference ($p=0.039$, df=4, 192) between average rating scores given by respondents with particular variability scores. By conducting a post hoc Tukey Test, the significant difference was seen to be between the variability score of 1 and 2. However, no statistically significant difference was found between a variability score of 1 and any other score higher than 2. This does not support the hypothesis that the greater the number of lighting styles the better able the respondents are to get a good light on the surfaces, thus a greater rating would be expected. Comparing average task scores of all tasks against the variability scores for each room showed only a statistically significant difference in the bathroom ($p=0.049$, df=4, 193). This indicates that only in the bathroom did the number of different styles of fitting affect the rating of light levels for performing tasks, suggesting that in the other rooms other factors may be involved.

Relationships involving alterations to lighting and willingness to alter
The results showed that the older the respondent the more likelihood that the respondent would not be willing to alter their lighting if money were no object. This may be expected, as the older people get, often the more reluctant they may be to go through the nuisance of change, and it may also be possible that they prefer sticking to what they have used in the past.

There was no significant difference between the time since respondents had last altered their lighting and the length of time since they first noticed they had difficulties with their vision. There was no significant difference found between the respondents’ willingness to alter their lighting and the length of time since they first noticed they had difficulties with their vision. However, there was a significant relationship found between task ratings and the willingness to alter lighting in all rooms ($p<0.05$, df=2 for all rooms). People scoring ‘fair’ or worse than ‘fair’ were more likely to report being willing to alter their lighting.

There were also significant relationships found between surface ratings and the willingness to alter lighting in all rooms except the hall and the stairs and landing. This suggests people may be more willing to alter their lighting on the basis of being able to perform particular tasks in these two areas than the general lighting provided on surfaces.

Relationships involving the frequency of trips and bumps in the home
There was no significant relationship found between the respondents’ residual vision scores and the frequency of tripping. However, when examining the relationship between residual vision and the frequency of bumping in each room a significant correlation was found for the lounge and the dining room. Although it may be that respondents were more willing to admit to bumping than tripping, it was seen that as residual vision decreased the reported frequency of bumping increased. This may result from more furniture being present in these rooms, the size of the room and distance judgement problems, and the frequency of the movement of objects and furniture often being higher in these places. Also, in smaller rooms distance judgements may be less critical in manoeuvring past objects so residual vision may have little effect on the frequency of bumping.
No statistical significances were found between the reported frequency of bumping and the variability score for lighting, so the number of fitting styles was not seen to have an effect on the frequency of bumping in any of the rooms. A number of other factors, for example bulb wattage, may have an impact on this due to the amount of light variance. A similar lack of statistical significance was found between the reported frequency of tripping with the variability score. Again, factors other than the number of styles of lighting may have an impact on the frequency of tripping.

The surface ratings for the floor, walls and doors were compared with the frequency of bumping in each room, and it was seen that as the surface ratings for the walls and doors got worse, respondents reported bumping more frequently. However, significant correlations were not found between the frequency of bumping and the rated light levels of the walls and doors in the lounge and dining room, and the floors in the lounge. This may indicate that for the lounge and dining room residual vision is a more important factor in the process of bumping than lighting on the walls and doors, although for the dining room the lighting on the floor may be a factor in the bumping process.

The surface rating for the floor, walls and doors was also examined with the frequency of trips for each room. Ratings for walls and doors were significantly correlated with the frequency of trips in the hall, the stairs, the landing, the bathroom and the bedroom. Ratings given for the light levels on the floor were also significantly correlated with the frequency of trips in the hall, kitchen, stairs, landing, bathroom and the bedroom. This showed that as the surface ratings for the walls, doors and floor got worse respondents reported trips more frequently. This may indicate that the light levels for the floors, walls and doors are more important factors in the process of tripping than residual vision, except in the lounge, kitchen and dining room, where neither relationship was found to be significant, and a number of other factors may be involved.

**Relationships involving general and close-up tasks**

The residual vision scores of respondents and their ratings of light levels for up-close tasks, such as reading and writing, and general tasks, such as moving around, were examined in each room. They were seen to be positively correlated in all but the dining room for reading, and the dining room and bedroom for writing. This shows that in the hall, lounge, kitchen and bedroom the worse the residual vision of the respondent the less favourably the lighting for carrying out reading was rated, and in the lounge and kitchen the less favourably the lighting for the task of writing was rated.

Residual vision scores also correlated with the rating of the general task of moving around in all rooms. A significant positive correlation was found in the lounge, kitchen, stairs and landing, and the bathroom, but it was not found for the hall, dining room and bedroom. This indicated that in the lounge, kitchen, stairs and landing, and bathroom, the worse the residual vision of the respondent, the less favourably the lighting for carrying out the task of moving around was rated.

**Results from the home surveys**

Although no recommendations exist for private dwellings, generally the mean recorded levels of illuminance in the 24 home surveys for this study were lower than the recommendations that exist for residential areas. Levels of general illuminance based on the floor measurements varied from as low as 1 lux to 1068 lux, with the kitchen having the highest mean level of illuminance. There was concern about the low levels of illuminance on the stairs, and it was thought that there may be a link between this and an increase in trips or falls on the stairs, although this may not only be due to lighting. The low levels of illuminance found generally in the home surveys reflects those found in the other surveys carried out before this project, although those surveys are much older.

Examination of task illuminances showed an equally wide range of values with some very low boundaries for those ranges. The highest recording of task illuminance was in the kitchen, where a spotlight was used to augment the lighting directly onto the hob. The levels for finding the step edge and handrail on the stairs were low – mean illuminances being 48 and 80 lux respectively. Therefore, it was surprising that the majority of survey participants rated their lighting for the tasks as ‘good’ or ‘very good’. This indicates that the participants were very tolerant of the lighting levels in their homes, or that they did not need high light levels for these tasks.

The lowest reflectance values were for the floor finishes – often due to the fact that people tend to have dark floor coverings, except in the kitchen and bathroom where vinyl floor coverings caused higher light reflectances. The values calculated for the walls showed these measurements to be typically mid range – typically a mean value of around 60% reflectance of light. These higher reflectance values probably result from the typical style of wall finish being fairly pale colours, which are good for light inter-reflection. Very high values indicated unreliable or highly improbable readings, resulting from glossy finishes such as tiles, sanitary ware, glossy ceilings and highly polished furniture.
Reflectance from ceilings was fairly high because they were generally light in colour, assisting with light inter-reflection. Curtains tended to be darker, and therefore had a lower reflectance of light than the walls.

**Semi-structured interviews**

A semi-structured interview was carried out at the end of each home survey. Each interview was structured around seven main themes. These were: experiences; needs and awareness; knowledge of technology; experimentation; other approaches to improving the home environment; safety; and support and attitude to change. Affinity diagrams were used to form common themes from the discussions with participants.

When discussing problems identified with lighting several sub-themes developed. There were problems relating to pattern, problems with general illuminance, and with position or location of lighting. For example, there were comments relating to glare, shadows, light reflection and adaptation. There were also problems reported with current lighting in particular rooms or particular areas of discontent. There were problems with equipment, for example, comments about the incompatibility of lamps and shades. There were also general comments about problems relating to the lighting outside participants’ homes. There were also positive comments on issues such as general illuminance, external lighting and specific solutions such as fitting style. Daylight was another theme that emerged, with most comments falling into the sub themes of general illuminance, too little daylight and glare, and reference to the need for artificial lighting during the day.

One topic discussed was changes to lighting, with examples given such as using task lighting, additional light fittings hard wired in the property and the building of a glass wall to allow seepage of light from other rooms. Changes to pattern of behaviour were also discussed. For example there were comments about the movement of both people and furniture and changing the time and place of an activity in order to perform tasks, (such as moving specific chairs to do particular tasks or taking items to read in particular places in the house).

Another topic discussed was equipment for daily living, where a variety of equipment was mentioned as being used by participants from bump on stickers to special telephones and magnifiers.

People’s attitude to change also had sub-themes. One sub-theme was the factors encouraging change such as brightness, aesthetic factors, environmental reasons and maintenance factors. Another concerned the factors preventing change. These included money issues, age of respondent, nuisance factors and access to places to see/try lighting first. Another sub-theme covered other factors to consider such as aesthetics or progression/gradation of eye condition or vision and the necessity for proof or evidence of the need for change.

The final sub-theme concerned the acceptable degree of change. Here participants were evenly split on a scale from just changing a bulb to rewiring. Those who did not state how far they would go on the scale said they would go ‘as far as it takes’.

Many participants talked about what they wanted in terms of lighting. Despite many participants saying they would go as far as it takes to change their lighting the majority of people said they would not want change. Reasons given were that they would not know what to do or who to go to. Others stated that their present lighting was comfortable. More people indicated that lighting was important than not, with many saying it had extreme importance. More people identified specific wants than general wants. This suggests that many participants have specific problems with lighting and would like to address these problems, however many were reluctant to change as they do not know what to do or who to go to. More participants said that their lighting was set up for the visually impaired person’s needs than for the non-Visually impaired person’s. Some people indicated clashes over their lighting set up, some compromise and some indifference. The length of time since the set up was last altered was another factor considered. More participants than not said that sharing their homes would not affect their experimenting with lighting.

In terms of safety, none of the participants admitted to a recent accident in their homes, although there were some references to bumping and tripping. Space, movement of furniture by others and moving too fast were some of the reasons given for bumping. Reasons cited for tripping included lack of attention and catching feet on wires and doorframes. There were a number of changes reported in response to safety worries, strategies such as counting the stairs, using rugs or mats to indicate particular areas such as the bottom of stairs, and the installation of a spotlight to highlight the bottom step after an accident had occurred.

Advice and support was another theme that emerged from the discussions. Comments were grouped under the sub-themes of potential sources for advice or support and sources from which actual advice or support has been received. Specific sources of advice or support mentioned ranged from family/friends through to
associations, vision professionals including social services and lighting professionals such as the electricity board or electricians. Many participants said they had little or no knowledge of lighting, switches and new technology. Very few people said they had a lot of knowledge, and many were interested in finding out more. In addition, knowledge of the layout of homes was often reported as a reason for not bumping or tripping.

Results from the user assessment of lighting solutions
On the basis of the twenty-four home surveys that were carried out, nine houses were revisited and twenty-five individual lighting solutions were installed in these homes. The acceptability of these lighting solutions was measured across a range of issues such as quality of light, quantity and pattern of light and aesthetic properties. The usefulness of the changes was measured using response scales, dichotomous questions and open ended questions. Findings were grouped based on the type of solution provided. Response scales from 1-5 were used to measure participants’ satisfaction of: how even the light was (from even to uneven); whether the lit area was too small, too large or just right (from too small to too large); how adequate the amount of light was (from adequate to inadequate); how easy it was to get the light directed to where participants wanted it (from easy to difficult); and how glaring the light was (from glaring to not glaring).

Addition or altering of under unit/cupboard lights
Seven lighting solutions were fitted under kitchen units or inside cupboards and assessed. It was found that they were used for an average of one hour 15 minutes per day. Participants said that they would be willing to pay up to £20 for these lighting solutions. For four of these fittings the light was rated as ‘even’, with mains fitted lights more frequently rated as ‘even’ than battery operated fittings. Over half of the fittings were rated as having a lit area that was ‘just right’, with the other ratings tending towards the ‘too small’ end of the scale. For over half these fittings the amount of light provided was rated as being towards the ‘adequate’ end of the scale. Over half of the fittings gave participants glare, something that may be caused by unsuitable design of these lights. If more consideration was given to the design and installation of under unit fittings, to shield the light source from view, this could help to reduce the occurrence of glare from these fittings. Only one fitting directed light where the user did not want it, while three caused adaptation problems.

One participant said that the under unit light made her vision loss more apparent, while only one fitting was reported as taking up too much space or interfering with the respondent’s daily living. No fittings were reported as getting too hot, and no one reported that the fittings created shadows. Five fittings were described as being useful for close up tasks, while two were useful for daily living. One participant reported that both types of fitting that they tested were useful to other people sharing the home, (the other participants who had these fittings lived alone and so could not comment on this aspect). All fittings were reported to be useful in daylight, as well as after dark, and better than using no light fitting. For four of the fittings participants said they would consider installing something similar in their homes.

Addition or altering of floor standing fitting
The floor standing uplighter was assessed by four participants. It was considered to be a very popular solution. It was used for an average of three hours and twenty minutes a day in total, meaning it was used for longer than any other lighting solution, although this may be because it was mainly used in the living room. All but one of the participants said the light produced by this fitting was even, with the other participant giving it a mid score. All the respondents found the area lit by this type of light ‘just right’ and said the amount of lighting was ‘adequate’. None of the participants found the area lit by this type of light interfered with their daily living or normal routine, as she had to rearrange her existing lighting to accommodate the lamp. Despite this, all the participants said that the light was useful for daily living, while half found it useful for close up tasks.

One said the uplighter was useful and comfortable to others sharing the house, one person made no comment regarding this, and the other participants lived alone. All participants said the light was useful after dark, and two said it was also useful in the daytime. All participants said that their lighting was better with the uplighter and that they would consider installing a similar solution in their home.

Regarding how easy it was to direct light where it was wanted, half said it was difficult, three of the respondents rated it as ‘easy’ and the fourth gave a mid score. All participants found the brightness controllable, although one reported problems with the dimming facility. One said the halogen lamp used inside the uplighter got too hot.
Addition or altering of task lights
There were four styles of task light and six different lamp types which provided six different task lighting solutions for assessment. These were reported as being used on average for one hour each day. Participants reported that they would be willing to pay around £10 for the swan neck task light, and £50 for the hobby light. Regarding the evenness of lighting, half of participants trying out the light rated the lights as ‘even’, two gave them a mid score and one said the light was ‘uneven’. In terms of evenness the Anglepoise and hobby lights were more frequently rated as ‘even’ than the swan neck task light. Half of the fittings were rated having a lit area that was ‘just right’, while the other scores for the other task lights tended towards the ‘too small’ end of the scale. On this issue the Anglepoise light was rated more favourably than the swan neck or hobby lights.

Over half of participants said the amount of light produced by the task lights was ‘adequate’, while the other two participants gave a mid score rating. Two of the task lights (both Anglepoise tungsten) resulted in glare, two were given a mid score, while the other two were reported as causing less of a problem with glare. Only one task light (the swan neck with 60 W Daylight) directed light where the participant did not want it. This caused adaptation problems and the light got too hot. No light was reported as taking up too much space or interfering with the participant’s daily living or normal routine, while two people said the swan neck task light created shadows. All but one of the task lights were found to be useful for close tasks, but only two were found to assist general living. None was reported as being useful to, or comfortable for, others sharing the house. Only one of the task lights (the swan neck with the 60 W computer lamp) was reported as not being useful after dark, while four out of six of the task lights were reported as being useful during daytime. All the task lights were reported as being better than using no light, and over half of the participants said they would consider installing a similar solution in their home. The light rated the lights as ‘even’, two gave them a mid score and the other two participants gave a mid score rating. Only one light caused glare. Two of the lights were said to be useful in close up tasks. All of the lights were reported as being useful after dark and better than the light they had replaced. Two of the lights were reported as being useful during daylight. With three of the lights, two energy efficient lamps installed in ceiling fittings were found to assist general living, while the computer lamp fitted in a task light was not. All of the light fittings were reported as being useful after dark and better than the light they had replaced. Two of the lights were reported as being useful during daylight. With three of the lights, two energy efficient lamps installed in ceiling fittings and one tungsten lamp designed for use with computers, participants said they would consider installing something similar in their home.

Addition or altering of lamp in fitting
There were four instances where a lamp was added to, or altered in, a fitting. Three instances were standard tungsten lamps in ceiling fittings, which were replaced with energy saving lamps, while the fourth was a tungsten lamp designed for use with computers, which replaced a standard tungsten lamp in a swan neck style task light. These lamps were used for an average of one hour and ten minutes a day, and participants reported being willing to pay up to £5 for each one.

Three of the lights were said to give ‘even’ light, while the other was given a mid score rating. Only one light caused glare. Two were said to cause less of a problem with glare and the other was given a mid score. The level of light provided by all the lights was said to be ‘just right’, and only one light caused adaptation problems. None of the task lights were reported as interfering with participants’ daily living or normal routine, and none got too hot. Two of the lights were said to be useful in close up tasks. All of the lamps that were used in ceiling mounted fittings were found to assist general living, while the computer lamp fitted in a task light was not. All of the light fittings were reported as being useful after dark and better than the light they had replaced. Two of the lights were reported as being useful during daylight. With three of the lights, two energy efficient lamps installed in ceiling fittings and one tungsten lamp designed for use with computers, participants said they would consider installing something similar in their home.

Other addition or alteration of lighting
Three solutions were each only tried by one individual, so any comparisons made have to be based only on the ratings of one individual. The first of these solutions was an uplighter shade that allowed light to be directed upwards, thus preventing glare and reflecting the light down from the white ceiling. The participant said the light provided from this solution was ‘adequate’ and the lit area was ‘just right’. There was little or no glare, and he did not get light where it was not wanted. There were also no problems with adaptation or shadows reported. The participant said that the solution was better than none, and that it was useful in both daytime and hours of darkness. The respondent was happy to consider installing a similar solution himself.

Another participant fitted a bulkhead light for extra illumination in the bathroom. She said that the area lit by this light was ‘just right’, and that it caused no shadows. However, she also said there were some adaptation problems and glare was also a bit of a problem. The light was said to be useful both in the daytime and in hours of
darkness, and for both close up work and general movement. The light also came on faster than the main ceiling fitting so the respondent got better light levels from the outset. The respondent reported that the experience gave her the motivation to make more changes to her lighting.

The most ambitious solution carried out by the research team was the creation of a false ceiling with white paper with the intention of covering dark beams and increase inter-reflection. The respondent reported that this made the room brighter and created fewer shadows. Even though doing this made the ceiling lower, the participant said this was preferable to the artificial beams, although there was concern that the paper might get too hot due to its proximity to the light fittings. The light from this solution was reported as being ‘adequate’, with little glare and no light where it was not wanted. The area lit was said to be ‘just right’, and there were no adaptation problems. It also did not interfere with the participant’s daily living or normal routine and was useful in the daytime and after dark. With the paper ceiling a general increase in illuminance on surfaces in the participant’s home (from 15 to 50 lux) was found. The floor standing dimmable uplighter, when used with the paper ceiling, showed the illuminance level as constant on shelves, but the floor, walls and table had higher mean illuminances without the paper ceiling, with an increase in light level of over 50%.

The participants’ comments and ratings suggest that overall the solutions proposed and implemented by the teams were successful. All of the solutions, when used in combination with the existing lighting, augmented the levels to a more reasonable degree of illumination. Of all the combinations measured the floor standing and overhead lights together gave the highest lux measurements.

Relevance of the findings

Light levels

A study by Cornelissen (1994) showed that people chose lighting that was best for seeing fine detail, not for general illumination.26 This study supports this to some extent in that the mean task illuminances were often higher than the mean general illuminances in each room. Also, there was a relationship found between the questionnaire respondents’ willingness to alter their lighting and ratings for task light levels, but not for levels on surfaces in the hall and on the stairs and landing. A previous study of office lighting by the RGIE (Cook et al 1999) showed that the average light level selected by participants for reading was 2400 lux.27 This study showed that in their own homes many participants were on average reading under 304 lux in the lounge and 236 lux in the dining room and these levels were accepted, although over a quarter said that light levels for reading were poor across all rooms. Task illuminances were much lower than those recommended by Julian (1983a).28 While Julian advised an illuminance of 600-1000 lux, the task illuminances measured in these home surveys found a range of mean illuminances from 48 lux to 396 lux. General levels of illuminance were considered to be low and were similar to results from studies such as Merz (1982).29

Cook et al (1999) found that in offices the colour of lamp preferred was fluorescent.30 In support of this, in our survey, the questionnaire participants rated the light levels for the task of reading as more positive in the kitchen, where fluorescent was the most common light source reported. In that study (Cook et al. 1999) a general illuminance of around 300 lux was considered too dim, yet mean general illuminations measured in our home surveys were often well below this level.31

Energy efficient lamps take time to reach their maximum output, which has negative implications for the 74% of questionnaire respondents who found it difficult moving between light levels. Also, the results from the home surveys support the DTI funded study (Hill et al, 2000) that there are problems with energy efficient

26 Cornelissen (1994), op.cit.
27 Cook et al (1999), op.cit.
29 Merz (1982), op.cit.
30 Cook et al, (1999), op,cit.
31 ibid
lamps not fitting into existing shades, and irritation with long warm up times. The surface with the greatest negative ratings for the light level was the floor in each room, which may be due to this being very critical for moving around, as it has been shown (Bright & Cook, 1999) that the floor is the surface that is most looked at during movement. Van Dijck (1994) presented an anecdotal report of the issue of older, darker furnishings in the home producing low light reflection, and this was sometimes seen to be the case in the home surveys.

Safety
The results from the home surveys showed that light levels varied greatly, being generally poor on the stairs. Tinetti & Speechley (1989) said that lighting is accepted as a contributory factor in the occurrence of falls, and is considered to be a hazard in the home, so this is a matter for concern. The Society of Light and Lighting (2001) suggest increasing light levels for hazardous areas such as the kitchen and stairs. The findings of this study highlight the need for this to be addressed in existing and newly built housing. While our study provides no objective evidence that increase in light levels would reduce frequency of trips, it may reasonably be hypothesised from this relationship that this may be the case. At the very least it may be one of the contributory factors, highlighting again the importance of addressing light levels within the home and providing recommendations.

Variability/flexibility of lighting
Merz’ (1982) study found that many rooms only had a single light source, while this RGIE study found that a choice of one or two fittings was most frequent, with a wider range in the lounge. This suggests that some improvement in the flexibility of lighting has been made in the last 20 years, and a greater range of lighting is now more widely available in a range of stores. However, the home surveys revealed that it is often hard for visually impaired people to get access to these stores. This highlights the need to provide easier access to ranges of lighting to allow visually impaired and older people to benefit from a wider choice of lighting styles than they currently have. The fact that, generally, more time is spent in the lounge, and more activities done there, than in other rooms may indicate why there is a greater diversity of lighting styles there, while other important areas, such as the stairs, are neglected.

Knowledge/awareness
Van Dijck (1994) concluded that many people do not realise the full extent of assistance that can be provided by illumination. This was supported by informal feedback to the research team from many health and social care workers. Results from this study also support this as little action had been taken to increase light levels even though the participants had knowledge of the benefits of lighting. Even so, factors such as the cost of changing lighting are also an issue preventing change. The need to illustrate the importance and difference that illumination can make to tasks has also been highlighted by van Dijck (1994), who said that a practical way to illustrate light levels to individuals was with a lux meter. This was shown to be true by the interest shown by, and the reactions of, many of the home survey participants.

There also seems to be a need to inform the general public better, both in terms of information on lighting and on where to obtain this information. There is also a need to inform social services and healthcare workers on lighting advice so they can provide advice and support to the public. Also, the lighting needs of many people may alter over time as eyesight deteriorates, so there is not necessarily one solution that will suit all eye conditions but a need to reassess lighting needs over time.

Open ended subjective feedback from participants
The results where participants rated light for doing tasks as ‘good’, but which the home surveys proved otherwise, may be due to the participant rating the position in the room best suited to the task, rather than where they would like to be able to perform the task but cannot. The fact that so many of respondents were willing to complete such a large questionnaire, often without assistance, may indicate the importance of lighting to them. A range of task lights was used to provide solutions for a series of activities. Distribution of more than one task light to one participant demonstrated that different types of task light may be more suitable for different tasks than others. This evidence from the trials of solutions supports the conclusion of van Dijck (1994) that an emphasis needs to be placed...
on providing access to a range of lighting solutions, ideally available for trials in people’s own homes before purchase.40

Policy relevance: emergent themes

The findings from this study will raise awareness through informed guidance and training for a range of related professionals and practitioners, from rehabilitation workers, social service teams, voluntary and charitable organisations to trainee building service engineers who are working with blind and visually impaired people. The Building Regulations Part L have been revised to insist on the provision of low energy light sources in new buildings. Our study suggests that a range of light sources are advisable to provide comfortable lighting.

In the mainstream design education curriculum lighting has been given inadequate consideration as a key topic and the findings of this RGIE study have the potential to influence this. The practical data is the ideal vehicle from which to develop case studies and related educational material to inform both lecturers and students in the understanding of lighting in the home. Findings could also be presented to bodies such as the Parliamentary group on Visual Impairment and the Parliamentary group on Lighting.

The research findings are of particular relevance to current policies, such as the proposed Housing Health and Safety Rating System (HHSRS) which identifies lighting as a key environmental variable which is a potential hazard in the home. The seriousness of hazards is rated along a spectrum and this could be adapted and extended as a tool to assess the risk within the home for certain groups. There is also the English Housing Condition Survey which is a national study investigating user satisfaction and housing quality. This has been expanded to include questions relating to accessibility for older and disabled people. There is scope for the inclusion of lighting within this context.

The solution-testing phase of the project showed that there were problems with the design of under unit lighting and cupboard lights, as well as glare. Manufacturers need to consider these problems. The project will also inform future research and the development of policies such as the National Service Framework for Older People, particularly in relation to the Older People’s Housing Taskforce.

Limitations of methodologies

A more even distribution of questionnaires across the UK would have been preferable. Another point to consider is that, while the local associations and rehabilitation workers who helped to distribute the questionnaire were useful, they may have been unintentionally targeting particular groups. Also, the majority of those who responded to the questionnaire would have had some level of support or contact with these groups or they would not have received the questionnaire. In future, it would be wise to address the issue of representing any people in the community who may not have as much access or contact with these teams or associations, in order to assess fully the level of support and knowledge across the population.

There were some limitations found with the confusion over questions about numbers of types of fittings and about exact styles of fittings, for example whether they were shining up or up and down. The research team tried to overcome such problems with the Useful Information booklet provided.

Due to the wealth of data, the amount of time for the analysis of home survey interviews was very restricted. Deeper analysis of important themes may reveal further links between issues and follow-up interviews could be arranged for this purpose. The participants’ enthusiasm meant that interviews were long, and the bond formed between them and the team could have made participants rate the solution implementations with a view to pleasing the research team, rather than giving honest criticism.

Examining the luminance ratios within the home was considered for the study, but it was ultimately considered to be invalid. This is something that is often done in offices but may be too complex to apply to the home environment. The time limit was also a consideration. It would be difficult to analyse this properly within the time allowed for each home visit. Another problem encountered by the research team was the difficulty in obtaining reliable readings in daylight, as much of the work was carried out in the summer months. This factor is an important one to consider for further studies of this kind.

As the length of the solution trials was only a week, it must be considered that the participants may not have had long enough to experience all the problems with, or the limitations of, the lighting solutions.
Conclusion
This study represents a scoping project to investigate existing lighting in the homes of visually impaired people. General and task illuminances were found to be varied between homes with some very low values found in some properties. Many participants reported awareness of the importance of lighting but a perceived difficulty was revealed in how to find out more information. A difficulty was also reported by many of getting access to the range of lighting available due to transport or travel difficulties. Low readings of illuminance in hazardous areas such as the stairs were cause for concern. Solution implementations were seen to be very useful and in most cases were favourably rated, although some task lights were seen to be more suitable than others depending on the task in hand. The need to address this issue further was highlighted through the data collected and analysed. Further investigation is also needed to examine a greater number of homes and study a wider representation of homes across the UK. This would enable many issues to be examined in greater depth than this project allowed.

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Glossary of Terms
The following abbreviations and terms are used in the report. These descriptions are intended to provide assistance to the reader. For further, technical explanations of terms we direct the reader to the glossary in the Society of Light and Lighting Code for Lighting (2001).

Colour rendering – a general expression used to describe the appearance of colours under a particular light source compared with a reference source. ‘Good’ colour rendering implies the colours seen under that particular light source appear in a similar way to under day light or other acceptable light sources. The performance of a light source is rated on a colour rendering index.

Colour rendering index – the colour performance of a light source is described by its colour rendering index, its ability to show colours accurately. A value of 100 is excellent.

Colour temperature – the appearance of the light from a lamp is described by its colour temperature. Lamps are termed ‘warm’ when they have a pinkish appearance or ‘cool’ when they have a bluish appearance.

Downlighter – direct lighting luminaire that directs most of the light downwards onto the floor and lower walls.

Illuminance – the amount of light falling on a surface, measured in Lumens per square metre (also called lux).

Lamp – the term used to refer to a light source, commonly termed a ‘bulb’.

Luminance – the amount of light emitted or reflected from a surface, measured in candelas/square metre (cd/m2).

Luminaire – another term for light fitting, it incorporates the lamp and the diffuser. A luminaire contains all the components necessary for fixing, connecting and protecting the lamp.

Lux – unit of measurement of illumination. Lux is a short word for Lumens per square metre lm/m2. It is a measure of the amount of light falling on a surface.

Reflectance Value – value calculated to describe the percentage of light reflected back from a surface. A value of 0.5 indicates that 50% of the light is reflected back from the surface.

Uplighter – luminaire that directs most of the light upwards onto the ceiling and upper walls.
A booklet ‘Useful Information’ was produced for distribution with the questionnaire, which is an important part of the research project. The booklet contained explanatory diagrams concerning a wide range of different lamps and luminaires that may be used in the home. This will be made available on the RGIE website (http://www.rdg.ac.uk/ie).

**References**


publications


URL:www.helptheaged.org.uk/AdviceInfo/_slips+and+trips+for+practitioners.htm as accessed 15/04/2003


Background on Thomas Pocklington Trust

Thomas Pocklington Trust is the largest specialist provider of housing and support services for people with sight loss in England. In addition to promoting services, Pocklington also funds a £750,000 social and public health research budget over a three year period.

Pocklington’s centres offer a range of sheltered and supported housing, residential care, respite care, day services and home care services, together with community based support services. A Positive About Disability and an Investor in People organisation, with quality assurance systems for its services, Pocklington is fast becoming a best practice organisation in its sector.

Pocklington has centres in Birmingham, Wolverhampton, Plymouth, Middlesex, and two in London. The charity also manages a day service and a community support service in the West Midlands and a Resource Centre in South London. Pocklington is increasingly working with partners to bring new services to people with sight loss living in the local community.

Email: info@pocklington-trust.org.uk
Web: www.pocklington-trust.org.uk

How to Get Further Information

A research findings summary of this work and the full report by Geoff Cook, Lindsay O’Neill and Sarah Hill are available from Thomas Pocklington Trust, 5 Castle Row, Chiswick, London, W4 4JQ, Telephone: 020 8995 0880 Email: info@pocklington-trust.org.uk