Occupational Therapy Home Assessment: Incorporating Task and Environmental Lighting

Graham Teaford, OTD, OTR/L, SCLV

Uyen Nguyen, OTD, OTR/L

Learning Objectives

1. Identify the occupations within the home which are most impacted by low vision
2. Identify the sources of lighting, assessment methods, and intervention approaches
3. Apply the home environment and lighting assessments to specific case presentations

Context and Introduction

- Older adult may have visual changes impacting occupational performance
- These concerns may not have been identified or addressed
- The client may not identify the concerns when asked
- The client may not be familiar with the role of OT or the ability to benefit from services

Eye Changes Associated with Typical Aging

- Presbyopia (aka farsightedness)
- Lens yellowing, clouding, and fluorescence
- Pupil size
- Decreased retinal illumination and increased scattering
- Cell loss
- Increased prevalence of retinal disease

Typical Aging and Vision

- Decreased visual acuity
- Decreased visual accommodation
- Floaters
- Dry eye
- Need more light
- Glare sensitivity
- Reduced light/dark adaptation
- Reduced contrast sensitivity
- Reduced color perception
- Reduced visual attention

What is Low Vision?

- No one consensus definition
- Acuity
- Visual field deficit (VFD)
- Best corrected vision
- Functional definition: An uncorrectable vision loss interfering with ADL and better defined by function than normative test results (Massof and Lidoff, 2019)
- Not enough vision to do what you need to do (American Foundation for the Blind, 2023)
- Vision on a continuum (some usable vision)
- Older adults have lived their lives as sighted persons

https://www.afb.org/blindness-and-low-vision/eye-conditions/low-vision-and-legal-blindness-terms-and-descriptions

https://www.aao.org/eye-health/diseases/low-vision

National Eye Institute (NEI) Definition

“Low vision is a vision problem that makes it hard to do everyday activities. It can’t be fixed with glasses, contact lenses, or other standard treatments like medicine or surgery.”

https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/low-vision

Vision Loss for the Older Adult

- Contributes significantly to ADL/IADL decline
- Interacts synergistically with other conditions
- Contributes to psychosocial issues

Occupational Therapy Practice Guidelines for Older Adults With Low Vision

- Interventions to enhance performance of ADLs and IADLs
- Multicomponent low vision intervention to improve ADL and IADL performance
- “[T]ailored multicomponent and multidisciplinary interventions to improve independence at home for older adults with low vision, and problem-solving training may be a useful component of such interventions.”
- (Kaldenberg & Smallfield, 2020)

Additional Considerations for Low Vision and the Home

- “Occupational therapy practitioners play a pivotal role in enabling people who have vision loss to age safely and independently in their homes. To fulfill this role, practitioners conduct home assessments and provide recommendations and intervention.” (Barstow et al., 2011).
- “[N]o standardized English-language home assessment has been developed for adults with low vision.” (Barstow et al., 2011).
- “To optimize occupational performance outcomes for clients with low vision and comorbidities, occupational therapy practitioners should do the following: …Provide at least some intervention in the clients’ home environment” (Barstow et al., 2015).

Justification for Home Assessments

- “[M]ulticomponent comprehensive low vision rehabilitation services that include education about low vision conditions, use of low vision devices, compensatory strategies (e.g., lighting, home modifications, sensory substitution, contrast enhancement), and low vision resources should be used routinely on the basis of strong evidence in the literature.”(Kaldenberg & Smallfield, 2020)
- Vision measured in the clinic is generally better than in the home with the main difference being poor home lighting conditions (Banerjee et al., 2024; Bhorade et al., 2013).

Barstow et al., 2011

- “Many existing standardized home assessments were developed on the basis of the researchers’ experience and knowledge, with little input from people with vision loss.
- This study examined the perspectives of older adults with vision loss on their occupational performance and home safety and focused on person–environment interaction.

Existing Home Assessments Examined

- The Safety Assessment of Function and the Environment for Rehabilitation (SAFER; Oliver, Blathwayt, Brackely, & Tamaki, 1993)
- The Westmead Home Safety Assessment (WeHSA; Clemson, Roland, & Cumming, 1992)
- The Housing Enabler (Iwarsson & Isacsson, 1996)

Established Home Assessments for Older Adults

Romli et al., 2018

- 10 Instruments developed by OT:

1. COUGAR
2. Home Environmental Assessment Protocol (HEAP)
3. HOME FAST
4. Home Safety Self-Assessment Tool (HSSAT)
5. In-Home Occupational Performance Evaluation (I-HOPE)
6. Safety Assessment of Function and the Environment for Rehabilitation–Health Outcome Measurement and Evaluation (SAFER-HOME)
7. Enabler
8. The Safe Living Guide
9. Usability in My Home (UIMH)
10. Westmead Home Safety Assessment (WeHSA)

Keglovits et al., 2020

- Slippery surfaces/spills on the floor
- Ice/snow
- Obstacles in traffic ways/clutter/cords on the floor
- Ladder/stepladder/chair used to climb/distance reaching
- Bed
- Floor mats/carpet edge
- Footwear
- Uneven, broken, or loose pathways/uneven floor surfaces
- Poor illumination
- Unstable/inappropriate use of mobility device
- Steps, Stairs/lack of hand support
- Bath
- Low or unsuitable seating
- Carrying heavy or large objects

Relationship of Home Evaluations with OT

- Having a tool with established content validity to identify hazards is important, but a tool is only a tool (Keglovits et al., 2020)
- A broader framework is needed that involves clinical reasoning, problem solving, and considering environmental risk and modification (Keglovits et al., 2020)
- Fall risk is related to body function and structures, activities and participation, and environmental factors, with the main focus on activities and participation (de Clerq et al., 2021) .
- OT theory is essential to articulating our distinct value in low vision (Weisser-Pike et al., 2024)

Why we care

- Visual deficits may contribute to a lack of participation in physical activities
- Distinction between visual function and functional vision
- Epidemiological support for an increased likelihood of falls and fractures within a 5 year period for older adults with visual impairment, independent of confounding variables (Hong et al., 2014)

In addition:

- People with eye diseases were three times more likely than those with intact vision to limit activities due to a fear of falling (Dhital et al., 2010)
- Poor visual contrast sensitivity, poor visual acuity, reduced visual fields, and decreased depth perception are associated with an increased risk of falling in older adults
- Environmental factors, including inadequate lighting, are associated with an increased risk of falling (Brundle et al., 2015)

Lighting, Falls, and Participation

- Ambient conditions, including poor lighting, limit the use of environmental features
- Inconsistent lighting results in shadows that can present challenges in object identification and increase environmental confusion.
- Bright sunlight also limits detection of surface level changes

(Seetharaman et al., 2024)

Home Assessment and Lighting Assessments

- Persons with low vision identified these areas of concern within the home environment:
- Lighting
  - Task
  - Environment
- Contrast
- Visual distractions
- Glare
- Compensation strategies

(Barstow et al., 2011)

Bhorade et al., 2013

“Clinicians often assume that vision measured in the clinic is equivalent to vision at home. However, many patients report visual difficulties greater than expected based on their vision testing in the clinic.”

“Median lighting levels in the home were more than 4 times lower than in the clinic in locations tested for DVA and nearly 3 times lower than in the clinic in locations tested for NVA, despite the use of diffuse lighting in the clinic for NVA testing. In addition, home lighting levels were below those recommended”

Westmead Home Safety Assessment (WeHSA)

- Has a component of lighting in general indoor and outdoor spaces
- Does not specifically address task lighting
- Only the housing enabler address storage or cabinet lighting
- Does not address lighting quality
- WeHSA does address window coverings in terms of access but not room illumination
- Participants noted the importance of light sources (bulb types) and placement

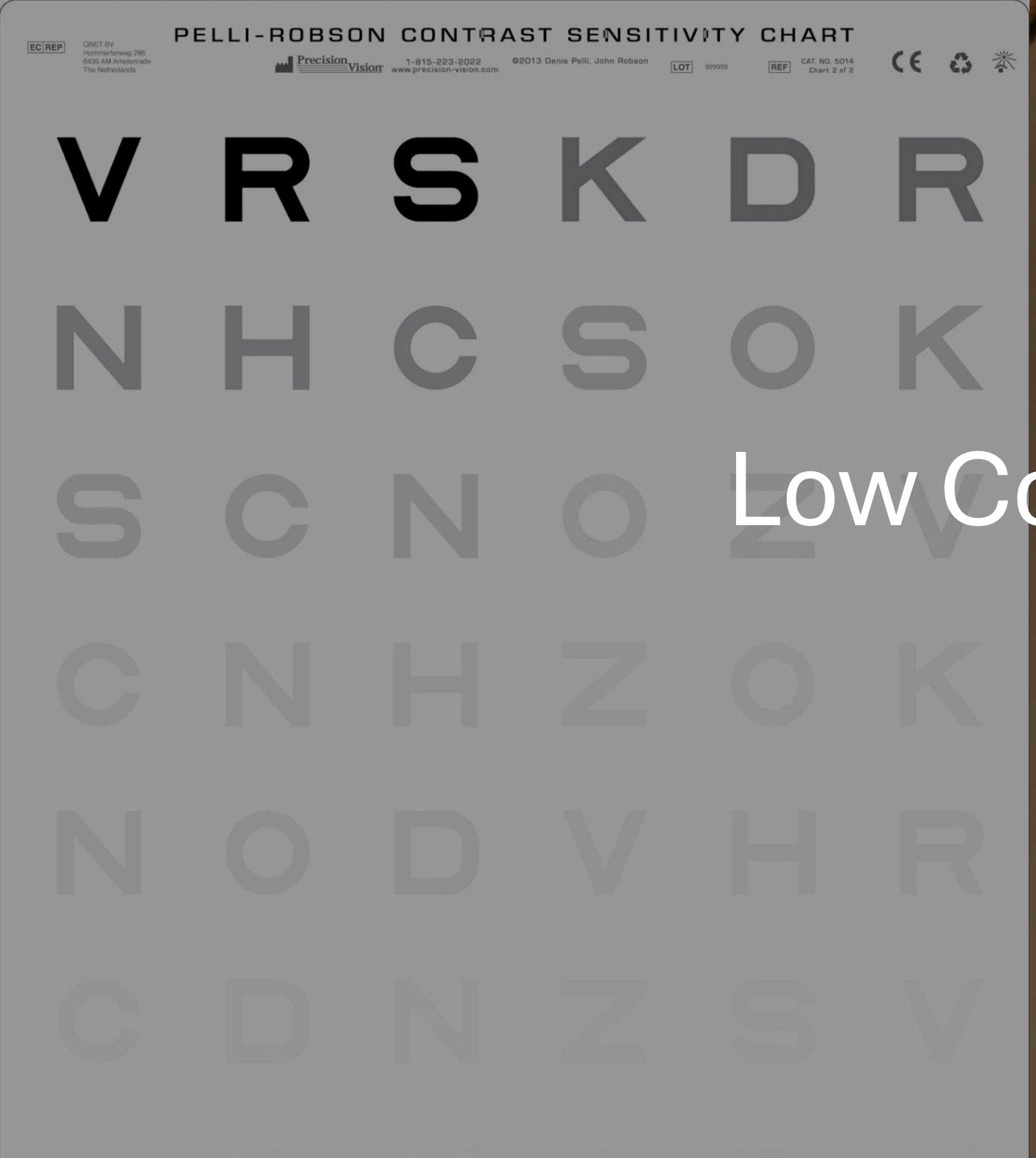
(Barstow et al., 2011)

How commonly used home assessments address visual impairment

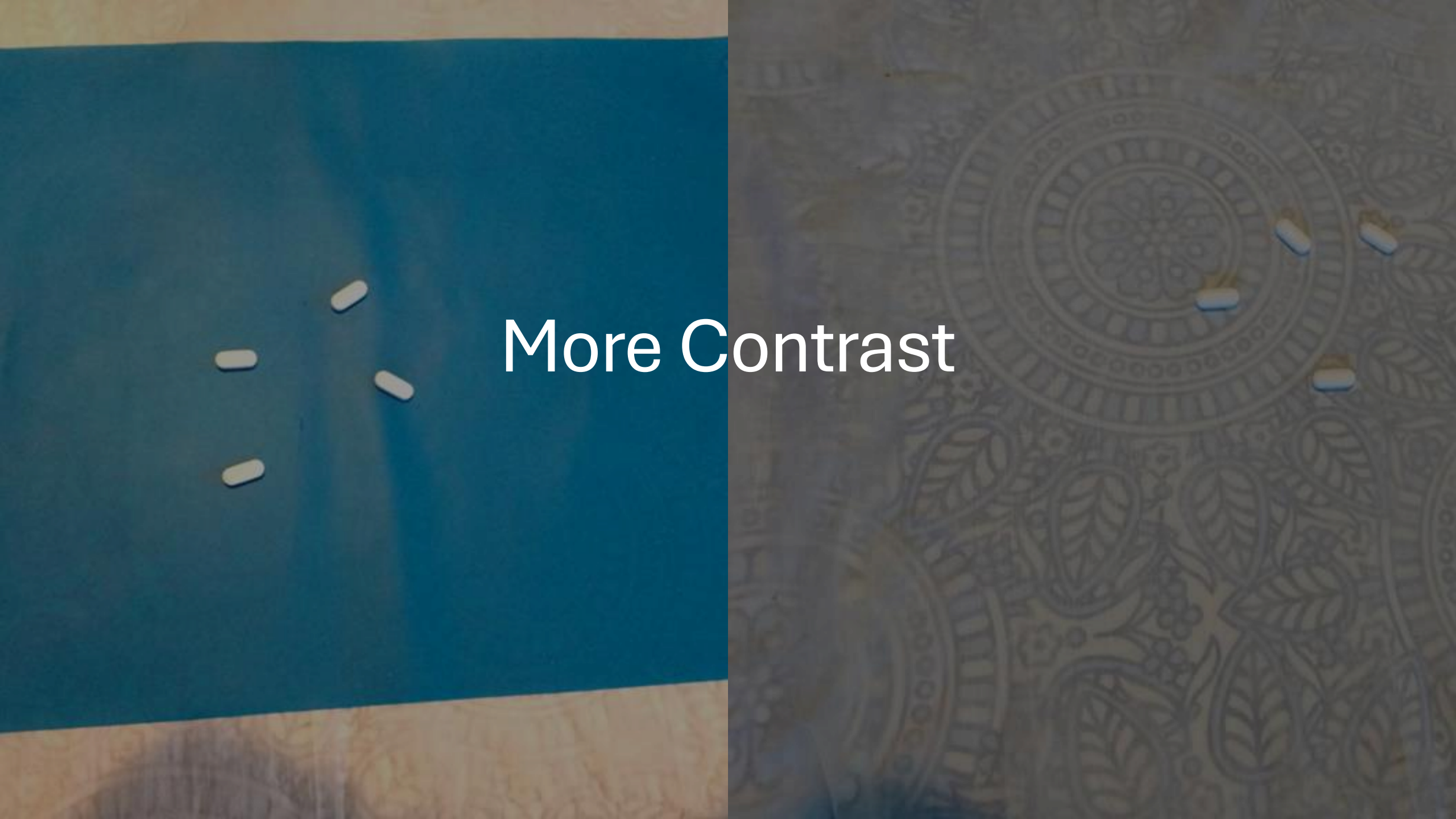
- Absent in all: type of lighting, wattage/lumens, task lighting
- In general contrast features were not emphasized throughout the home
- Visual distraction was well represented in WeHSA but excess pattern wasn’t
- Glare was underrepresented in WeHSA and absent from the others
- Compensations strategies were underrepresented in all assessments

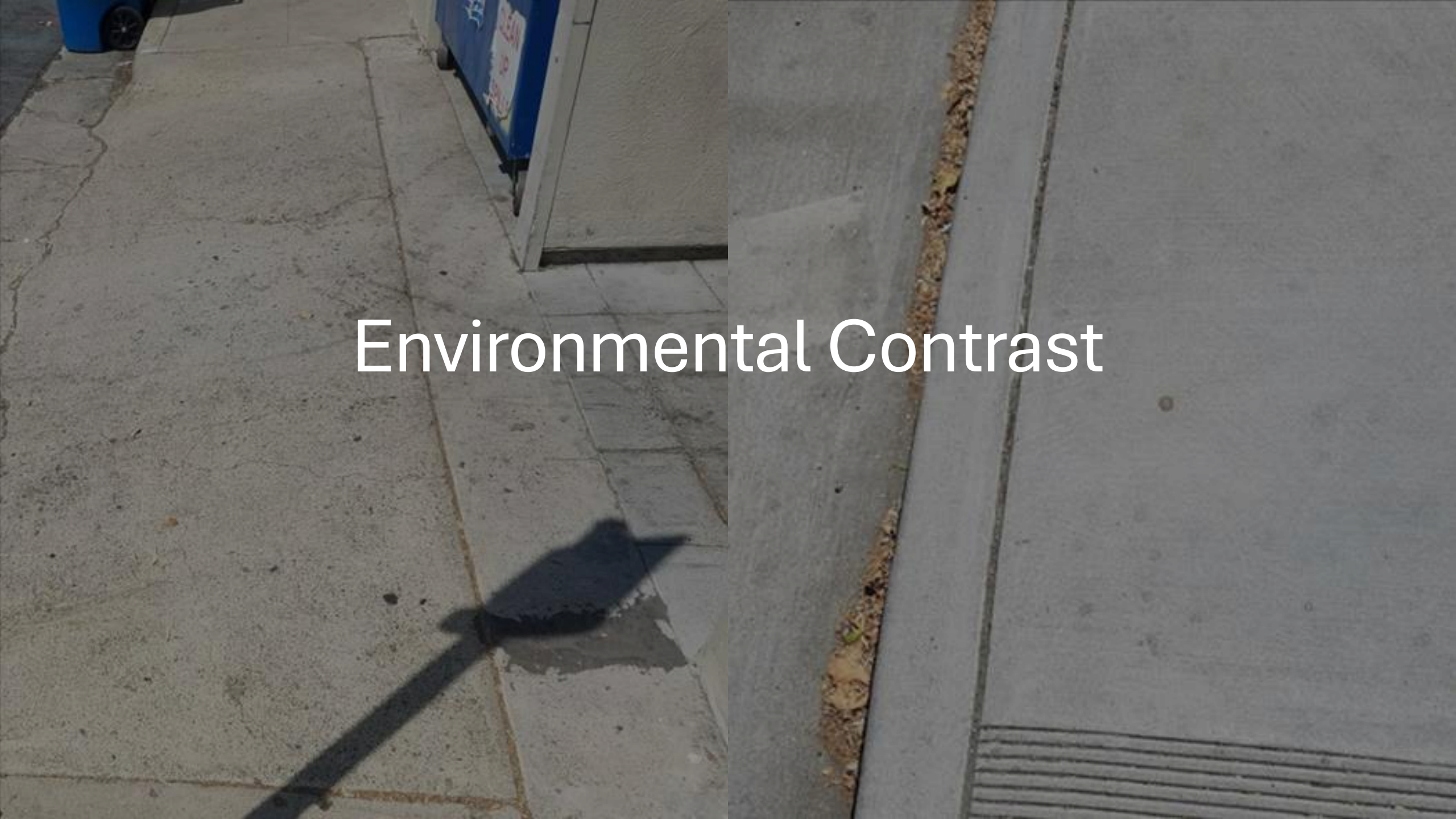
(Barstow et el., 2011)

Overview of Elements Mentioned

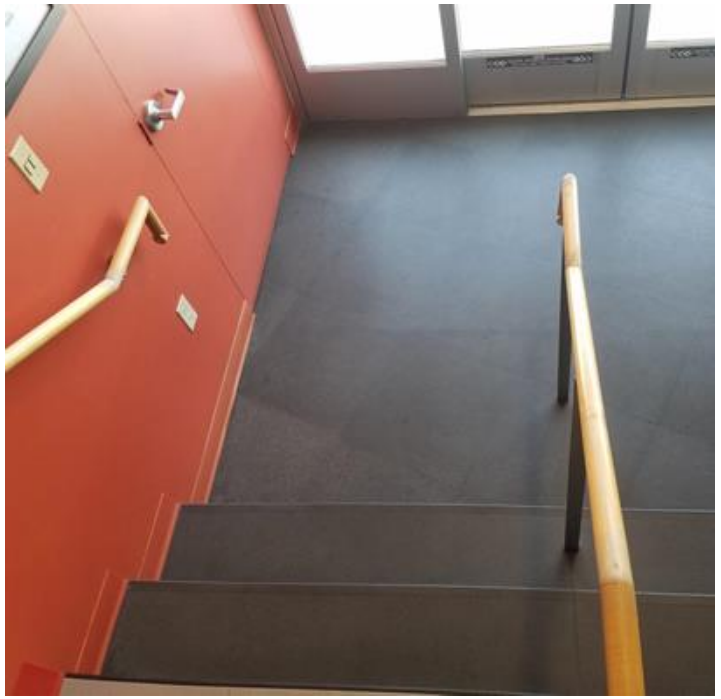


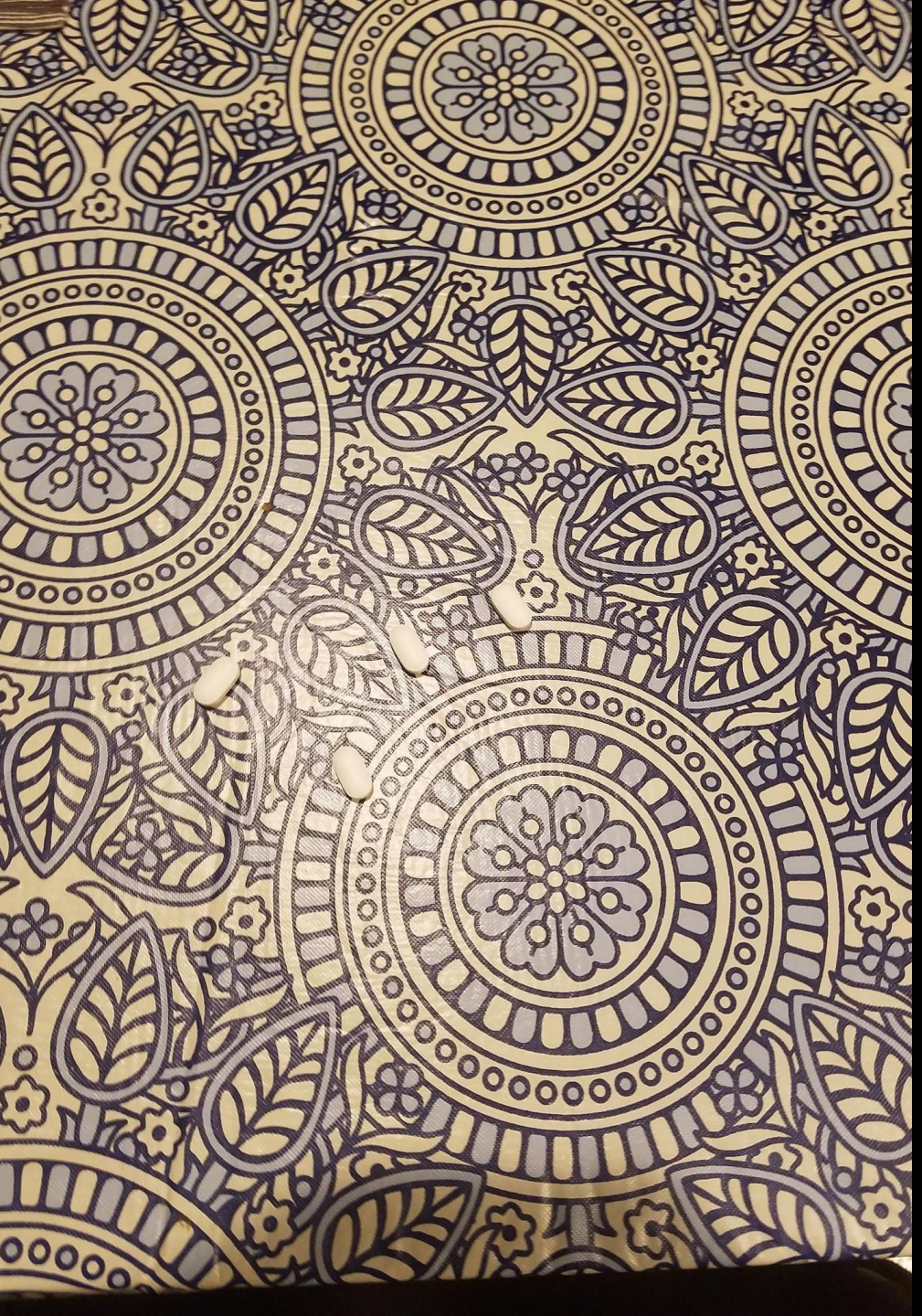
Low Contrast


More Contrast


Environmental Contrast

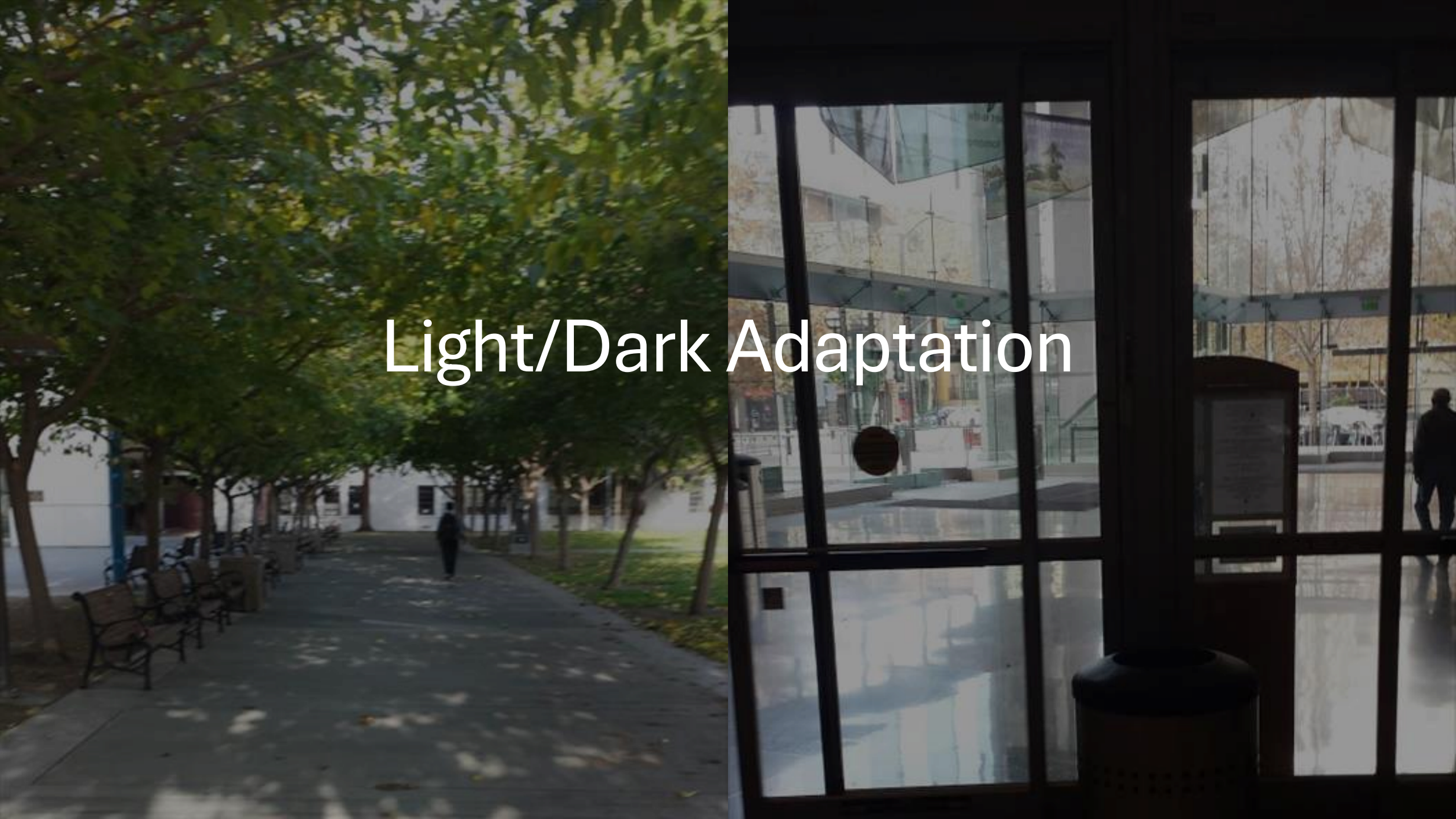
Home Contrast





Visual Pattern

Glare/Reflected light


Light/Dark Adaptation

Approaches to Supplement Established Home Assessments with Additional Lighting Assessment

- Add an assessment of ambient or environmental lighting
- Add an assessment of near task lighting
- Assess the impact of glare or light sensitivity


Basics of Home Lighting

Light: An Overview

- All electromagnetic radiation (EMR) is light
- Visible light, light that can be detected by the human eye, consists of wavelengths from 370 nanometers (nm) to 700 nm
- Beyond the shortest wavelength of visible light 370 nm (violet) and the longest 700 nm (red) are other types of EMR

https://science.nasa.gov/ems/09_visiblelight/

EMR Spectrum

- Radio waves
- Microwaves
- Infrared
- **Visible light**
- Ultraviolet
- X-rays
- Gamma waves

https://science.nasa.gov/ems/

The new labeling standards tell us many things about light sources

- Brightness
- Energy use and costs (estimated)
- Lifespan f the bulb
- Light appearance in color temperature (CCT)

From Department of Energy

https://www.energy.gov/energysaver/lumens-and-lighting-facts-label#:~:text=The%20label%20includes%20the%20following,scale%2C%20from%20warm%20to%20cool.

Watts (incandescent bulbs)	Lumens
100 W	1600
75 W	1100
60 W	800
40 W	450

https://www.energy.gov/energysaver/lumens-and-lighting-facts-label#:~:text=The%20label%20includes%20the%20following,scale%2C%20from%20warm%20to%20cool.

Lumens Compared with Watts

Bulb Options

- Incandescent
- Fluorescent
- Compact Fluorescent (CFL)
- Halogen
- Light-emitting diode (LED)

Bulb Label Information

Light bulb labels (lumens):
https://www.consumerreports.org/cro/news/2015/08/how-to-read-a-lightbulb-label/index.htm

https://www.energy.gov/energysaver/save-electricity-and-fuel/lighting-choices-save-you-money/lumens-and-lighting-facts

https://www.energy.gov/sites/prod/files/lighting_tip_card_lores.pdf

Light bulb labels (temperature):

https://www.lumens.com/how-tos-and-advice/kelvin-color-temperature.html

http://www.westinghouselighting.com/color-temperature.aspx

Light Temperatures

Amber:
2,200K

Soft white:
2,700-3,00K

Warm white:
3,000-4,000K

Cool white:
3,100-4,500K

Daylight:
4,500-6,500K

Common Issues within the Home Environment

- Illumination
- Contrast
- Visual distraction
- Glare
- Compensation Strategies

Lighting (Room and Task)

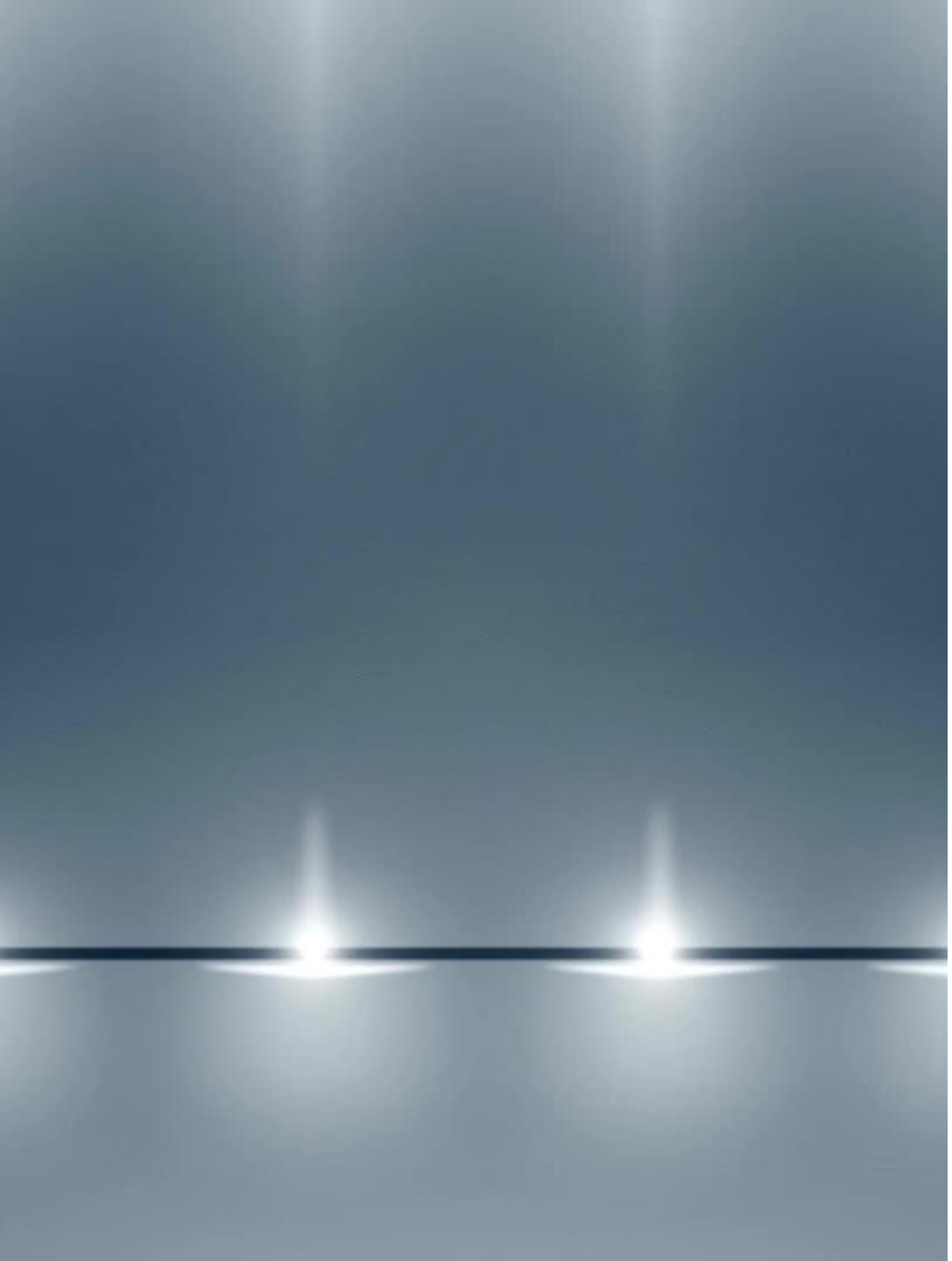
- dialing a telephone
- determining clothing color
- reading
- setting a thermostat
- finding the door keyhole (exterior flashlight)
- storage areas (such as closets and kitchen cabinets)
- outdoor lighting

(Barstow et al., 2011)

Types of Lighting

Electrical Lightning Systems

- Ambient
- Task
- Accent



Ambient Lighting

- General background of lighting
- May not produce all the light needed for a specific task
- Assumes uniform illuminance on planes of a task
- Gives us an overall impression of lighting (brightness, dimness, glare, comfort, discomfort)
- Can come from ceiling minted, floor mounted, floor mounted, furniture mounted, or grade mounted light sources
- Contributes in varying amounts to task lighting

(*SLL Lighting Handbook*, 2018)

Task Lighting

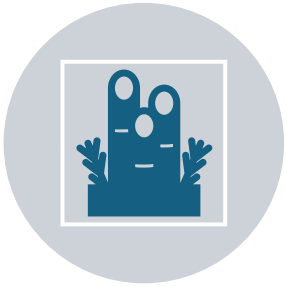
- Produces light on the specific plane on which a task or tasks are located
- Specific to the task and operates in conjunction with ambient lighting

(*SLL Lighting Handbook*, 2018)

Accent Lighting

Produces light effects for various reasons including drawing attention to an item, visual relief, perceived brightness, wayfinding, or visual attraction.

May draw attention to design features.



May include, but not limited to, art lighting or decorative lighting.

Unlike ambient and task lighting, it may not contribute significantly to overall illumination levels

Lighting

- Task Lighting
  - Higher intensity
  - Specific to task but comfortable for duration of time
- Environmental Lighting
  - Lower intensity
  - Wider area of coverage
  - Emphasis on safety and object identification

Light Measure

- Measures of illuminance (usually in lux but could also be foot candles)
- Typical residential lighting is between 50-100 lux
- Residential reading 200-500 lux
- Classroom (bright) is typically between 500 and 1,000 lux

Calculating Surface lighting

Divide the candle power of the source light (500 lumens) by the distance between the source and surface squared (4 feet squared =16)

500÷16= 31.25 foot candles (or 336.37 lux)

So moving the light source closer can make a great deal of difference (e.g., 2 feet)

500÷4=125 foot candles (1345.49 lux)

Reflectance

- Amount of light reflected back from surface to the eyes
- Measured in foot lamberts
- Hold light meter at distance above the source

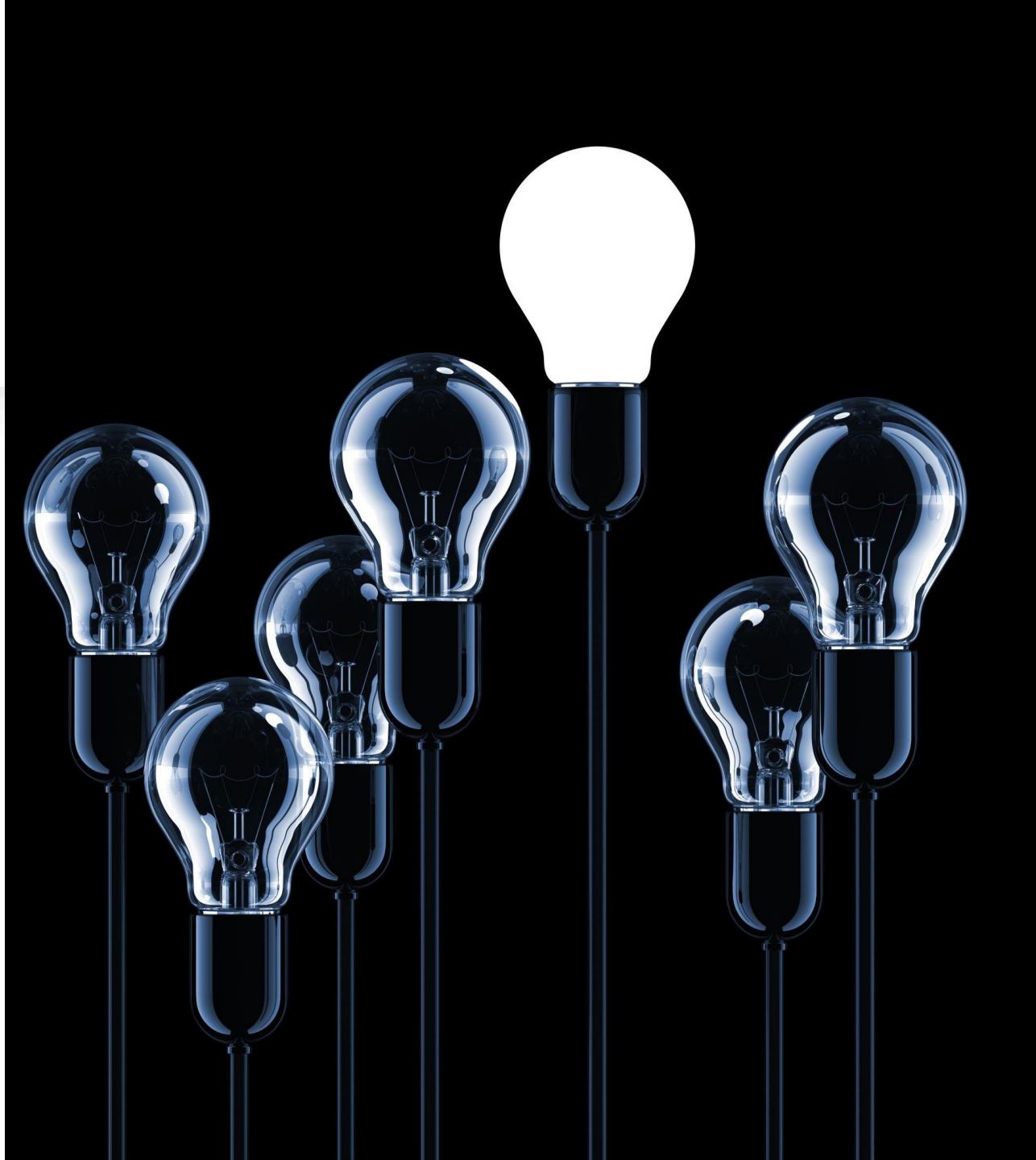
Lighting Sources and Properties of Lighting

- Context specific
- Lighting preferences are highly individualized requiring both objective and subjective assessment
- Depends on the occupation and occupational profile
- There are general lighting recommendations
- Reading for adults over 55 is recommended at 540 lux, typically (Perlmutter, 2013)
- We typically examine amount of light, type of light (temperature), and location of the light sources

Three Measurements

1. Luminance (amount of light) from source
2. Illuminance (amount of light) reaching source
3. Glare

(Whitaker et al., 2016)

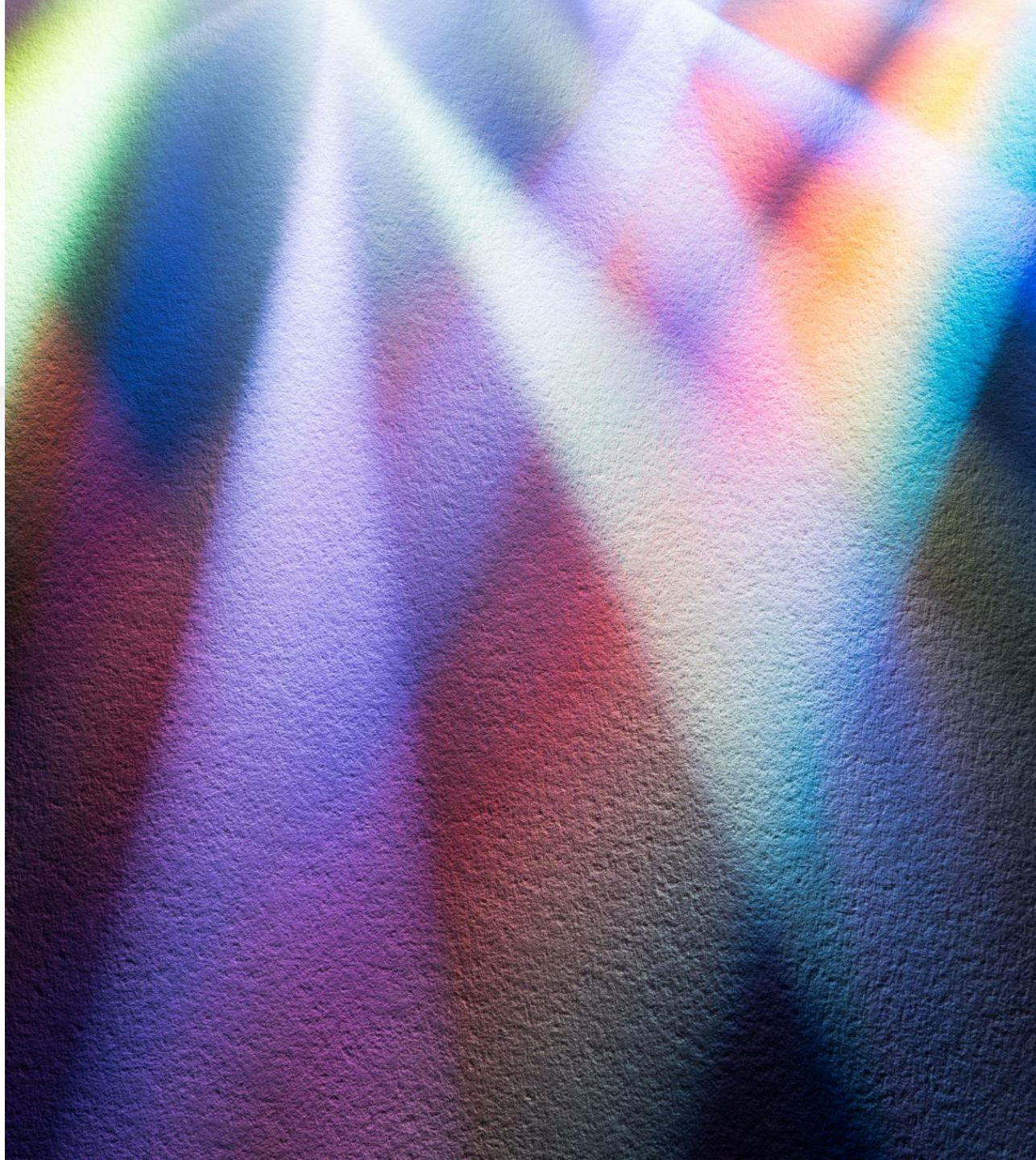


How we Measure the Amount of Light or Brightness

- Illuminance is measured using a light meter
- It is a measurement of light reaching a source
- It is measure either in Lux or Footcandles
- 1 Footcandle = 10.7639 Lux
- Can be determined as a calculation also

Process of Measuring Illuminance

- Use a light meter in consistent height throughout the room for environmental lighting
- Using a grid, you can determine the average illumination for the space
    - Average illumination: divide the sum of all illuminance measurements by the number of measurements (there are illuminance calculation grids available online)
- You can also determine illuminance variation
    - Illuminance diversity: ration of the minimum illuminance on a surface to the maximum illuminance on a surface
    - Illuminance uniformity: divide the minimum illumination by the average illuminance (number between 0 and 1, the lower number means more contrast)
- Task lighting involves a different process

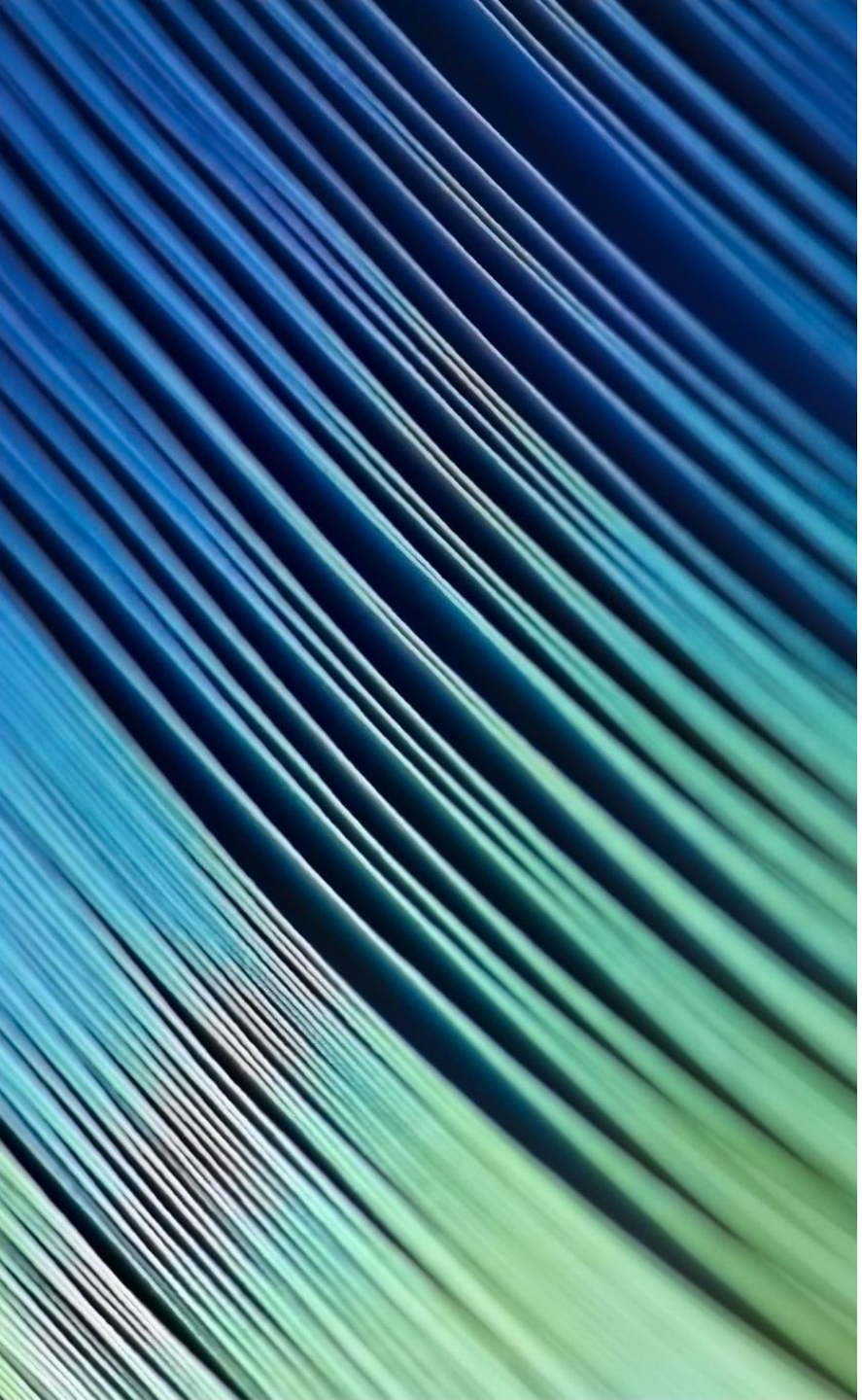


Process of Assessing Measuring Glare

- Look for sources
- Observe the client in spaces with glare
- Interview and ask the client questions about comfort and performance
- Note any current strategies or adaptations

Process of Measuring Glare

- We measure reflectance (or the amount of light reflected back from the table surface) by holding a light meter at a consistent level above the surface.
- We take a measure in foot lamberts
- If we divide foot lamberts by foot candles of the light source, we get an approximate percentage of reflected light.
- Repeat this measure on different surfaces to see variations in reflectance
- Source can be direct or indirect



Glare

Discomfort glare

Disability glare

Primary

Secondary

Strategies

- Wearable filters
- Polarized lenses
- Photochromatic (“transition lenses”)
- Visors, brimmed hats, umbrellas,acetate filters
- Environmental changes: light source, table mats, pain finish, window treatments

(Maffit et al., 2022)

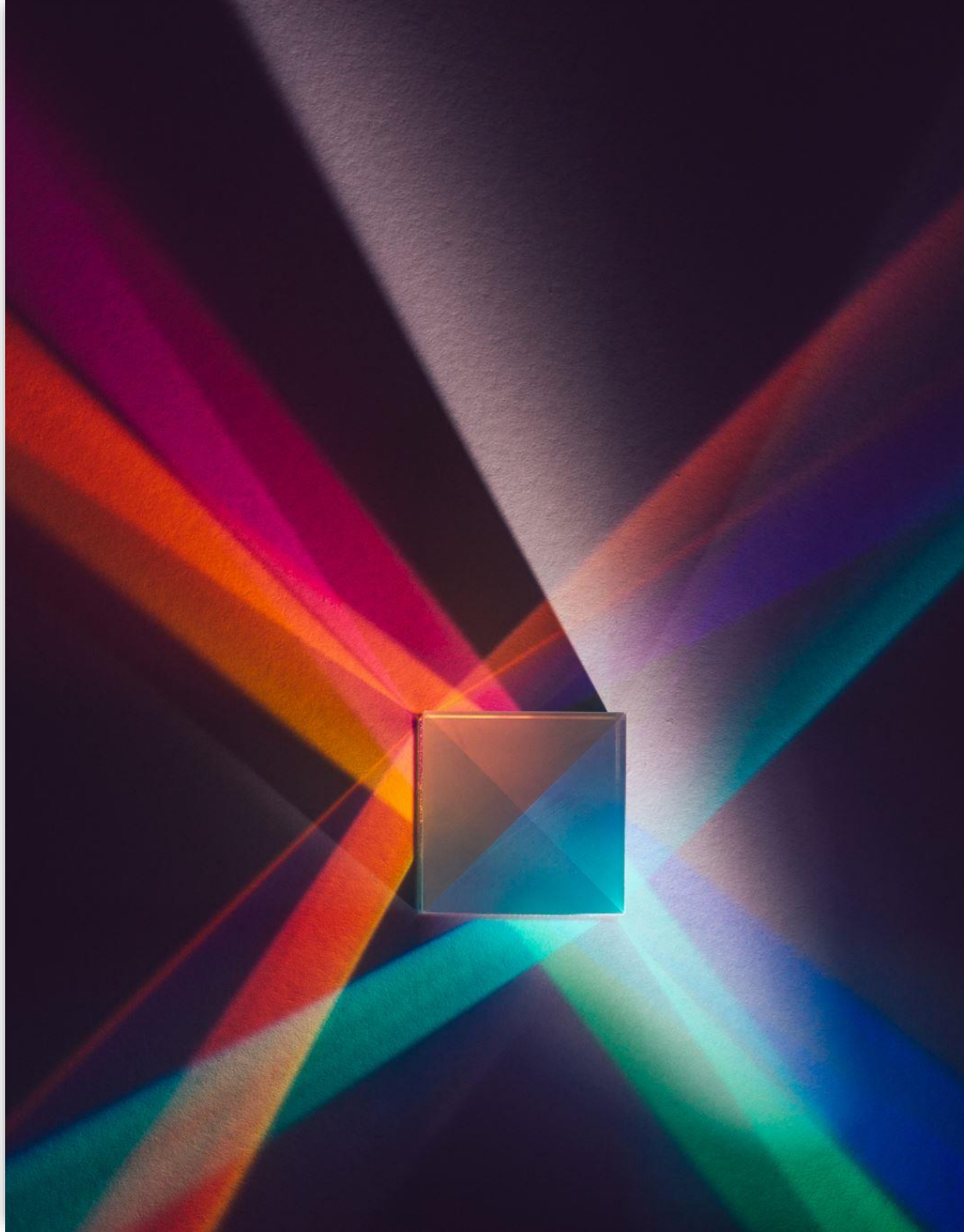
Environmental Light Placement and Inverse Square Law

A light's intensity is inversely proportional to the square of the distance.

(e.g., light at 1 foot= 1:1, 2 feet=1:4, 3 feet 1:9, 4 feet 1: 16)

When a light source is closer to the object, it falls off more quickly (shadow or contrast)

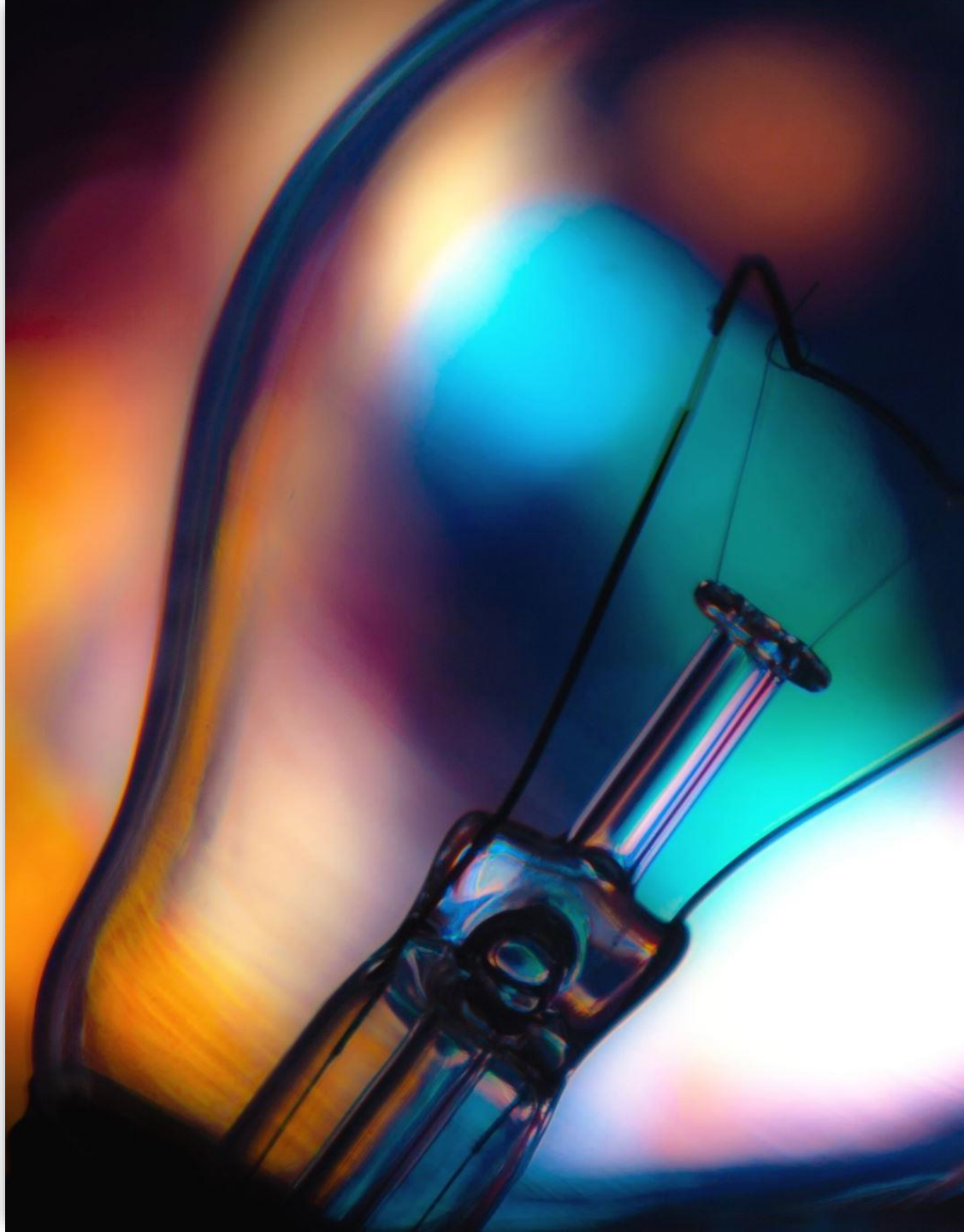
https://youtu.be/_o98TZhzhXU



Home Assessment Specific to the Needs of Older Adults with Visual Impairment

- “Home lighting is a modifiable factor affecting vision and visual function in the home.”
- “Increased home lighting has been associated with better vision in older adults with and without vision impairment…as well as…improved activities of daily living and quality of life and a potential reduction in falls.”
- “Older adults may rate their home lighting as adequate despite being below the recommended levels.”
- “Public health awareness and patient education of the importance of home lighting may improve visual function of many older adults in their homes.”

(Bhorade et al., 2013)



Lighting for Older Adults

- “Although our results suggest a relationship between high lighting and better vision, increased home lighting is not recommended for all patients. Certain patients may prefer low levels of lighting owing to reduced glare or difficulties with light/dark adaptation. While recommendations of increased home lighting may improve visual function in many patients, a client-centered, individualized, in-home evaluation by an occupational therapist or referral to a low-vision specialist may be most beneficial to this subset of patients.”

(Bhorade et al., 2013)

Generally for Older Adults

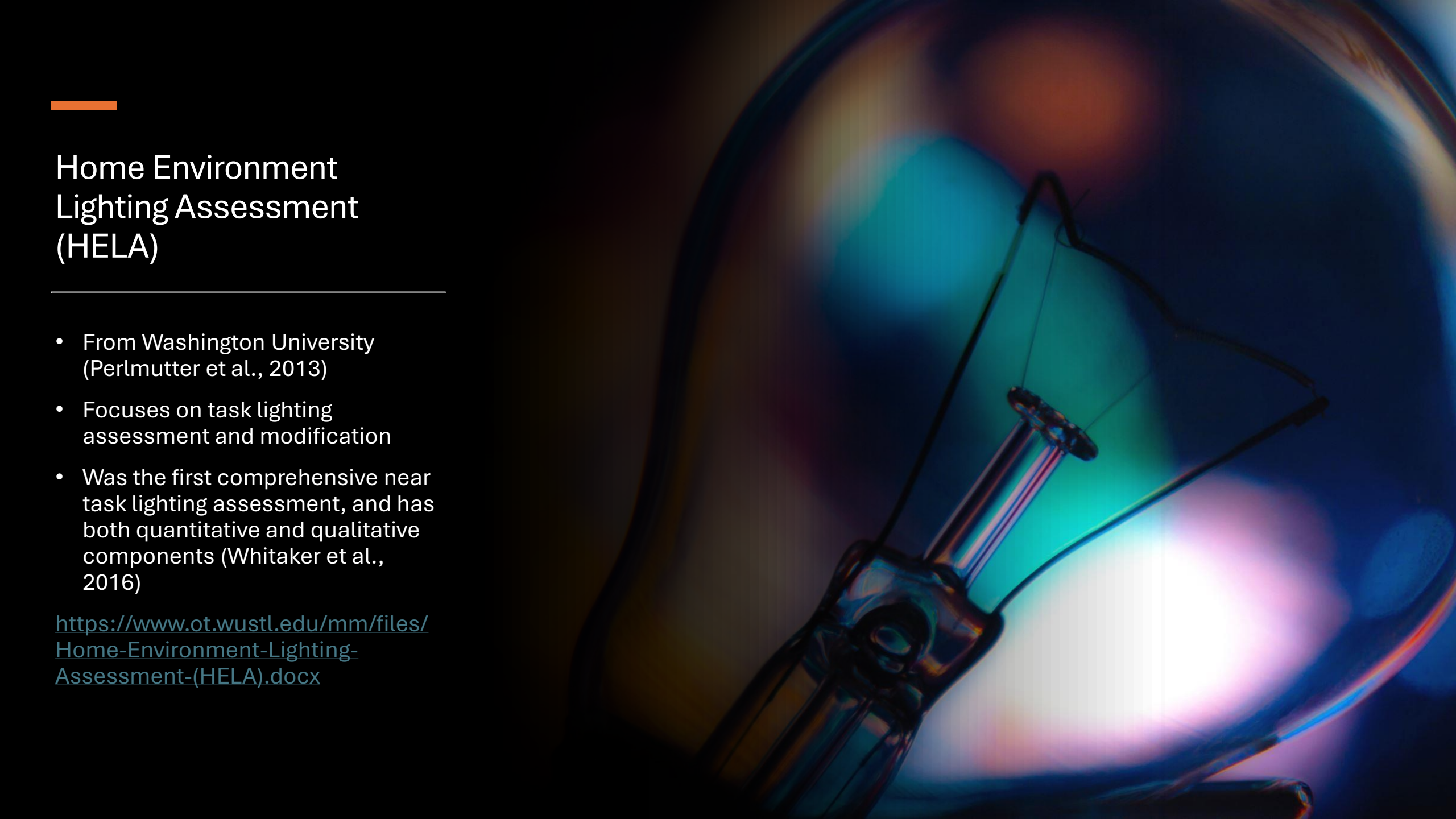
- Dilemma is that as lighting increases so does glare (Whitaker et al., 2016)
- Challenge is to increase object illuminance while minimizing glare (Whitaker et al., 2016)

Current Task Lighting Assessments

Home Environment Lighting Assessment (HELA)

- From Washington University (Perlmutter et al., 2013)
- Focuses on task lighting assessment and modification
- Was the first comprehensive near task lighting assessment, and has both quantitative and qualitative components (Whitaker et al., 2016)

https://www.ot.wustl.edu/mm/files/Home-Environment-Lighting-Assessment-(HELA).docx



Administering the HELA

- 4 Parts
    1. Pre-intervention assessment of task lighting
    2. Lighting intervention for task lighting
    3. Post-intervention assessment
    4. Lighting modification follow up survey

Pre-intervention assessment of task lighting

- Location of task within the home
- Client position
- Position of lamp and material
- Type or material being viewed
- Description of outdoor lighting
- Description of lighting sources
- Light meter assessment and photo (optional)
- Glare (subjective)
- Repositioning of material
- Quality of task lighting experience (eye strain, length of time, enjoyment)

Lighting Intervention (Task Lighting)

- Lighting modifications
  - Change bulb lumens
  - Change # of bulbs
  - Reposition light source
  - Change lamp shade
  - Provision of lamp (table, floor, portable)
  - Glare reduction methods
  - Reposition source material

Post Intervention Light Meter Assessment

- Outdoor conditions
- Measure post intervention lighting of material using light meter and share results with client

Lighting Modification Follow up Survey

- Are modifications still in place?
- If not, what are the barriers?
- Is the task more enjoyable with the modification?
- Are you able to complete the task for longer periods of time?
- How much eye strain do you experience with the task in this location?
- Satisfaction with the length of time they are able to participate in the task

Lux IQ Protocol for Testing (Perlmutter, 2013)

1. Measure baseline lighting
2. Determine baseline near visual acuity
3. Determine illumination preferences
4. Determine color temperature preferences
5. Double check illumination and color temperature preferences
6. Re-test near visual acuity with preferred lighting configuration
7. Client experiences improved lighting with preferred personal reading materials
8. Provide preferred lamp and light bulb recommendations
9. Complete follow up and reassessment

Alternatives to LuxIQ

- Lamps for task lighting assessment
  - Adjustable brightness
  - 3 color spectrums (2800k-warm; 4000k-daylight, 5500k-cool)
- Stella Lighting
  - https://lowvisionlighting.com/
- Lightbulbs (various types) in a bag

The LuxIQ is a Useful Addition to the HELA

- It is a quicker method of assessment for optimal task lighting
- Can be used in combination with HELA
- Is small and portable and can indicate preferred reading lighting when a home visit isn’t possible (Henry & Wittich, 2020)
- Some concerns about range of preferred lighting and standardization (Wittich et al., 2018)

Implementing Assessment and Intervention in Practice

Current Consensus

Identification of barriers or problems with client involvement (Whitaker et al., 2016)

Boyce and Sanford (2019) note that while there are clear differences in lighting needs based on pathologies, this should only be a guideline

Investigators have expressed a need for studies “that examine the impact of a home-based, client-centered, multifaceted approach to lighting intervention” and explore the “qualitative experience of lighting environments” (Perlmutter et al., 2013, p. 680).

case studies in groups

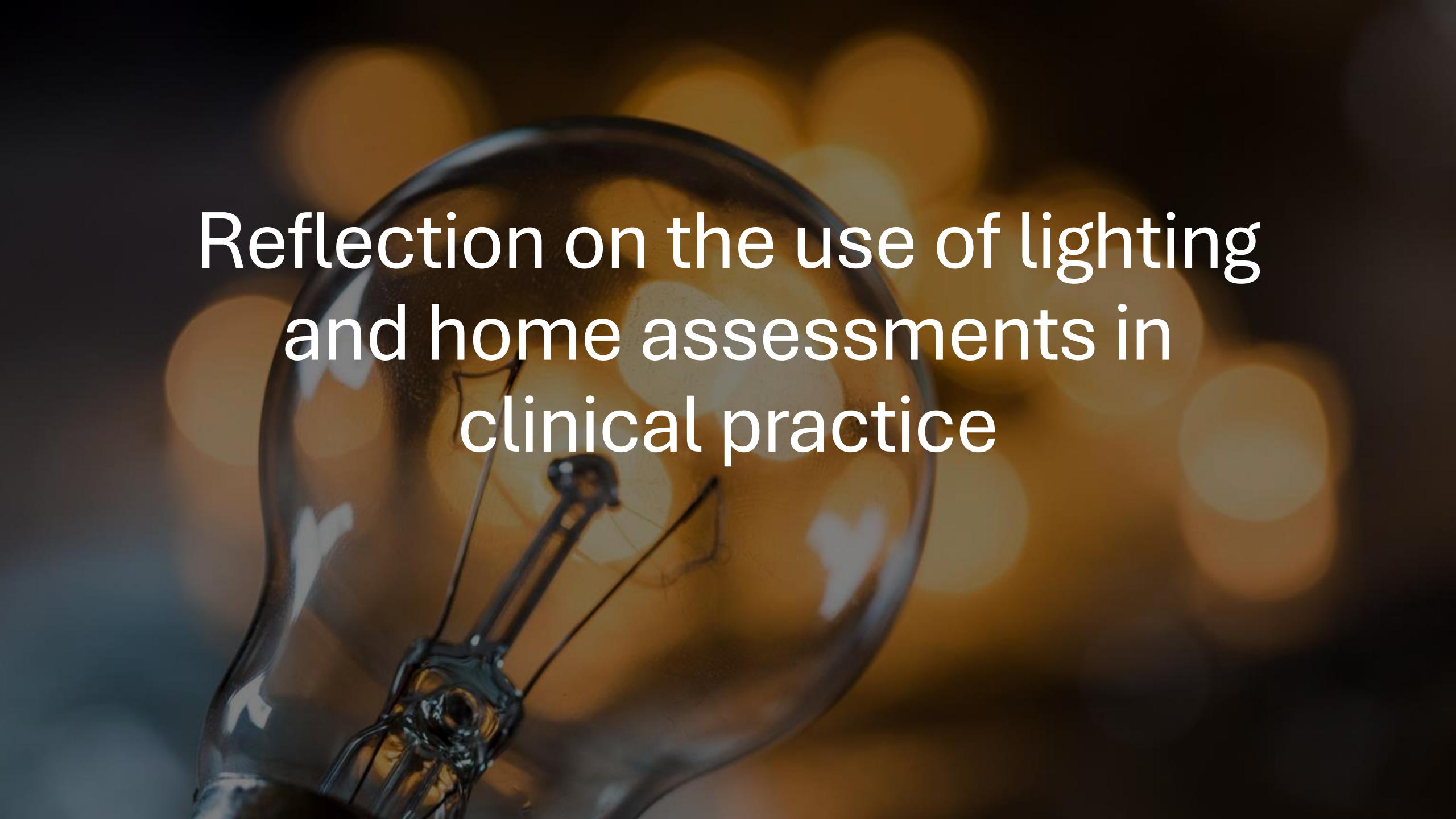
Case Study (or select a case from your practice setting)

- **Name:** J.C. (pronouns she/her)
- **Age:** 78 years old
- **Gender:** Female
- **Diagnosis:** Diabetic Retinopathy (Moderate to Advanced Stage)
- **Living Situation:** Resides with her husband in a two-story home
- **Medical History:** Type 2 diabetes mellitus for 30 years, hypertension, osteoarthritis
- **Referral Reason:** Increased risk of falls and difficulty performing ADL due to decline in vision, especially in low-light conditions

Issues and Concerns

- J.C. reports having trouble identifying objects and hazards within her home, having difficulty reading medication labels, and difficulty performing Some IADL (e.g., cooking and financial management).
- She is able to read books (continuous text) but it is difficult. She states that it takes “great effort”. She has largely stopped reading for longer than 5-10 minutes intervals once or twice a day.
- She has had a few near-falls, particularly in low-light areas like hallways and the stairs.
- J.C.’s primary goals are to reduce her fall risk, maintain her BADL status, and complete IADL independently.

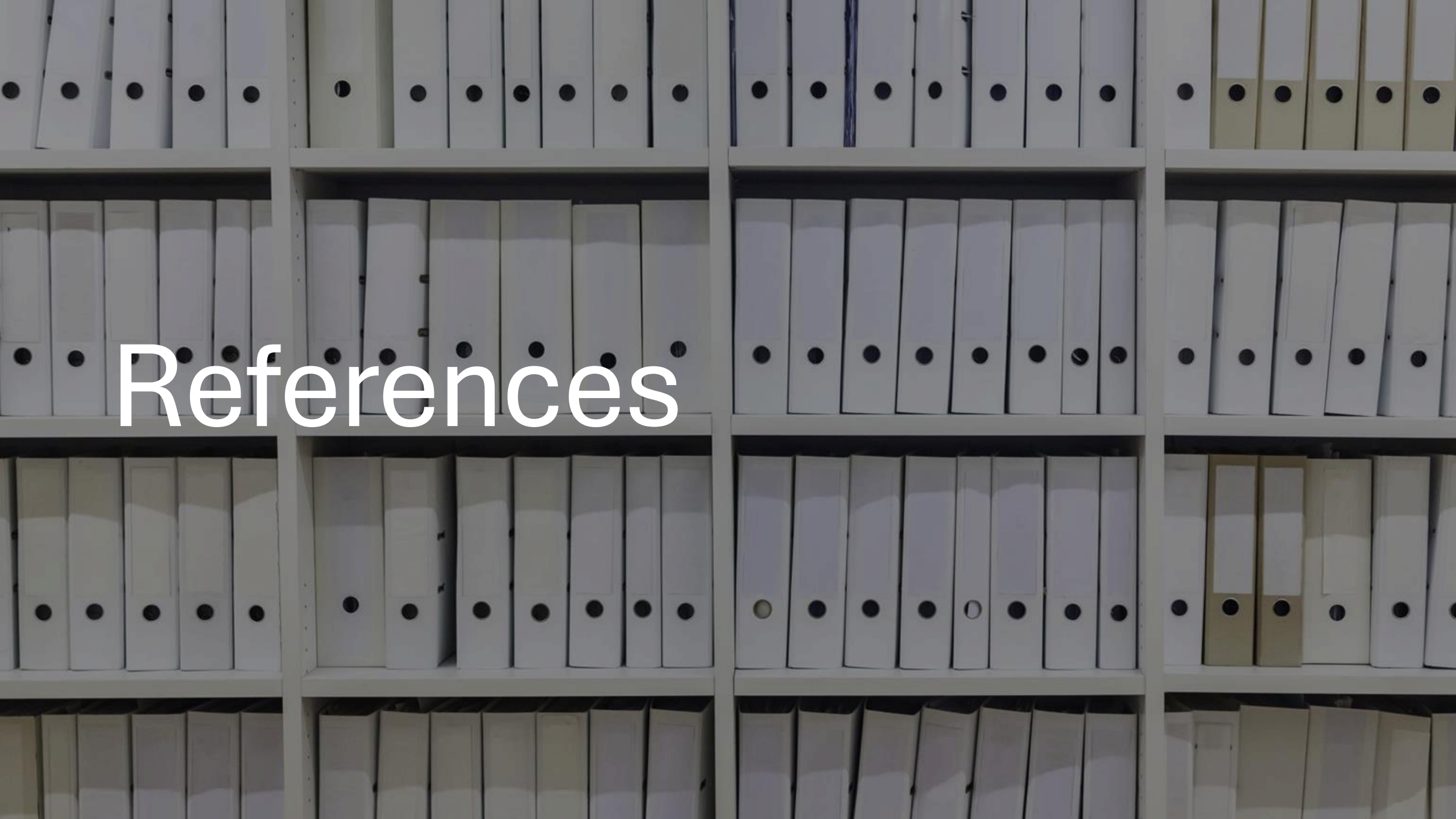
Suggestions for evaluation and interventions?



Reflection on the use of lighting and home assessments in clinical practice

What are some specific steps you could take for clinical practice?

- Incorporating subjective information
- Assessment of occupational performance
- Addressing glare
- Addressing environmental lighting
- Addressing task lighting (HELA, Lux IQ)



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