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Ageing, Disability & Home Care

Evidence Based Practice Review

Use of Colour for Safe Movement

PEER REVIEWED

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Abstract

Background: Vision impairment and getting older may result in a decreased ability to distinguish visual cues based on colour. Colour provides useful cues about the position and direction of objects, and assists in detection of any potential hazard when navigating natural and artificial environments. Colour detection is an important attribute for safe and independent movement. The role that colour plays in focusing attention, which has been linked to memory and improved recall, was excluded in this edition.

Objectives: To identify the effectiveness of colour and contrast, enabling individuals with vision impairment and older people to move safely and independently in the home environment.

Search Methods: Systematic search through the HMinfo Library, Google Scholar and Standard Electronic Databases comprising six main resources: CINAHL, EMBASE, Medline, Proquest, Scopus and Trove to retrieve 360 publications, four online resources classified as grey literature, three legislative/ regulatory documents and one item of anecdotal evidence.

Data Collection and Analysis: 360 publications were identified and 24 studies were analysed and included in the review matrix

Results: Three of four colour interventions in the previous edition are still relevant: the use of bright colours, colour coding and colour contrast/ cueing. The effects of colour on the older eye and those with vision impairment addressed in this review are similar to that of the previous edition. Appropriate colour interventions improve four aspects in navigation of older people and individuals with vision impairment: recognition of the environment; spatial orientation; independence in performing daily activities; and mood.

Conclusions: Bright, clear, or strong colour improves attention and may be easier for people with partial sight to detect. More effective use of colour or luminance contrast and colour coding provides better cues. Better colour cues improve movement, and safe and independent performance of activities in the home environment. There is insufficient evidence that aesthetically preferred colours are as effective. Luminance contrast may be more important than colour per se.

Keywords: **Colour; Contrast; Safe and Independent Movement; Vision Impairment; Home Environment**

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Contribution of Authors

This is the 2nd edition of *Evidence Based Practice Review: Use of Colour for Safe Movement*, replacing the original publication *The application of colour and colour contrast in the home environment of the elderly and visually impaired individuals*, authored by Gohar (2009) for the Home Modification Information Clearinghouse, UNSW Australia.

Aldyfra Lukman developed and updated materials contained in the 1st edition regarding colour application and colour contrast by reviewing studies conducted and articles written from 2009 to 2016.

Catherine Bridge guided and provided advice for developing and updating the materials contained in the 1st edition regarding colour application and colour contrast.

Joanne Quinn assisted in defining the research question and search terms, guiding the process of developing and updating materials contained in the 1st edition regarding colour application and colour contrast.

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Background

Human stereo colour vision is a very complex process that is not completely understood, but it is known that colour is vital for detecting and distinguishing elements in natural and artificial environments. People with "normal vision[1]", might regard colour as something that relates more to visual comfort, preferences, or aesthetics. However, people with limited or impaired vision use colour to identify elements to provide useful information about access, egress, hazardous elements, obstacles, and directionality, all essential for safe and independent navigation in the environment. Colour can affect visual accessibility, which is defined as use of vision to support safe and efficient travel in an environment (Legge, 2014), for people with mild or moderate vision impairment still having capability of visually perceiving elements in a limited degree.

This review focuses on the impact of colour on visual accessibility for older people and individuals with low vision. The *International Statistical Classification of Diseases and Related Health Problems*, 10th Revision (ICD-10) and the World Health Organisation (WHO) classify vision impairment into four types: normal; moderate visual impairment; severe visual impairment and blindness (WHO, 2014). These four types are differentiated by the ability to distinguish fine details (visual acuity) and what can be seen (visual field) (Seidman, 2003). Visual acuity of 6/18 (in meter) signifies that an individual with vision impairment needs to stand 6 meters from an element to see or visually perceive it with the same conspicuity as a person having normal vision positioned 18 meters from the same element (Andreas Kleynhans & Fourie, 2014). The visual field possessed by people with normal vision is 180 degrees (Andreas Kleynhans & Fourie, 2014). Low vision on the other hand is described as having visual acuity less than 6/18 (in meter) and more than or equal to 3/60 (in meter) and a visual field below 20 degrees, whereas blindness could be defined as having no light perception or possessing visual acuity less than 3/60 (in meter) or visual field below 10 degrees (Andreas Kleynhans & Fourie, 2014; Legge, 2014). Older people who have limited capability of performing visual tasks could also be classified as having low vision. This review assumes that older people and those with low vision will utilise any remaining visual ability to detect colour difference under certain conditions for assisting them to perform daily activities.

Illumination/ lighting, colour, distance, height and shape are all environmental cues that can be utilised by older people with vision impairment to detect objects and recognise their surroundings as part of safe and efficient wayfinding (Kallie, Legge, & Yu, 2012). Two colour-related terms frequently mentioned in the accessibility descriptions or

[1] "**Normal**" visual acuity (the clarity or sharpness of **vision**) or the ability to see a certain size line on the eye chart at a distance of 20 feet. If you have 20/20 **vision**, you can see clearly at 20 feet what should **normally** be seen at that distance. That is Snellen's chart 6/6 meter, 20/20 feet, 1.00 decimal or 0.0 logMAR.

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standards concerning building or environmental elements are ‘luminance contrast’ and ‘colour contrast’. Theoretical exploration concerning colour as a part of object detection and/or identification also includes the term ‘contrast’ or ‘difference between two surfaces’ (Bright & Cook, 2010). Outlining the difference between the constructs of ‘colour’ and ‘luminance’ aims to identify what or which construct is most critical to whom, and under what circumstances.

In terms of a surface’s properties, luminance can be regarded as having the closest relation to lightness or brightness. ‘Lightness’ and ‘brightness’ could be utilised to signify particularly similar conditions of a surface, but the use of these terms could also be differentiated, depending on the relationship between an examined surface and other reference surfaces. Lightness of a coloured surface is defined by the amount of light reflected from the surface that is perceived or measured in relation to light reflected from other surfaces, whereas brightness is the perceived or measured intensity of light reflected from a surface that does not necessarily require the relation between the surface and other surfaces (Blakeslee & McCourt, 2015). Brightness is however measured in a number of ways including:

- the amount of light: coming from a light source is luminous flux (lumens),
- surface light or illuminance (lux), and
- the amount of light reflected off a surface is luminance (cd/m2).

Luminance contrast is the comparison of the light reflected from one surface or object, and the light reflected from another surface or object (*AS 1428.1-2009*, 4.11; *NCC 2016*), represented as a percentage. Colour contrast is the difference both in luminance and colour that makes a surface or object distinguishable from another. Contrast is determined by the difference between surfaces or objects when they are in the same field of view. An example of difference or contrast between luminance and colour is shown in Figures 1 and 2. Figure 2 is the grayscale version of Figure 1. Figure 1 displays the colour difference between ‘red’ and ‘yellow’, whereas Figure 2 presents the luminance difference between ‘red’ and ‘yellow’.

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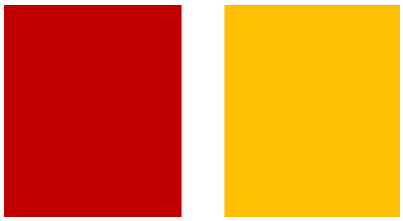

Figure 1. Colour Contrast between 'Red' and 'Yellow'

Figure 2. Luminance Contrast between 'Red' and 'Yellow'

Properties of colour are defined by referring to a colour order system. The system of specifying colours aims to support common understanding among different persons and industries, considering that identical colours could be perceived and labelled differently by two or more individuals. Two of several systems commonly applied to specify colours are the Munsell Colour System and the Natural Colour System (NCS).

The Munsell Colour System (Color & Munsell, 1965), which is displayed in Figure 3, contains three variables represented by particular numbers and letters arranged in three-dimensional perceptual space. These three variables are:

- hue, which indicates the name of the colour (red, green, blue, yellow and purple);
- value, which signifies lightness/darkness; and
- chroma, which characterises purity or saturation (Cochrane, 2014; Nayatani, 2004).

The Natural Colour System, which consists of six primary colours: white, black, red, green, blue and yellow, can also be depicted by three-dimensional diagram as displayed in Figure 4 (Nayatani, 2004). White and black in the Natural Colour System could determine lightness or darkness of the colour, which is parallel to value/ lightness in the Munsell system. The axes of the Natural Colour System comprise whiteness, blackness and chromaticness; chromaticness is considered as a more comprehensive term encompassing hue and chroma, saturation (Nayatani, 2004; Pridmore & Melgosa, 2015). While Munsell Colour System has five unique hues: red, green, blue, yellow and purple; the Natural Colour System has four unique hues: red, green, blue and yellow. The Natural Colour System, which refers to colour opponency theory (Nayatani, 2004), is placing red in the opposite position to green, and blue in the opposite position to yellow. The Natural Colour System, and colour opponency theory as its foundation, do not acknowledge mixture of opposing colour in one axis such as reddish green or bluish yellow.

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Colour opponency theory is also used as reference for the CIELAB and CIELUV, colour specification systems developed by CIE (Commission Internationale de l'Eclairage or International Commission on Illumination), that can be utilised to calculate contrast or difference of colour (Goodman, 2012). The CIELAB and CIELUV systems can also be applied to estimate luminance contrast; the results can be compared to other formulae commonly used for measuring luminance contrast such as: Michelson formula, Weber formula, RMS (Root Mean Square) formula (Pelli & Bex, 2013) and Bowman-Sapolinski formula, which is applied in Australian Standard *AS 1428.1-2009 Design for Access and Mobility Part 4.1: Means to assist the orientation of people with vision impairment-Tactile ground surface indicators* (*AS 1428.4.1 -2009*).

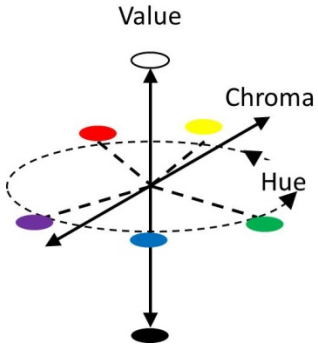

Figure 3. Munsell Colour System – Variables of Hue, Value and Chroma

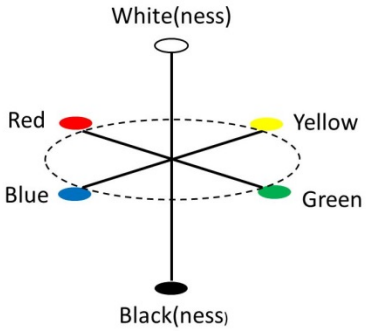

Figure 4. Natural Colour System (NCS) – Opponency of Colours

Decreased or impaired vision affects the abilities to distinguish the differences in colour combinations. Older or younger individuals with mild vision impairment might still be able to rely on a few colour contrasts for visual detection. Others with more severe vision impairment might depend on merely luminance contrast. Standards and Building Codes in Australia have included the minimum values of luminance contrast that can be applied to design visually detectable building elements for people with residual vision. However, these Standards and Building Codes have not specified the application of colour contrast or colour difference, which could be important for architects and designers to provide accessible environment for people with and without vision impairment. Specifying colour contrast could be in accordance with, or conversely, conflicting with colour preference or current trends, which vary and change depending on contexts, culture, age and gender.

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Importance of the Review

Selecting appropriate colour combinations for safe and independent movement in the home environment requires comprehending the physical condition of its occupants' visual sense. Based on dominantly impacted area in the eyes, people with vision impairment can be classified into two types: those who have dominantly impaired central area and those who have dominantly impaired peripheral area (Geruschat & Dagnelie, 2012). Impaired vision could be related to ageing and also to other factors such as disease, accident and genetics. Examples of declining vision quality linked to ageing are: reduced contrast sensitivity, decreased ability of dark adaptation, and slower visual processing (Owsley, 2011). Various vision impairments or declining visions demand different colour-related facilitations. This review deals with recognising diverse needs and colour-related solutions concerning safety and navigability as part of visual accessibility (Kallie et al., 2012) of older people and individuals with various vision impairments. Safety embraces identification of hazardous features and obstacles. Navigability entails recognising positions, shapes and functions of surrounding elements to provide more distinct information about the environment when moving from one place or position to another.

Home modification, which deals with elimination or minimisation of barriers in an existing home environment, is closely connected not only to safety and navigability, but also to comfort, psychological and social aspects. Appropriate colour and contrast combined with lighting, support safer and more independent movement of older people and individuals with vision impairment. Particular colours could also enhance mood, improve memory and provide support to overcome psychological and social problems linked to vision impairment such as depression and decreasing social-connectedness (Kuijsters, Redi, de Ruyter, & Heynderickx, 2015; Maguire et al., 2014; Thurston, Thurston, & McLeod, 2010). This review emphasises how colours should be applied and combined, as part of designing, constructing and modifying the home environment for safe and independent movement of older people and individuals with vision impairment within it. The term 'safe' indicates a state of performing activities without being harmed, whereas 'independent' signifies a state of conducting activities without assistance from others. The scope of 'movement' in this review encompasses moving the whole body from one position to another, and moving or turning parts of the body such as head or hands while residing in a fixed position..

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Prior Review

The previous edition contains descriptions and effects of four types of colour intervention aiming to provide a safe and comfortable environment for older people and individuals with vision impairment. These colour interventions consist of bright colour usage, colour coding, colour cueing and colour selection (Gohar, 2009). Older people and individuals with vision impairment regarded that the interventions improved their visual recognition of the environment, supported more vibrant spatial orientation, enhanced their memory and mood, and increasing their independence to perform activities (Gohar, 2009). The current review examines to what extent colour interventions and their effects described in the previous edition should be revised or supplemented. The need for revision and supplement are based on new findings relating to colour applications since the publication of previous edition.

The previous edition presented that older people and individuals with vision impairment can maintain perception of brightness longer than that of hue, which implies that luminance supported more effective identifications based on colour, than hue and or saturation (Gohar 2009). The positioning of luminance as described above, might serve as one of the reasons why luminance contrast is more frequently specified than colour contrast in the standards and building codes. Recent studies on colour, ageing and vision impairment, could indicate which contrast could be utilised by older and or impaired eyes for visual detection; colour contrast that contains lightness, hue and saturation or luminance contrast that deals with merely lightness. This review is intended to identify the role of luminance contrast and colour contrast on effective visual detection by older people and individuals with vision impairment. Identifying the role of colour contrast in effective visual detection by referring to recent studies could assist in measuring the importance of specifying colour contrast in the standards and building codes.

What had been addressed in the previous edition but would not be included in the current review, is colour perception of older people with cognitive impairment such as dementia and Alzheimer's. The current review focuses only on visual perception or colour perception affected by deficit in vision or visual sense, not in certain parts of the brain. Analysing appropriate interventions for the groups with vision impairment is separated from that of groups with cognitive impairment, based on consideration of specific needs of each group, depending on physical and psychological characteristics of its members, and potentially conflicting results between needs of these groups.

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Objectives

This review was conducted to check and update the previously published materials regarding the effectiveness of the use of colour and contrast for enabling older people and individuals with vision impairment to move safely and independently in various environments. Checking and updating the materials in previous edition are based on recent findings related to colour applications and contrast for supporting safe and independent navigation in the built environment. Effective use of colour and contrast identified in the reviewed studies were expected to inform what kinds of colour interventions are appropriate to be applied in building elements and tools for supporting safe and independent movement of older people and individuals with vision impairment inside and outside their home.

Methods

A systematic review of literature was conducted by referring to *The Protocol Guidelines for Systematic Reviews of Home Modification Information to Inform Best Practice* (Bridge & Phibbs, 2003).

Research Question

How effective are colour application and colour contrast for enabling older people and individuals with vision impairments to move safely and independently in their home?

Question Refinement Strategy

Following on from the HMinfo systematic review protocol (Bridge & Phibbs, 2003), the research question was refined into an operational format that could be researched systematically by application of appropriate search criteria.

Problem	Intervention	Participants	Outcome
Home	Effective use of colour	Older people and individuals with vision impairments	Safe and independent movement

Table 1. Question Refinement

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Search Terms

Problem	Intervention	Participants	Outcome
Home	Colour/Color	Vision	Mobility
Dwelling	Contrast	Vision Impairment	Independency
House	Colour contrast/ Color contrast	Low Vision	Navigation
Residence	Luminance Contrast	Older	Orientation
Space		Age	Walk
		Ageing/Aging	Ambulation
		Elderly	Locomotion
		Senior	Travel
		Disability	Wayfinding
		Disabled	Safety

Table 2. Search Terms

Connectors

AND, OR, ADJ (adjacent)

Truncation symbols

*, $,?, #

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Inclusion Criteria

References were selected if they:

- Were written in English
- Were published from 2009 onward
- Could be accessed and retrieved freely via UNSW Australia library and or the internet
- Engage the actual older people and or individuals with reduced or impaired vision, who have no cognitive impairment, as participants
- Examine the effects of colour combinations, colour contrast or luminance contrast on visual perception or detection that can be linked to safe and independent movement within built environment or home environment
- Contain applicable materials across different cultures and countries
- Measure and or present outcomes that are relevant to safe and independent movement within built environment or home environment in a form of quantitative and or qualitative data
- Utilise systematic review or apply methods involving participants other than the writer(s) or researcher(s) that include: randomised controlled trial, quasi experimental, observational study and case study.

Exclusion Criteria

Materials that had been retrieved were excluded from the review if they:

- Were not written in English
- Were published before 2009
- Could be accessed and retrieved only through purchasing
- Employ simulated vision impairment or do not engage the actual older people or individuals with vision impairment as participants at all
- Contain materials that are limited to specific culture(s) or country(ies)
- Do not measure or present outcomes that could be relevant to safe and independent movement within the built environment or home environment at all.
- Utilise methods that do not include participant(s) other than the writer(s) or researcher(s), such as: expert opinion, unsystematic review, and anecdotal evidence.

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Search Strategy

The search strategy was performed in accordance with the HMinfo systematic review protocol (Bridge & Phibbs, 2003). The search regarding subject and title linked to question refinement by using search terms, was conducted via the internet to identify and acquire potential studies for review. The electronic sources searched were:

- HMinfo Research Library
- Databases linked to UNSW Library
    - CINAHL
    - EMBASE
    - Medline
    - Proquest
    - Scopus
- Google Scholar
- Trove

HMinfo Research Library search

The HMinfo Research Library is an online resource containing an in-depth collection of materials on home modifications and related subjects (HMinfo, n.d., Research Library). The search of the HMinfo Research Library, using search terms, resulted in 35 potential studies or articles being found. The review included one relevant study.

Standard Electronic Database search

The search of Standard Electronic Databases: CINAHL, EMBASE, Medline, Proquest, Scopus and Trove, using the search terms, resulted in 167 studies or articles being found. The review included 14 relevant studies.

Online (World Wide Web) Search

The online search using the Google Search Engine and search terms, resulted in 158 studies or articles being found. The review included nine relevant studies.

Grey Literature

The online search using the Google Search Engine and the HMinfo Research Library, using the search terms ‘colour’ and ‘contrast’, resulted in four relevant resources.

- *Colour Contrast Analyser* by Vision Australia (Vision Australia, 2012)
- *Colour Contrast Check (Snook.ca, 2015)*
  Luminosity Colour Contrast Ratio Analyser (Juicy Studio, 2016)
- *CUBE* instrument and application to check the properties of colour *(Palette, 2016)*

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Legislative and Regulatory Documents

The search of Australian Building Codes and Australian Standards resulted in three relevant documents.

- *National Construction Code (NCC) 2016 - Volume 1: Building Code of Australia – Volume 1 (Class 2 to Class 9 Buildings) (NCC 2016)*
- Australian Standard *AS 1428.1-2009: Design for access and mobility - General requirements for access - New building work (AS 1428.1-2009; AS 1428.4.1 -2009)*
- Australian Standard *AS 1428.4.1-2009: Design for Access and Mobility Part 4.1: Means to assist the orientation of people with vision impairment-Tactile ground surface indicators (AS 1428.4.1 -2009)*

Anecdotal Evidence

The search of HMinfo Online Forums (HMinfo, 2016b) resulted in three relevant discussion threads being found in the *HMinfo Occupational Therapist (OT) Forum.* The *HMinfo OT Forum* is an online forum for registered occupational therapists who are interested in home modifications. It provides a medium for home modification related discussion, exchange of information and opinions, and sharing of resources (HMinfo, 2016c).

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Outcomes of Search

The review process, with the number or relevant studies and other documentation, is outlined in Figure 5.

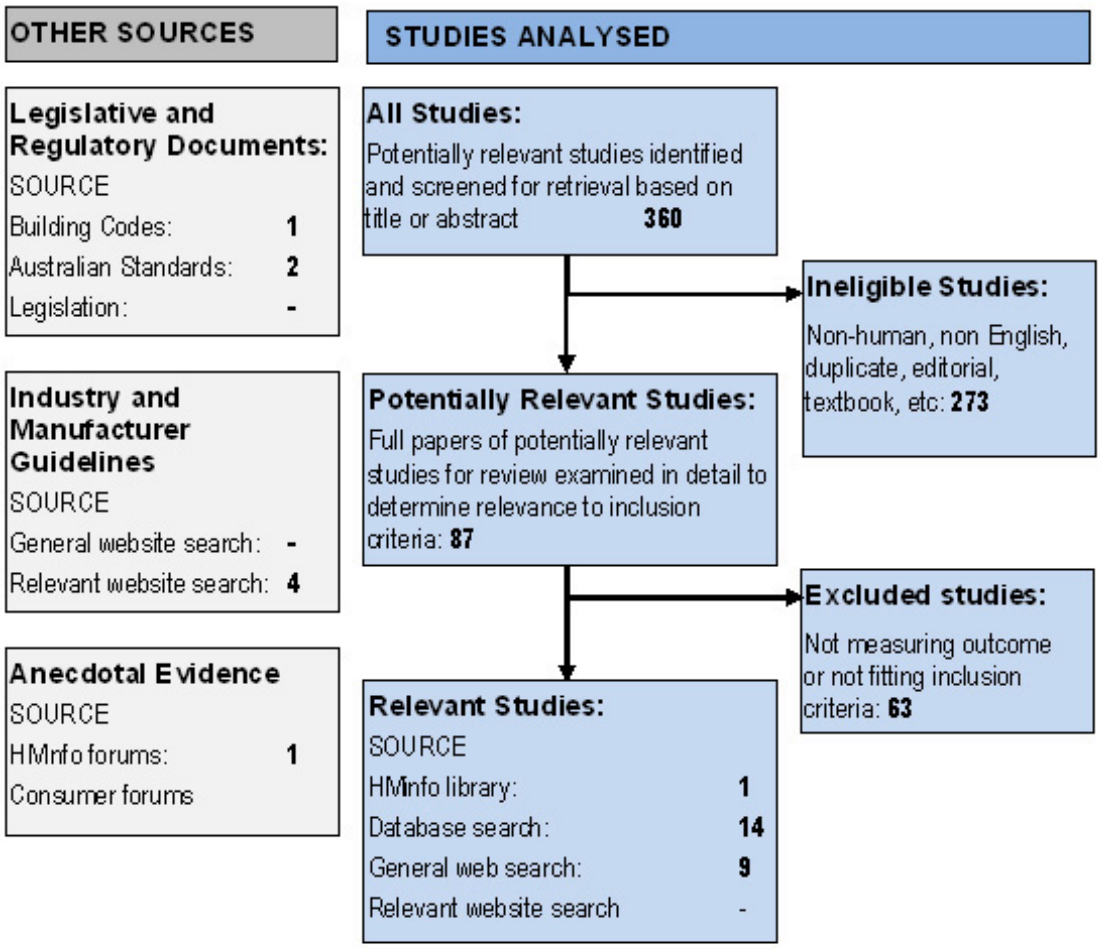

Figure 5. Review Process

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Studies Analysed

The colour interventions described in the previous edition were still considered relevant for this review. The interventions are: use of bright colours, colour coding, colour contrast/ colour cueing and use of selective colours. This review adds more detailed discussion than what has been described in the previous edition, concerning luminance contrast or differences in brightness or lightness, as part of colour contrast/ colour cueing. Highlighting luminance contrast as part of the discussion on colour contrast intended for safe navigation, is based on these considerations:

- several participants with vision impairment involved in the reviewed studies have decreased or limited capabilities of distinguishing colours between objects; some individuals with severe low vision could only detect the difference in brightness or luminance, not in hue and or saturation.

- A few recently reviewed studies concerning detection of objects by older people and individuals with vision impairment emphasise on difference in brightness or lightness or differences of achromatic colours such as: black, white and grey.

The types of colour interventions identified in the reviewed studies are described as follows:

1. Use of Light or Bright Colours

Several studies, which are conducted in various settings, imply the use of bright or lighter colours for object detections by older people and individuals with vision impairment (Ainsworth, Baigent, Cordiner, & de Wit, 2011; Alexander & Cowey, 2010; Fabriek, de Waard, & Schepers, 2012; Jenkins, Yuen, & Vogtle, 2015; Lewis & Torrington, 2012; Maguire et al., 2014). The benefits of utilising bright or lighter colours are:

a) Enhancing conspicuity or distinctiveness of particular colours, as presented in study involving participants with hemianopsia/ blindness over half of the visual field by Alexander and Cowey (2010).

b) Enhancing conspicuity or distinctiveness of particular objects within outdoor or indoor environment, as shown in case study regarding home of an old woman with vision impairment conducted by Ainsworth et al (2011), study concerning bicycle infrastructure performed by Fabriek, de Waard and Schepers (2012) and study on multisensory perception of older people and individuals with vision impairment about home environment by Jenkins, Yuen and Vogtle (2015).

c) Enhancing internal reflectance of the surroundings, as displayed in study on lighting of home environment by Lewis and Torrington (2013)

d) Identifying dirt on the floor as a part of cleaning or maintenance process, as reported in the study on kitchen environment by Maguire et al (2014).

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The degree of conspicuity and distinctiveness of colours and objects does not always have linear relationship with the degree of illuminance and reflectance, it could be affected by visual condition or nature of vision impairment. An example supporting this statement is displayed in the study on colour detection by participant with hemianopsia/ blindness over half of the visual field by Alexander and Cowey (2010). One of the participants who still have residual colour vision regards that certain colours with low luminance are detectable when they are compared to other different colours with low or high luminance but become less detectable when they are compared to different colours with moderate luminance.

2. Use of Colour Coding/ Association

Marking or associating objects/ elements with particular colours is useful for identifying building elements or features of appliances. Colour coding/ association can be utilised by the older people and or individuals with vision impairment to:

a) Select or memorise certain environmental cues, as displayed in study on place identification by the older adults, conducted by Davis and Therrien (2012).

b) Locate particular feature(s), such as operating button on appliances, as shown in the study on kitchen environment by Maguire et al (2014).

c) Differentiate various features, services or functions located within one element or space such as labels, information service, walls; as presented in evaluation of transportation facilities in Ireland according to people with vision impairment performed by Gallagher, Hart, O' Brien, Stevenson and Jackson (2011), in study on home modification guidelines according to people with Age-related Macular Degeneration (AMD) by Riazi, Ying-Boon, Bridge and Dain (2012) and in study on needs of customers with vision impairment concerning shopping activity by Yu, Tullio-Pow and Akhtar (2015)

3. Use of Contrasting Colours and or Luminance

The use of contrasting colour and or luminance is identified in almost all the reviewed studies (96% of 23 studies). This implies that contrast is one aspect on which older people and or individuals with vision impairment frequently and mostly rely when performing activity or moving in their home or other environments. The elements or materials related to contrast observed in the reviewed studies range from texts to elements of dwelling and public spaces, considering that contrast can be useful not only for identifying locations and environmental features but also for acquiring written or graphic information about the surroundings.

There were 5 of 23 studies (22%) discussing colour contrast, focus on luminance contrast or difference in lightness or brightness of objects (Bochsler, Legge, Gage, & Kallie, 2013; Crossland & Rubin, 2012; Elton, Johnson, Nicolle, & Clift, 2013; Pardhan, Gonzalez-Alvarez, & Subramanian, 2012; Shikder, Mourshed, & Price, 2012). Luminance contrast had been implied in the previous edition; Gohar (2009)

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stated that bright white against dark black provides most accessible contrast. One significant difference between luminance and colour contrast identified in the reviewed studies is situated on the quantification. Luminance contrast values found in the reviewed studies are mostly presented in number or percentage (0-100%), which are calculated and analysed through quantitative methods and formulae, whereas most of colour contrasts mentioned in the reviewed studies are described qualitatively or derived through qualitative analysis.

There is a considerable difference when comparing the effect of luminance contrast on visibility that is described in the reviewed studies. Several studies verify that the amount of luminance contrast significantly affects the degree of visibility. High values of luminance contrast (above 80%-90%) are regarded as supporting texts or written information to become visually accessible for people with vision impairment (Crossland & Rubin, 2012; Elton et al., 2013). Study on luminance contrast and grasping performed by Pardhan, Gonzales-Alvarez and Subramanian (2012) confirms that target with high contrast (such as white against black) is easier to detect than target with low contrast, even though the degree of contrast does not significantly affect the speed of grasping. Systematic review by Shikder, Mourshed and Price (2012) implies the importance of luminance contrast on locating or detecting objects, despite of the absence of recommended exact values. Different from studies on luminance contrast described above, study conducted by Bochsler, Legge, Gage and Kallie (2013) presents that the effect of lighting and contrast on visual performance of participants with vision impairment is weaker than what have been predicted, which could be relating to unique visual functions of participants with vision impairment or degree of the impairment.

This review also identify similar results with what were presented in the previous edition concerning lack of specified colours regarded as the most effective to provide cues. Red against white or light colour is regarded as one of the sufficiently detectable combinations, whether it is applied on three-dimensional settings such as home entrance (Dalke & Corso, 2013), bathroom (Lewis & Torrington, 2012) and outdoor environment (Fabriek et al., 2012) or on target displayed on two-dimensional surfaces (Shima, Markowitz, & Reyes, 2013). A few studies also present the application of yellow or white lines in the outdoor environment (Fabriek et al., 2012; Parkin & Smithies, 2012). Highly variable factors influencing colour contrast such as lighting, hue, saturation, distance and visual functions lead to diverse outcomes concerning visually accessible colour combinations and might have an effect on the difficulty of specifying appropriate combinations in the standards. Other factors or issues that might affect the selection or application of visually accessible colour combinations are colour preferences depending on psychological, social, cultural and financial aspects.

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4. Use of Preferred/ Selective Colours

Preferred/ selective colours identified in the reviewed studies concern with ability to carry out personal grooming and dressing, as described in the study on occupational performance from perspectives of individuals with low vision conducted by Blaylock, Barstow, Vogtle, Bennett (2015) and with ability to control the feeling, as displayed in the study regarding the effect of ambient lightings on the mood of older people performed by Kuijsters, Redi, de Ruyter and Heynderickx (2015). Kuijsters et al (2015) do not only apply coloured surfaces but also coloured illumination/ lighting. Preferred/ selective colours contained in the reviewed studies are more related to the confidence and mood than to the safe and independent movement.

Effects of colour on the living environment of older people and individuals with vision impairment addressed in this review are slightly different from what were described in the previous edition. Gohar (2009) describes in the previous edition that application of colour and contrast improves five aspects linked to the movement or navigation of older people and individuals with vision impairment. These five aspects are:

- vision, sight and clarity regarding environmental features;
- spatial orientation;
- independency in performing activities;
- mood; and
- memory.

Since this review excludes studies incorporating older adults with cognitive impairment, therefore there is no materials related to memory improvement could be identified in currently reviewed studies. According to older people and individuals with vision impairment involved in the reviewed studies, colours are useful to:

1. Improve vision, sight and clarity of environmental features

Bright/ light colours and colour/ luminance contrast are factors supporting the identification and clarity of environmental cues. Use of bright colours and high colour contrast could enable older people and individuals with vision impairment or residual vision to recognise building elements in the home such as elements of entrance, circulation, bathroom and kitchen; electrical features and electronic appliances (Ainsworth et al., 2011; Dalke & Corso, 2013; Demirkan & Olguntürk, 2014; Lewis & Torrington, 2012; Maguire et al., 2014; Riazi, Ying Boon, Bridge, & Dain, 2012).

Contrast or difference of colour or brightness also support text and object detection by people with vision impairment (Alexander & Cowey, 2010; Bochsler et al., 2013; Crossland & Rubin, 2012; Davis & Therrien, 2012; Elton et al., 2013; Fabriek et al., 2012; Jenkins et al., 2015; Pardhan et al., 2012; Shima et al., 2013; Yu, Tullio-Pow,

& Akhtar, 2015); which could be useful for obtaining or gathering information about the environment and its features including existing obstacles.

2. Improve spatial orientation

Contrast or difference in colour or luminance could be applied to inform older people and individuals with vision impairment about their current position and surroundings; location of destined position or space; how to reach or access the destined position or space and features that could be utilised to access destination position or space. Materials related to spatial orientation that could be identified in the reviewed studies consist of: rooms at home (Ainsworth et al., 2011; Dalke & Corso, 2013), the characteristics of place (Davis & Therrien, 2012), the location and direction within public or shared spaces (Hammond & Musselwhite, 2013; Jenkins et al., 2015; Parkin & Smithies, 2012) and the position of informative elements in the environment (Lewis & Torrington, 2012; Yu et al., 2015).

3. Enhance ability to function independently

Colour contrast can be utilised by older people or individuals with vision impairment to carry out daily tasks or activities at home independently, such as: personal care, grooming or dressing (Ainsworth et al., 2011; Blaylock, Barstow, Vogtle, & Bennett, 2015; Lewis & Torrington, 2012); item organisation (Glen & Crabb, 2015), cleaning (Maguire et al., 2014); and meal preparation (Warren, 2009). Colour contrast could also be beneficial for older people or individuals with vision impairment to conduct activities outside their home such as performing sport or leisure activity in the outdoor environment (Fabriek et al., 2012), traveling by using public transportation (Gallagher, Hart, O'Brien, Stevenson, & Jackson, 2011) or shopping (Yu et al., 2015).

4. Enhance mood

Two reviewed studies incorporate the effect of colour and or luminance on mood of older adults (Kuijsters et al., 2015; Shikder et al., 2012). Study performed by Shikder et al.(2012) is a systematic review addressing physical and psychological aspects of lighting and their role in providing healthy and safe environment for older people that includes mood aspect. Study conducted by Kuijsters et al. (2015) focuses specifically of lighting and its effect on mood of the older people. The issue identified in Kuijsters et al. (2015) is the lack of description regarding colour vision of the participants, which might affect their mood related to lighting and colour.

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Other Sources

The minimum values of luminance contrast concerning building elements or facilities regarded as appropriate for safe navigation of older people and/or individuals with vision impairment are stated in *NCC 2016*; A*S 1428.1-2009* and *AS 1428.4.1-2009.* Specified values or descriptions of colour contrast could not be identified.in these sources and other standards.

Legislative and Regulatory Documents

As described in Volume 1 of *NCC 2016* and *AS 1428.1-2009*, information facilities and building elements should have values of luminance contrast equal to or more than 30% to enable visual detection by older and impaired eyes (*AS 1428.1-2009*; *NCC 2016*). Contrast and safety aspects of public facilities are also outlined in *AS 1428.4.1-2009*, which require tactile warnings on the floor surfaces to have minimum values of luminance contrast ranging from 30% to 60%, for enabling visual detection by people with vision impairment (*AS 1428.4.1 -2009*). The reviewed studies display significantly different results from values in the Australian Standards and Australian Building Code, by implying that a high amount of luminance contrast, more than 60%, enables visual detection by most of people or participants with vision impairment.

Industry and Manufacturer Guidelines

The *Colour Contrast Analyser* by Vision Australia (Vision Australia, 2012) is one of the online resources that could provide guidance for industries and consumers on how to mix or combine colours to produce visually accessible contrast for older and or impaired eyes. Other online tools such as *Colour Contrast Check* (Snook.ca, 2015) and *Luminosity Colour Contrast Ratio Analyser* (Juicy Studio, 2016) could also be used to check and compare the degrees of contrast resulted from mixture of various colours.

These online tools are useful in examining adequacy of colour contrast for enabling visual detection by older and or impaired eyes. However, they are more applicable to texts, signage or screen than to the actual building elements in real environment. Combining these tools with other facilities such as colour databases from paint manufacturers or colour digitizer called *CUBE* (Palette, 2016) could provide clearer guidelines to apply visually detectable colour combinations or contrast for older people and individuals with vision impairment. *CUBE* is a tool developed by Palette that measures and presents properties of colour of a surface; the measurement outcomes can be displayed and read in installed application in IOS and Android-based instruments (HMinfo, 2016a). *CUBE* is actually intended to enable designers to identify and select the colours for their design based on colours available in the environment and manufacturers' databases. Nevertheless, to ensure the reliability of *CUBE* in determining appropriate colour contrast for older and impaired eyes, the outputs from *CUBE* should be compared with results from other instruments commonly utilised to

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calculate colour properties and contrast in built environment such as Photometer, Spectrodensiometer and Colourluminator.

Anecdotal Evidence

HMinfo Online Forums

The materials concerning application of colour and contrast for activities of people with vision impairment briefly mentioned in the *HMinfo Occupational Therapist Forum* (HMinfo, 2016c) were relating to oxygen-provider apparatus, stair nosings and toilets. The discussion threads did not specify how colour and contrast should be applied. No material related to colour and contrast could be found in other *HMinfo Forums* (HMinfo, 2016b).

Completeness and Quality of Evidence

The systematic search acquired 360 references based on applied search terms. There were 24 publications included in the analysis and described in the matrix (see Appendix 2).

The settings of the reviewed studies consisted of home environment (38%), laboratory (33%), public space (21%), retail space (4%) and unspecified (4%). Several studies that did not specifically focus on home environment were included by considering that the results were relevant for colour application intended to support safe and independent movement of the older people and individuals with vision impairment inside and around their home.

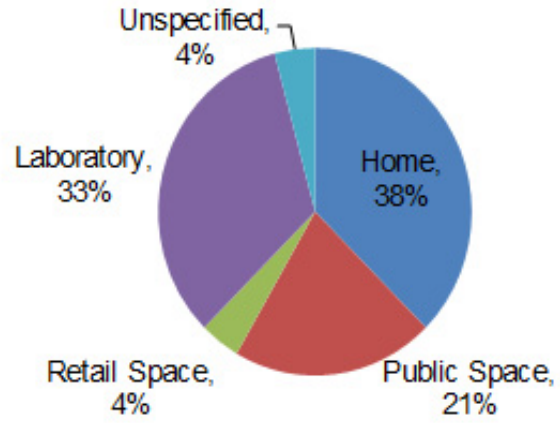

Figure 6. Pie chart of Study Settings

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The interventions identified in the reviewed studies consisted of: use of colour contrast (62%), use of bright colours (19%), use of colour coding/ association (14%) and use of selective/ preferred colours (5%). There were 12 studies addressing more than one intervention, therefore the number of total interventions is exceeding the number of reviewed studies: 24.

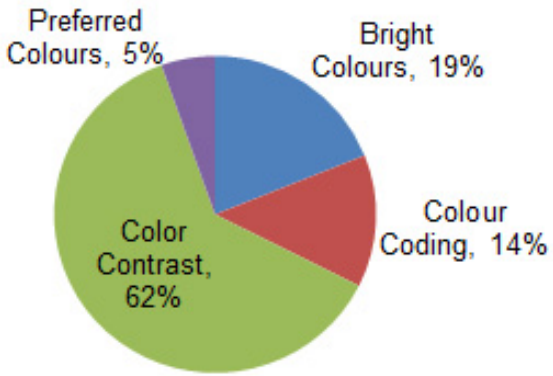

Figure 7. Pie chart of Colour Intervention

The types of participants taking part in the reviewed studies consisted of: group of individuals or older people with vision impairment only (67%), group of individuals or older people with normal vision or colour vision deficit only (8%) and both groups (25%).

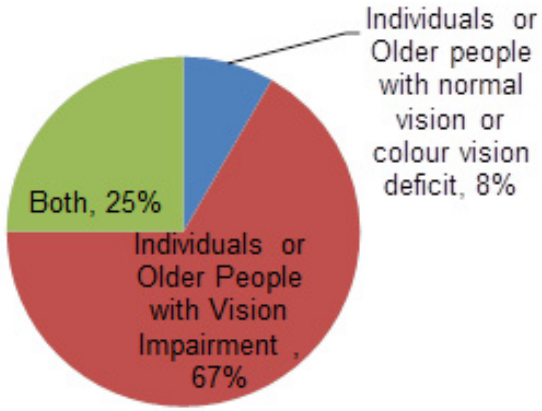

Figure 8. Pie chart of Participants

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The actual/ expected outcomes identified in the reviewed studies consisted of: improving vision, sight and clarity (46%), improving spatial orientation (22%), enhancing ability to function independently (27%) and enhancing mood (5%). There were 10 studies addressing more than one outcome, therefore the number of total outcomes exceeded the number of reviewed studies: 24.

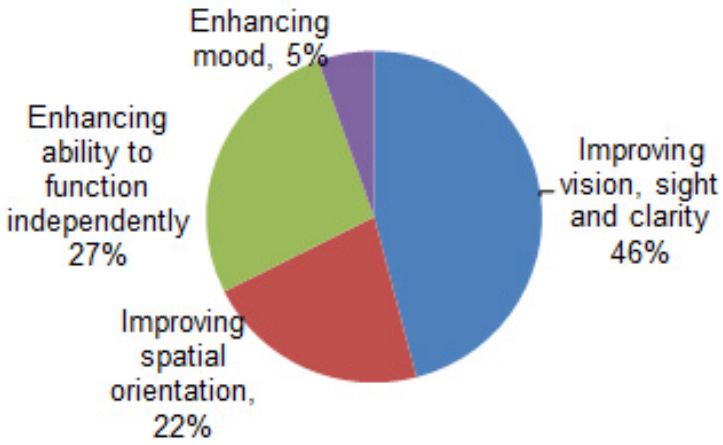

Figure 9. Pie chart of Actual/Expected Outcomes

The methods applied in the reviewed studies consisted of: observational study (64%), quasi-experimental study (20%), case study (12%) and systematic review (4%). The study conducted by Fabriek et al (2012) concerning visibility of bicycle infrastructure utilised two methods: observational and quasi-experimental study.

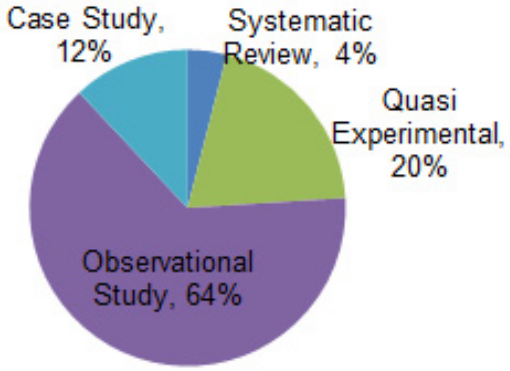

Figure 10. Pie chart of Study Method

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The reviewed studies were conducted in these countries: United Kingdom (38%), United States of America (33%), Canada (8%), Netherlands (8%), Australia (4%) and other (8%).

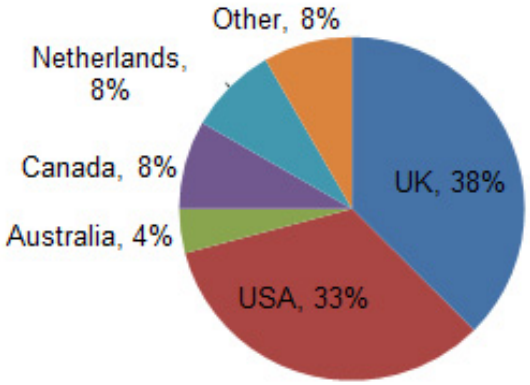

Figure 11. Pie chart of Nationality of Literature

Conclusions

Using bright colours, associating colour with reference objects and applying highly contrasting colour or luminance provide effective cues for groups of older people and individuals with vision impairment to safely navigate the environment because bright colours and high contrasts are easier for these groups to detect visually. There is insufficient evidence from the review, that preferred colours could effectively support safe and independent movement of older people and individuals with vision impairment. In terms of movement of older people and individuals with vision impairment in their home, the use of bright colours and high colour contrast improves:

- recognition of the environment;
- spatial orientation;
- independency in performing daily activities;and
- mood.

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Reviewed studies discussing the effect of luminance contrast on visibility mostly applied quantitative methods. Numeric values of luminance contrast stated in these studies provide tangible requirements that are applicable across different settings. However, reviewed studies addressing colour contrasts, mostly did so qualitatively. The lack of numerical or tangible representation of colour contrast in the reviewed studies, limits applicability of the study outcomes in a broader context. Also, the colours utilised in the reviewed studies were limited to primary and commonly familiar colours:

- chromatic colours: red, green, blue and yellow; and
- achromatic colours: white and black.

More varieties of hues, saturations and brightness in colour applications combined with different lightings in the real environment might produce different outcomes from results described in these studies.

Research Strategies

Further review or study should address quantitative assessment on effectiveness of application of colour contrasts in the home environment of older people and individuals with vision impairment. Home environment in this context should encompass indoor and outdoor spaces of the residential dwelling, all elements constituting these spaces, and functions accommodated by these spaces.

Further review or study is expected to provide more descriptions of required colour contrasts that are based on not only psychophysical measurements, but also on social and financial assessments such as colour trends, cultural values and budget constraints.

Further review or study might also need to include the effectiveness of applying colour and contrast in the home environment of groups of older people and individuals with cognitive impairment. These groups might require different colour-related interventions or facilitations to those required by groups with vision impairment, to support safe and independent movement in their home. Identifying similarities and differences in requirements of these different groups could be beneficial for improving or complementing the requirements for safe navigation in Australian Standards.

Information Strategies

The information contained in this publication will be disseminated in the form of industry and consumer factsheets. The factsheets will be distributed to:

- colour-related industries such manufacturers of paint or building elements;
- building professionals such as architects, designers and builders; and
- consumers, including residents and their families, friends and carers.

The factsheets will provide guidance for applying colour combinations in the home environment, that can support safe and independent movement of people of all ages, with a range of visual function.

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References

* Ainsworth, E. , Baigent, K. , Cordiner, R. , & de Wit, S. (2011). Case Studies. In E. Ainsworth & D. de Jonge (Eds.), *An Occupational Therapist's Guide to Home Modification Practice* (Vol. 1st, pp. 289-325). USA: SLACK Inc.

Alexander, Iona, & Cowey, Alan. (2010). Edges, colour and awareness in blindsight. *Consciousness and cognition, 19*(2), 520-533.

Andreas Kleynhans, Stefanus, & Fourie, Ina. (2014). Ensuring accessibility of electronic information resources for visually impaired people: The need to clarify concepts such as visually impaired. *Library Hi Tech, 32*(2), 368-379.

AS 1428.1-2009: Design for access and mobility - General requirements for access - New building work. (2010). SAI Global Limited.

AS 1428.4.1-2009: Design for Access and Mobility: Means to assist the orientation of people with vision impairment-Tactile ground surface indicators. (2014). SAI Global Limited.

Blakeslee, Barbara, & McCourt, Mark E. (2015). A common theoretical framework for brightness and lightness perception. *Perception, 44*(4), 359.

Blaylock, Sarah E, Barstow, Beth A, Vogtle, Laura K, & Bennett, Deborah K. (2015). Understanding the occupational performance experiences of individuals with low vision. *British Journal of Occupational Therapy, 78*(7), 412-421.

Bochsler, Tiana M, Legge, Gordon E, Gage, Rachel, & Kallie, Christopher S. (2013). Recognition of Ramps and Steps by People with Low VisionRecognition of Ramps and Steps. *Investigative ophthalmology & visual science, 54*(1), 288-294.

Bridge, C., & Phibbs, P. . (2003). Protocol guidelines for systematic reviews of home modification information to inform best practice. Sydney: Home Modification Information Clearinghouse, University of Sydney.

Bright, Keith, & Cook, Geoffrey. (2010). *The Colour, Light and Contrast Manual: Designing and Managing Inclusive Built Environments* (1st ed.): Wiley-Blackwell.

Cochrane, Sally. (2014). The Munsell Color System: A scientific compromise from the world of art. *Studies in History and Philosophy of Science Part A, 47*, 26-41.

Color, Munsell, & Munsell, Albert Henry. (1965). *Munsell book of color*: Munsell Color.

Crossland, Michael D, & Rubin, Gary S. (2012). Text accessibility by people with reduced contrast sensitivity. *Optometry & Vision Science, 89*(9), 1276-1281.

2nd ed., October 2016; DOI: 10.4225/53/57DA00675000F
ISBN: 978-0-7334-3664-2 Evidence Based Practice Review Series ISBN: 978-0-7334-3663-5 www.homemods.info

Dalke, Hilary, & Corso, Alessio. (2013). Making an entrance: colour, contrast and the design of entrances to homes of people with sight loss.

Davis, Rebecca L, & Therrien, Barbara A. (2012). Cue color and familiarity in place learning for older adults. *Research in gerontological nursing, 5*(2), 138-148.

Demirkan, Halime, & Olguntürk, Nilgün. (2014). A priority-based 'design for all'approach to guide home designers for independent living. *Architectural Science Review, 57*(2), 90-104.

Elton, Eddy, Johnson, Daniel, Nicolle, Colette, & Clift, Laurence. (2013). Supporting the development of inclusive products: the effects of everyday ambient illumination levels and contrast on older adults' near visual acuity. *Ergonomics, 56*(5), 803-817.

Fabriek, Eva, de Waard, Dick, & Schepers, J Paul. (2012). Improving the visibility of bicycle infrastructure. *International journal of human factors and ergonomics, 1*(1), 98-115.

Gallagher, Bláithín AM, Hart, Patricia M, O'Brien, Colm, Stevenson, Michael R, & Jackson, Andrew J. (2011). Mobility and access to transport issues as experienced by people with vision impairment living in urban and rural Ireland. *Disability and rehabilitation, 33*(12), 979-988.

Geruschat, Duane, & Dagnelie, Gislin. (2012). Low Vision: Types of Vision Loss and Common Effects on Activities of Daily Life. *Assistive Technology for Blindness and Low Vision*, 59.

Glen, Fiona C, & Crabb, David P. (2015). Living with glaucoma: a qualitative study of functional implications and patients' coping behaviours. *BMC ophthalmology, 15*(1), 1.

Gohar, Nicholas. (2009) The Application of colour and colour contrast int the home environment of the elderly and visually impaired individuals. (1st ed.): Home Modification Information Clearinghouse.

Goodman, T.M. (2012). International Standards for Colour. In J. Best (Ed.), *Colour design: Theories and Applications* (1st ed., pp. 177-218): Woodhead Publishing Limited in association with the Textile Institute.

Hammond, Victoria, & Musselwhite, Charles. (2013). The attitudes, perceptions and concerns of pedestrians and vulnerable road users to shared space: A case study from the UK. *Journal of Urban Design, 18*(1), 78-97.

HMinfo. (2016a). Colour and Luminosity Measurement Tools to Improve Accessibility. from http://www.homemods.info/news/colour-and-luminosity-measurement-tools-to-improve-accessibility#main-content

2nd ed., October 2016; DOI: 10.4225/53/57DA00675000F

ISBN: 978-0-7334-3664-2 Evidence Based Practice Review Series ISBN: 978-0-7334-3663-5 www.homemods.info

HMinfo. (2016b). Forums. http://www.homemods.info/forums

HMinfo. (2016c). Occupational Therapist Forum. http://www.homemods.info/forums/occupational-therapist

Jenkins, Gavin R, Yuen, Hon K, & Vogtle, Laura K. (2015). Experience of Multisensory Environments in Public Space among People with Visual Impairment. *International journal of environmental research and public health, 12*(8), 8644-8657.

Juicy Studio. (2016). Luminosity Colour Contrast Ratio Analyser. from http://juicystudio.com/services/luminositycontrastratio.php

Kallie, Christopher S, Legge, Gordon E, & Yu, Deyue. (2012). Identification and Detection of Simple 3D Objects with Severely Blurred VisionObject Visibility with Severely Blurred Vision. *Investigative ophthalmology & visual science, 53*(13), 7997-8005.

Kuijsters, A, Redi, J, de Ruyter, B, & Heynderickx, IEJ. (2015). Lighting to make you feel better.

Legge, Gordon E. (2014). Prentice Medal Lecture 2013: Visual Accessibility: A Challenge for Low-Vision Research. *Optometry and vision science: official publication of the American Academy of Optometry, 91*(7), 696.

Lewis, A, & Torrington, J. (2012). Extra-care housing for people with sight loss: Lighting and design. *Lighting Research and Technology*, 1477153512450451.

Maguire, Martin, Peace, Sheila, Nicolle, Colette, Marshall, Russell, Sims, Ruth, Percival, John, & Lawton, Clare. (2014). Kitchen living in later life: Exploring ergonomic problems, coping strategies and design solutions. *International journal of design, 8*(1).

National Construction Code Series 2016. (2016). http://www.abcb.gov.au/: Australian Building Codes Board.

Nayatani, Yoshinobu. (2004). Transformation from Munsell space to Swedish NCS—Through Nayatani theoretical space. *Color Research & Application, 29*(2), 151-157.

Owsley, Cynthia. (2011). Aging and vision. *Vision research, 51*(13), 1610-1622.

Palette. (2016). CUBE. from http://palette.com/cube

Pardhan, Shahina, Gonzalez-Alvarez, Carmen, & Subramanian, Ahalya. (2012). Target contrast affects reaching and grasping in the visually impaired subjects. *Optometry & Vision Science, 89*(4), 426-434.

2nd ed., October 2016; DOI: 10.4225/53/57DA00675000F
ISBN: 978-0-7334-3664-2 Evidence Based Practice Review Series ISBN: 978-0-7334-3663-5 www.homemods.info

Parkin, John, & Smithies, Nicola. (2012). Accounting for the needs of blind and visually impaired people in public realm design. *Journal of Urban Design, 17*(1), 135-149.

Pelli, Denis G, & Bex, Peter. (2013). Measuring contrast sensitivity. *Vision research, 90*, 10-14.

Pridmore, Ralph W, & Melgosa, Manuel. (2015). All effects of psychophysical variables on color attributes: A classification system. *PloS one, 10*(4), e0119024.

Riazi, Abbas, Ying Boon, Mei, Bridge, Catherine, & Dain, Stephen J. (2012). Home modification guidelines as recommended by visually impaired people. *Journal of Assistive Technologies, 6*(4), 270-284.

Seidman, K.R. (2003). Understanding Visual Impairments. In E. S. Axel & N. S. Levent (Eds.), *Art Beyond Sight : A Resource Guide to Art, Creativity, and Visual Impairment.* New York: Art Education for The Blind, Inc. (AEB) and AFB Press of the American Foundation for The Blind.

Shikder, Shariful, Mourshed, Monjur, & Price, Andrew. (2012). Therapeutic lighting design for the elderly: a review. *Perspectives in public health, 132*(6), 282-291.

Shima, Noboru, Markowitz, Samuel N, & Reyes, Sophia V. (2013). Residual colour detection abilities in age-related macular degeneration. *Canadian Journal of Ophthalmology/Journal Canadien d'Ophtalmologie, 48*(4), 274-278.

Snook.ca. (2015). Colour Contrast Check. from https://snook.ca/technical/colour_contrast/colour.html#fg=33FF33,bg=333333

Thurston, Mhairi, Thurston, Allen, & McLeod, John. (2010). Socio-emotional effects of the transition from sight to blindness. *British Journal of Visual Impairment, 28*(2), 90-112.

Vision Australia. (2012). Colour Contrast Analyser. from http://www.visionaustralia.org/digital-access-cca

Warren, Mary. (2009). Pilot study on activities of daily living limitations in adults with hemianopsia. *American Journal of Occupational Therapy, 63*(5), 626-633.

WHO. (2014). Visual impairment and blindness. from http://www.who.int/mediacentre/factsheets/fs282/en/

Yu, Hong, Tullio-Pow, Sandra, & Akhtar, Ammar. (2015). Retail design and the visually impaired: A needs assessment. *Journal of Retailing and Consumer Services, 24*, 121-129.

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Appendix 1: Table of electronic resources utilised to identify relevant data

Databases	Study Found	Study Reviewed	Study Included
HMInfo Library	35	2	1
CINAHL	12	3	0
EMBASE	16	6	0
Medline	37	8	0
Proquest Central	56	18	9
Proquest Databases	9	8	2
Proquest Dissertations & Theses	1	1	0
Scopus	23	3	3
Trove	5	1	0
Google Web Searching	158	37	9
Others	8	0	0
Total	**360**	**87**	**24**

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Appendix 2: Matrix of Analysis

Author(s) and Year	Nationality	Issues	Main Findings	Problems / Settings	Intervention	Participant	Outcome	Method
Ainsworth, Baigent, Cordiner & de Wit (2011)	USA	Intervention and modification on home environment of an old woman with vision impairment living alone in an apartment.	High colour contrast enables the old woman to detect and identify the ramp, to access the front door and the shower at her home	Home	Bright colours and colour contrast	Individuals or older people with vision impairment	Outcome 1: Improvement of: sight, vision, clarity and spatial orientation. Outcome 2: Enhancement of ability to function independently	Case Study
Alexander & Cowey (2010)	UK	A case study on detection ability of two individuals with hemianopia/ blindness over half of the visual field (n=2)	One participant could detect short to long wavelength stimuli, the other participant could only detect short wavelength stimuli.. Certain colours are detectable when compared to other colours with lower or higher luminance but became less detectable when compared to colours with moderate luminance.	Laboratory	Bright colours and colour contrast	Individuals or older people with vision impairment	Outcome 1: Improvement of: sight, vision and clarity	Case Study

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Author(s) and Year	Nationality	Issues	Main Findings	Problems / Settings	Intervention	Participant	Outcome	Method
Blaylock, Barstow, Vogtle & Bennett (2015)	USA	An observational study aims to identify challenges regarding occupational performance from perspectives of individuals with low vision to implement effective treatment	Lighting, contrast, familiarity and organisation included in the environment determine the degree of facilitation or conversely barrier to participation according to persons with low vision. Identification of these factors is expected to guide practitioners in selecting effective interventions concerning safety and independence of persons with low vision in their home	Home	Colour contrast and preferred colours	Individuals or older people with vision impairment (n=22)	Outcome 1: Enhancement of ability to function independently	Observational study
Bochsler, Legge, Gage & Kallie (2013)	USA	This study investigated the effect of environmental factors on detection of ramps and steps by people with low vision and normal vision wearing simulation goggles	Visual performance is affected by viewing distance and locomotion. The effects of contrast and lighting on visual performance of participants are weaker than hypothesised/ predicted. The locomotion might strengthen the visibility	Laboratory	Colour contrast	Individuals or older people with vision impairment (n=16) and People with normal vision wearing simulation goggles (n=48)	Outcome 1: Improvement of: sight, vision and clarity	Quasi-experimental study

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Author(s) and Year	Nationality	Issues	Main Findings	Problems / Settings	Intervention	Participant	Outcome	Method
Crossland & Rubin (2012)	USA	This study aims to examine the relationship between written texts on various mediums with high luminance contrast and older adults with reduced contrast sensitivity	Printed and displayed texts with high value of luminance contrast (above 80%) are regarded as visually accessible by more than 90% of the sample having vision impairment	Laboratory	Colour contrast	Individuals or older people with vision impairment (n=2520)	Outcome 1: Improvement of: sight, vision and clarity	Observational study
Dalke & Corso (2013)	UK	This study aims to identify problems encountered by people with vision loss in entering and exiting their home and the modifications that are required and could be implemented as solutions	High colour contrast is important for people with vision loss to identify home entrance and its features such as door panel, door frame, handrails, keyhole and steps. Bright colours could be regarded as easing the process of entering and exiting	Home	Bright colours and colour contrast	Individuals or older people with vision impairment (n=91)	Outcome 1: Improvement of: sight, vision, clarity and spatial orientation. Outcome 2: Enhancement of ability to function independently	Observational study

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Davis & Therrien (2012)	USA	This study compared the ability and learning process regarding identification of place and its features among different age groups of older adults	Colourful and familiar cues enhance the ability of older adults to identify the place and its features. Familiar and different chromatic cues enhances place identification and learning than abstract and achromatic cues	Laboratory	Colour coding and colour contrast	Older People (≥ 55 years, n=142)	Outcome 1: Improving spatial orientation	Observational study

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Demirkan & Olgunturk (2014)	Turkey	This study aims to identify and rank factors of home design enabling independency according to adults and older people with physical impairment. The scope that is not limited to vision impairment might lead to positioning colour contrast as not having high position	Colour and contrast are moderately prioritised to enable independent living for adults and the older people. The higher factors than colour are lighting, the use of kitchen appliances and sufficient space. The lower factors than colour are the use of kitchen and bathroom furniture, availability of vertical circulation, privacy and safety of the bathroom, non-slip surfaces and accessibility of rooms and corridors	Home	Colour contrast	Individuals or older people with vision impairment (n=66) and Individuals or older people with normal vision or colour vision deficit (n=95)	Outcome 1: Improvement of: sight, vision and clarity	Observational study

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Author(s) and Year	Nationality	Issues	Main Findings	Problems / Settings	Intervention	Participant	Outcome	Method
Elton, Johnson, Nicolle & Clift (2013)	UK	An experimental study aims to examine the effects of various types of illumination and degrees of luminance contrast on visual acuity of older adults	Higher luminance contrast increase near visual acuity of older adults. Decreasing luminance contrasts from 70% to 50% and from 50% to 30% significantly reduce visual acuity, especially under overcast and street-lighting conditions.	Laboratory	Colour contrast	Individuals or older people with vision impairment (n=38)	Outcome 1: Improvement of: sight, vision and clarity	Quasi-experimental study
Fabriek, de Waard & Schepers (2012)	Netherlands	This study aims to examine the visibility problems of bicycle infrastructure and their possible solutions.	Poorly visible obstacles in bicycle infrastructure, which are difficult to detect, lead to unsafe feelings of people with vision impairment. Red-white bollards, white or bright-coloured kerbs, bright pavements and high-contrast markings can enhance the visibility of the obstacles or facilities.	Public space	Bright colours and colour contrast	Persons or older people with vision impairment (n=68 in phase 1; n=4 in phase 3) and People with normal vision (n=16 in phase 2; n=28 in phase 3)	Outcome 1: Improvement of: sight, vision and clarity Outcome 2: Enhancement of ability to function independently	Observational and quasi-experimental study

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Gallagher, Hart, O'Brien, Stevenson & Jackson (2011)	Ireland	This study aims to evaluate and improve accessibility of transportation facilities in Ireland	Poorly accessible public transportation facilities and lack of awareness concerning vision impairment lead to higher dependence of people with vision impairment on others. Colour contrast in facilities and information services could minimise challenges faced by people with vision impairment when traveling	Public space	Colour coding and colour contrast	Individuals or older people with vision impairment (n=121)	Outcome 1: Improvement of: sight, vision and clarity Outcome 2: Enhancement of ability to function independently	Observational study

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Glen & Crabb (2015)	UK	An observational study aims to identify coping strategies of individuals with glaucoma	Persons with Glaucoma perform active, psychological and behavioural adjustments to cope with vision impairment and maintain their independence in daily life. They also often use social and practical support. Colour and contrast commonly used to identify things, are part of the active adjustment.	Home	Colour contrast	Individuals or older people with vision impairment (n=16)	Outcome 1: Improvement of: sight, vision and clarity Outcome 2: Enhancement of ability to function independently	Observational study
Hammond & Mussellwhite (2013)	UK	A case study aims to evaluate shared space based on attitudes, perceptions and concerns of pedestrians with mobility impairment , older people and individuals with vision impairment	The participating pedestrians include users with vision impairment regards shared space in Widemarsh Street, Hereford, UK as relatively safe and comfortable for their mobility. However poor colour contrast is considered as one of negative aspects in the shared space by participants with vision impairment	Public Space	Colour Contrast	Individuals or older people with vision impairment (n=4) and Older people (n=5) and Individuals with mobility impairment (n=4)	Outcome 1: Improvement of spatial orientation	Case Study

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Jenkins, Yuen & Vogtle (2015)	USA	An observational study aims to explore how multisensory perceptions are utilised to provide environmental cues and information for people with vision impairment when navigating within outdoor and indoor spaces.	Facilities that stimulate multisensory responds could provide valuable information for people with vision impairment when navigating an environment. Brightly coloured lettering in the signage and elements with high luminance contrast could serve as orientation cues and warning of upcoming hazards.	Public Space	Bright colours and colour contrast	Individuals or older people with vision impairment (n=48)	Outcome 1: Improvement of spatial orientation	Observational study
Kuijsters, Redi, de Ruyter & Heynderickx (2015)	Netherlands	This study aims to examine the effects of illumination and colour on mood of older adults. However, this article does not describe the colour vision of the participants, which might affect their mood as well.	Ambient coloured lighting combined with particular colours could enhance positive mood and reduce negative mood of the older people	Laboratory	Preferred colours	Older people with normal vision (n=38)	Outcome 1: Enhancement of mood	Quasi-experimental study

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Author(s) and Year	Nationality	Issues	Main Findings	Problems / Settings	Intervention	Participant	Outcome	Method
Lewis & Torrington (2012)	UK	An observational study aims to identify whether UK-based extra-care housing complies with existing guidelines concerning lighting required by of people with vision impairment in their home	The lighting in kitchen and bathroom is sufficient, whereas illumination in lounges and bedrooms is below the recommended values. More specific requirements daylight or sunlight are needed. Many rooms utilise light colours enhancing the reflectance, however, colour contrasts have not been optimally used for legibility of the rooms.	Home	Bright colours and colour contrast	Individuals or older people with vision impairment (n=44)	Outcome 1: Improvement of: sight, vision, clarity and spatial orientation. and Outcome 2: Enhancement of ability to function independently	Observational study
Maguire, Peace, Nicolle, Marshall, Sims, Percival & Lawton (2014)	UK	This study identified problems and solutions in the kitchen area according to the older people with and without vision impairment Solutions are expected to enable older people to do activities in the kitchen safely and independently	Ergonomic problems and solutions concerning kitchen according to older people comprise: sight, hearing, reaching, strength/dexterity and others. Colour application and contrast on crockery, cutlery, labels, surfaces and edges could support safe activity for the older people and also cleanliness in the kitchen area	Home	Bright colours, colour coding and colour contrast	Older people with and without vision impairment (n=48)	Outcome 1: Improvement of: sight, vision and clarity Outcome 2: Enhancement of ability to function independently	Observational study

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Author(s) and Year	Nationality	Issues	Main Findings	Problems / Settings	Intervention	Participant	Outcome	Method
Pardhan, Gonzalez-Alvarez & Subramanian (2012)	USA	An experimental study aims to examine the effect of luminance contrast on grasping and reaching of people with central visual impairment compared to people with normal vision	People with vision impairment took longer time to detect the target than people with normal vision. Once the target has been detected, the speeds of grasping between of the two groups are almost similar. People with vision impairment need longer time to detect low contrast target than high contrast target	Laboratory	Colour contrast	Individuals or older people with vision impairment (n=14) and Individuals or older people with normal vision (n=14)	Outcome 1: Improvement of sight, vision and clarity	Quasi-experimental study
Parkin & Smithies (2012)	UK	This study aims to investigate perception of people with vision impairment regarding public space, especially shared space. (n=19 in the questionnaire stage; n=4 in the interview stage)	The observed shared space is acceptable in terms of safety and mobility according to participants with vision impairment. Colour contrast could provide valuable information about paths, different functions of surfaces and obstacles in this shared space.	Public space	Colour contrast	Individuals or older people with vision impairment (n=23)	Outcome 1: Improving spatial orientation	Observational study

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Riazi, Ying-Boon, Bridge & Dain (2012)	Australia	An observational study aims to examine evidence-based materials based on perspective and experience of people with Age-related Macular Degeneration (AMD) for home modification guidelines for individuals with vision impairment .	Elements of home modification in the existing guidelines are regarded useful by people with AMD. Colour contrast, colour coding and familiarity could support people with AMD to perform their activity at home. However, existing guidelines have not included appropriate solution to problems regarding small texts of printed materials deemed as visually inaccessible by people with AMD	Home	Colour coding and colour contrast	Individuals or older people with vision impairment (n=31)	Outcome 1: Improvement of sight, vision and clarity	Observational study
Shikder, Mourshed & Price (2012)	UK	A systematic review on research concerning physical and psychological aspects of lighting and their role in providing healthy and safe environment for older people	Luminance contrast together with illumination, glare control, chromacity of light and time and duration of exposure are parameters required for therapeutic lighting design intended for supporting healthy and safe environment for older people	Not specified	Colour Contrast	Older people with and without vision impairment	Outcome 1: Improvement of sight, vision and clarity Outcome 2: Enhancement of mood	Systematic Review

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Shima, Markowitz & Reyes (2013)	Canada	An observational study aims to examine and quantify residual colour detection abilities on participants with Age-related Macular Degeneration (AMD)	Participants with Age-related Macular Degeneration still have residual abilities to detect coloured targets with unique hues (red, green, blue and yellow) against white background. The authors suggest to examine the compatibility of quantified results regarding residual colour vision with measurement of visual functions	Laboratory	Colour contrast	Individuals or older people with vision impairment (n=40)	Outcome 1: Improvement of sight, vision and clarity	Observational study

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Author(s) and Year	Nationality	Issues	Main Findings	Problems / Settings	Intervention	Participant	Outcome	Method
Warren (2009)	USA	An observational study aims to identify problems concerning activities of daily living (ADL) encountered by adults with impaired visual field in each eye	There are difficulties identified in activities of daily living (ADL) such as driving, shopping, using telephone, managing finance and preparing meal. Lack of colour contrast affects the activities of personal hygiene, preparing meal and using telephone. High contrast on served meal and plate is an example of the solutions.	Home	Colour contrast	Individuals or older people with vision impairment (n=46)	Outcome 1: Improvement of: sight, vision and clarity Outcome 2: Enhancement of ability to function independently	Observational study
Yu, Tullio-Pow & Akhtar (2015)	Canada	This study aims to identify the needs of customers with vision impairment concerning shopping activity and how to accommodate these needs in retail design	Factors related to accessible retail design for customers with vision impairment can be classified into tangible and intangible factors. Tangible factors consist of: store layout, colour application, lighting, and signage. Intangible factors comprise store personnel and checking out procedures.	Retail space	Colour coding and colour contrast	Individuals or older people with vision impairment (n=17)	Outcome 1: Improvement of spatial orientation Outcome 2: Enhancement of ability to function independently	Observational study

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