Incandescent Cultures:
Cultural Expressions in Lighting Design

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Abstract

Lighting design and cultural expression have the potential to create cultural nostalgia leading to positive emotional states. The above phenomena were explored with immigrants from Persian, Chinese, South Asian and Anglo-Saxon ethnicities living in Toronto, with the objective of creating a human-centered design of a culturally inclusive lighting design. Using an inclusive design approach and a human-centered design process, data were gathered from 15 participants from above cultures about their preferences relating to lighting and aesthetics using a questionnaire survey and contextual interview in their residences. Photographs of lighting and cultural artefacts around their living spaces were collected with their consent. Analysis of the data revealed significant information about their use of lighting, space and colour to enhance their positive emotions. Based on the findings, three personalizable, multicultural lighting system designs were conceptualized.

Keywords: Lighting Design, Cultural Expression, Space, Proxemics, Ethnicity, Immigrants, colour, Cultural Nostalgia, Positive Psychology.

Acknowledgment

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I thank my brother, Ashish Sharma, who supports and loves me at every turn of life, for encouraging me through these two years.

Dedication

To you, Mother ...

I find myself in a spiritual plight,
these pleasures mundane, could not atone.
The loss I bore as your heavenly flight,
quenched the flame that once had shone.
Now once again I follow the White,
in fires and skies and gods of stone.
But I endeavour to find the light,
and find it in the hearts that moan.
The time has come to take alight,
to seek that guiding light that's gone.
To find the blaze and kindle it bright,
and shape it into something quite…
that peace abides and worlds adorn.

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1. Introduction

Canada's arms have always been open to immigrants of various ethnicities arriving from different parts of the world, as can be seen from official statistics of permanent residents as a percentage of Canada's population from 1860 to 2014 shown in Figure 1. Empirical studies have reported ethnic identity as one of the significant predictors

Figure 1: Permanent residents as a percentage of Canada's population

of cultural values (Desmet, Ortuño-Ortín & Wacziarg, 2015). Canada supports the cultural diversity brought about by immigrants of different ethnicities to create a cultural mosaic, which distinguishes it from other countries such as the USA, where immigrant identities blend into a cultural melting pot to become a single local culture (Palmer, 1976).

Cultural expressions can take different forms, some of them being lighting and colour. Lighting affects people emotionally in different ways depending upon their cultural sensitivities, individual tastes and past experiences (Laganier & Van Der Pol, 2012). Using cultural expression of lighting design as the focus, this major research project studied immigrants from three ethnicities─South Asian, Chinese and Persian─as well as the local, Anglo-Saxon, to examine their cultural preferences in lighting and aesthetics. Deriving design criteria from the research findings, three four-in-one, customizable, multicultural lighting system designs were conceptualized.

1.1. Cultural Diversity

This research project was situated in Toronto. Across the major cities in Canada, Toronto has been the largest hub of multitudes of people with a variety of ethnicities, cultures, religions, languages and customs, migrating from around the globe (Immigration Act, 1976). Toronto attracts the maximum immigrants, with foreign-born

population constituting 48.6% of its total population (NHS, 2011). Figure 2 shows the breakup of Toronto's immigrant population by ethnicity, with South Asians ranking highest at 12.3%, followed by Chinese at 10.8%.
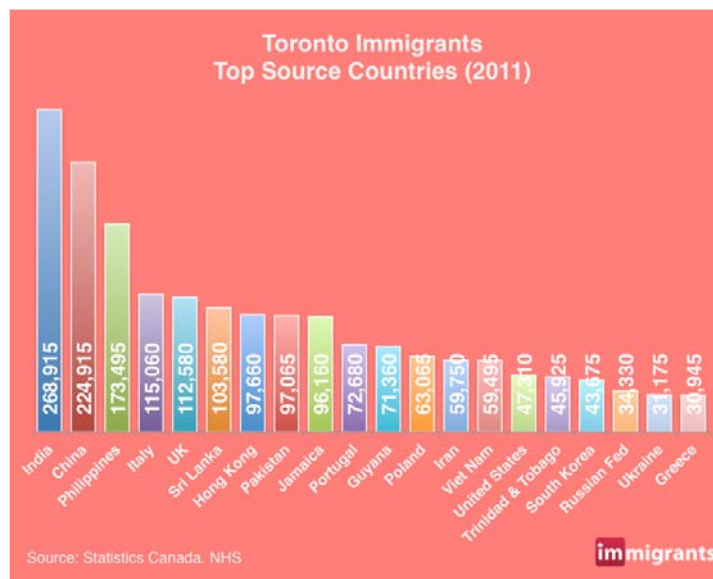
Figure 2: Toronto's immigrant population by ethnicity

From among these immigrant ethnicities, South Asian (India, Nepal, Bangladesh, Sri Lanka, Pakistan), Chinese (China, Hong Kong, Macau), and Persian (Iran) were selected for this major research project on account of the distinctness of their cultures, especially in the context of lighting, art, and colour. In addition, the Anglo-Saxon ethnicity local

to Toronto was also studied. This was done to identify adaptations, if any, that these immigrants choose to make from their cultures of origin to the local culture.

1.2. Lighting Design

Lighting design involves the design of lighting systems that include natural light, electric light, or both, to serve human needs (Julian & Turner, 1984). This project studied cultural expression by immigrants in terms of preferences they exhibited for lighting design in their living spaces in terms of light colour, intensity, style and aesthetics. Their cultural preferences in terms of colour, artefacts and aesthetics were also studied. The author's familiarity with these concepts on account of her previous creative work experience on the topic in India facilitated this research design. Some samples of her work are shown in Figure 3 and Figure 4.

Figure 3: Intricate Islamic Arabesque patterns using GI wire

Figure 4: Antique finish glass and stone cutwork Christmas Votives

1.3. Research Approach and Methods

The objectives of the project were:

- To explore how immigrants express their culture through lighting design within their standardly constructed living spaces such as condos/apartments (refer Section 4);
- To identify some aesthetic and philosophical elements in the expression of cultural ethnicity through colour, patterns, shapes, forms, structure, contours, objects and architecture in

lighting design that trigger a feeling of cultural nostalgia (refer Section 5); and

- To design a customizable lighting system using aesthetic and philosophical elements from Persian, Chinese, South Asian and Anglo-Saxon Cultures to evoke a positive nostalgic feeling in the users (refer Section 6).

To this end, the following research questions were examined:

- How do immigrants residing in Canada express their cultural preferences through lighting design?
- How can the stimulating elements of their cultural nostalgia be identified and interpreted in the form of a product design?

A human centered design (HCD) approach was adopted to arrive at answers to the above questions, with user preferences as the central focus. This approach enables designers to understand the users and their requirements on a psychological and empathetic level where the tailor-made design solution is functional as well as comprehensive on an emotional level. There is a fundamental need to understand the user's requirements at an emotional level so as to create a solution that is relevant in functionality with an emotional value. Such solutions

require the understanding of the lifestyle of the immigrants, their ethnic and cultural inclination, aesthetic sense and interactions with products that trigger nostalgia.

HCD is "inspired by behaviours rather than demographics, takes place in natural contexts versus controlled settings, and relies on dynamic conversations rather than scripted interviews" (PlusAcumen, 2014, n.p.). Data were collected through a survey and contextual interviews at the residences of fifteen immigrants (3 Persians, 3 Chinese, 6 South Asians and 3 Anglo-Saxons). Findings and insights from the research were used to design a four-in-one customizable lighting system aimed at evoking a positive nostalgic feeling in users from these ethnicities.

The research design is depicted visually in Figure 5.
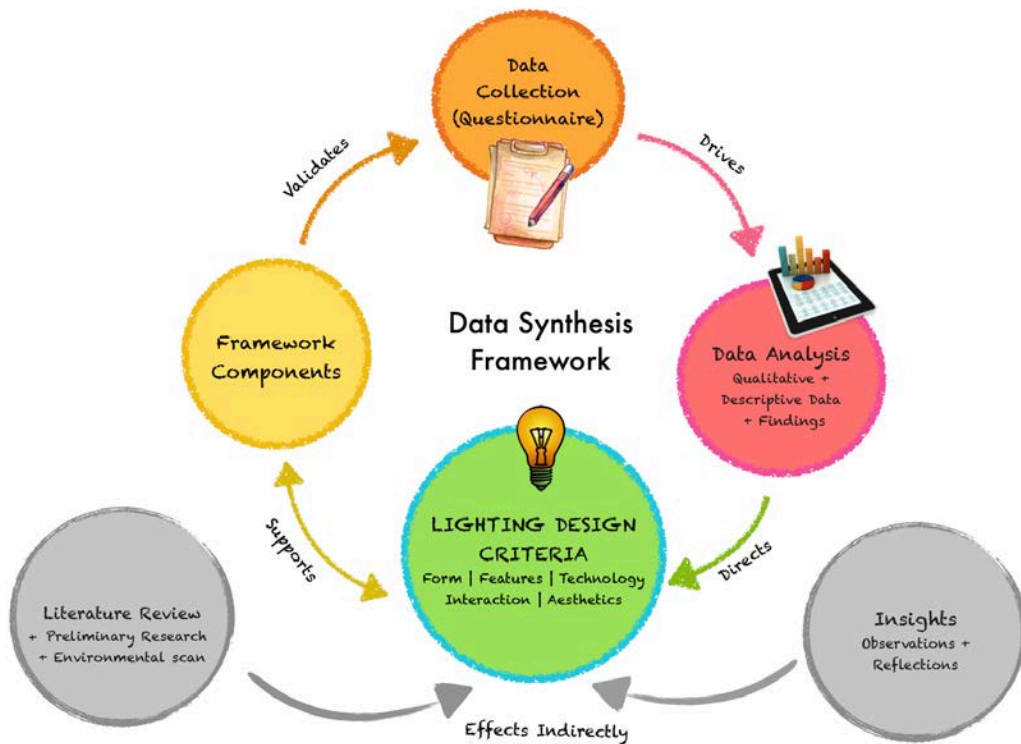
Figure 5: Research design

1.4. Conceptual Framework (Lighting-Space-Culture)

To carry out the research, the following steps were undertaken:

- Exploration of the cultural preferences of immigrants towards lighting design in terms of light, colour, intensity, style and aesthetics.

- Examination of the cultural background of immigrants from the perspective of **cultural anthropology**[1] in terms of preferred colour, artefacts and aesthetics;
- Identification of elements of immigrants' culture that stimulate in them **cultural nostalgia**[2] prompted by **positive psychology**[3];
- Understanding the interaction of immigrants with their spaces using the principle of **proxemics**[4]; and
- Interpretation of the identified elements into lighting design: product design, using a human centred design approach.

The main concepts, indicated by bold font above, are reviewed in greater detail in the Section 2.

A sketch of the project philosophy is given in Figure 6.

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[1] Cultural anthropology, among other things, studies differences between persons from the same cultural background.

[2] In the context of immigrants, cultural nostalgia denotes sentimental longing around memories of cultural artifacts or rituals from their homeland.

[3] Positive psychology is about the basic human urge to live a meaningful and fulfilling life and identifying what makes people happy and satisfied.

[4] Proxemics deals with the interaction between people and their organization of space around them.
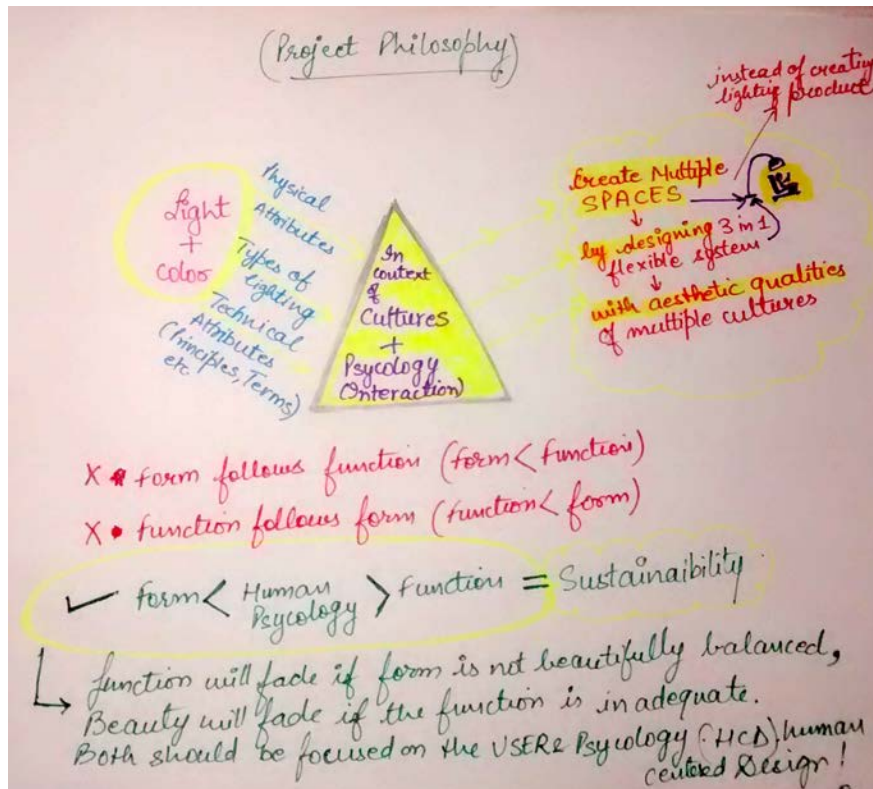
Figure 6: Project philosophy

1.5. Report Outline

The rest of this report is organized as follows.

- **Section 2:** presents an expanded view of the concepts contained in the framework that was introduced in Section 1.4.
- **Section 3:** presents some exemplar samples of lighting design from contemporary practice that served as an inspiration for this research.

- **Section 4:** describes the methodological processes followed for data collection.

- **Section 5:** summarizes the findings and insights gathered through analysis of the data.

- **Section 6:** details the lighting design that was the outcome of this research study.

- **Section 7:** presents sketches and design concepts for three inclusive lighting products.

- **Section 8:** concludes the report by highlighting the contributions made by the study to the fields of lighting design and inclusive design and listing plans for future work.

2. Conceptual Framework Expanded

2.1. Cultural Significance of Lighting

Niesewand (1989) states that light is much more than waves of electromagnetic energy. It is an essential component of both psychological and physiological equilibrium and carries with it substantial emotional energy.

2.1.1. Light Colour

Light intensity and colour are two important factors that impact the user's performance in the space. While people are known to adapt to different environments, it is believed that there is a loss of productivity and general well being if they are not in certain conditions. According to some scholars, lighting can play an important role in reinforcing spatial perception, activity, and mood setting. Nadeen (2006) reports that light should produce a mood and atmosphere in a room, which corresponds to people's demand and expectation.

Light from the sun and sky, light from hot surfaces such as candle flames or incandescent filaments, and light from fluorescent lamps all give light that we would broadly describe as white, although, as the spectra show, the composition of this white light varies. We shall now show that the property of colour, which we normally attribute to a surface or object, is due to the absorption of part of the spectrum by the pigment or dye, and the reflection of the remaining parts. A century after Newton had shown that white light contained all the spectral colours, the scientist Young proposed the Tristimulus theory of colour perception (Baker & Steemers, 2002). This states that any colour sensation can be generated by a combination of three primary light colours.

Heller (1989) states that the sensations or reactions created by colour are a universal rather than personal experience, and are linked to cultural, anthropological and even biological factors - given that colours develop sign value and this information is passed on through generations over time. According to Heller (1989), colours induce

automatic and unconscious reactions and associations; for example references to nature such as forest/green or sea/blue. Every culture gives specific symbolic meanings to colours and most of the times these meanings coincide. Warm colours like red, orange and yellow are seen as stimulating and jovial whereas cold blues and greens are deemed relaxing and serene. Since in Iranian architecture house is a respected area in which all needs are fulfilled, it has also included the psychological aspects of life. Traditional architects are also aware of psychology of colours and use them accordingly.

2.1.2. Intensity

Among the several statements made by Gregory (1973) on the brightness of light, the most significant is that brightness is an experience. This sensation is roughly related to the intensity of the light entering the eyes and that light itself is not coloured, but gives rise to sensations of brightness and colour (*ibid*). For example, to the Europeans, according to Clair (2003), a dimly lit room will be perceived as comfortable because the warm, orange light is reminiscent of

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candles. Another example related to the colour of light and psychology of humans is its association with sunset and warm fire. According to Kramer (2006) they are closed related, which human can feel by a warm light colour. However, under excessively dim white lighting, the same room will give rise to a feeling of unease, comparable to how people feel under an overcast sky in broad daylight (Clair, 2003). On the other hand, according to Clair, if it is too brightly lit, it will feel less comfortable under the 'warm' orange light than under the 'cold' white light. This is all to do with the physiology of the eye.

2.2. Light Qualities
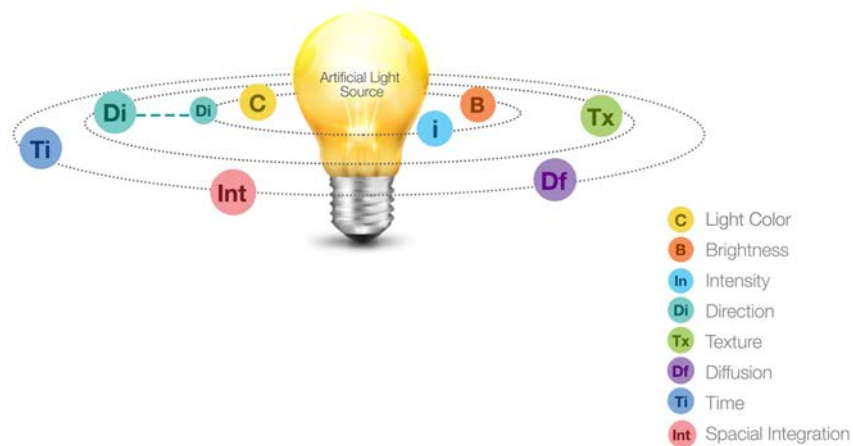
Figure 7: Light qualities conceptualization

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Figure 7 illustrates some light qualities, described below. As a designer, it is important to understand how light affects the eye/brain coordination and effects feelings and emotions in an environment. Before discussing the qualities of light, it is important to understand some of the terms used in lighting design as explained in Phillips Electronics Glossary[5]:

Light is radiant energy that is capable of exciting the retina and producing a visual sensation. This definition excludes ultraviolet (UV) and infrared (IR) wavelengths. UV is shorter in wavelength than light and IR is longer. The visible wavelengths of the electromagnetic spectrum extend from about 380 to 770 nm.

Luminance: is the amount of light reflected or transmitted by an object.

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[5] http://www.designingwithlight.com/resources/edu_glossary.jsp

Luminaire: Can be defined as a complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light.

Luminous lux: is visible power, or light energy per unit of time. It is measured in lumens. Since "light" is visible energy, the lumen refers only to visible power.

Lux: The metric unit of luminance. One lux is one lumen per square meter (lm/m2).

Illuminance: Can be defined as the brightness of an object, or the strength of the light reflected from it. The luminance is directly proportional to the visual stimulation of the human eye, i.e. the greater the luminance, the stronger the visual stimulation, and the easier the object is to see (Ganslandt & Hofmann, 1992). Illuminance of an illuminated surface created by natural light is 10,000 lux (overcast sky) to 100,000 lux (bright sunlight). For indoor activities like writing and reading, we need less illuminance, which is generally provided by artificial lighting of 500 lux. For more visually demanding tasks,

illuminance should be at least 750 lux. The values set out in the standard, are minimum requirements. Most people find a higher level of illuminance more agreeable and more motivating. In winter especially, when the level of daylight entering a room is lower, more light is needed to avoid fatigue and loss of concentration (Ganslandt & Hofmann, 1992).

2.2.1. Colour
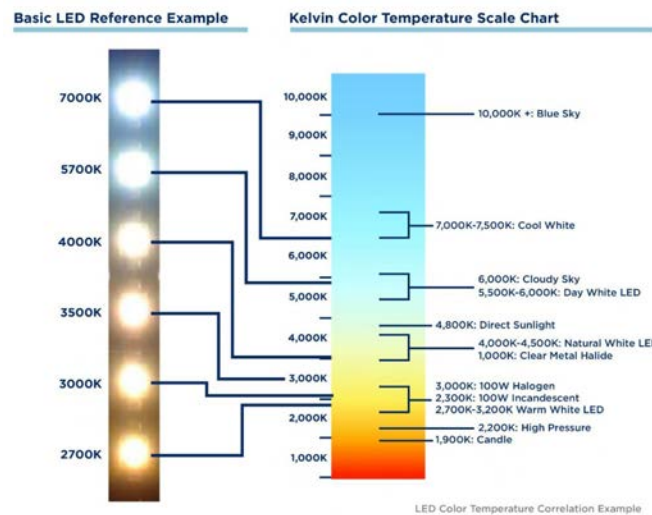
Figure 8: Colour temperature chart

Generally light colours are known as Warm White, Natural White, Day White, and Cool White. Basically yellow-red colours (fire)

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are considered warm, depicting higher visual temperature, and blue-green colours (like light from an overcast sky) are considered cool, depicting low temperature. In lighting, the colour temperatures are perceived opposite, i.e higher temperature is used to depict cool colour and lower temperature depicts warm colour. The colour temperature is measured in Kelvin (K) (Abd El Maksoud El Hawary, 2011). The visual light colours (natural and artificial) and their temperature in Kelvin are (Figure 8):

- Warm White: 2700 – 3000K
- Natural White: 3000 – 4000K
- Day White: 4000 – 5700K
- Cool White: 5700 – 7000K

In artificial lighting, these light colours are used according to different spaces and tasks. For example warm light is preferred for living spaces because it is more flattering to skin tones and clothing. A colour temperature of 2700–3600 K is generally recommended for most indoor general and task lighting applications, whereas cool light

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colour is generally preferred for visual tasks because it produces higher contrast than warm light (*ibid*).

2.2.2. Brightness

Brightness can be defined as an illuminance of a surface as perceived by a human eye. It can be expressed as a ratio of luminous intensity of a surface under certain angle to the surface area of its projection. Brightness is a directional unit, depending on luminous intensity in different directions and directional reflectiveness of a surface and the projected area of a surface in a given direction.

Figure 9: Brightness distribution

For uniformity and sharpness of vision, it is important that the brightness in an environment is distributed harmoniously with minimum contrast. Low brightness can cause strain on the eyes, decreasing the visual stimulation, which affects a user's work performance negatively. Therefore, a well-distributed illumination is necessary to avoid discomfort and perceive the visual cues in an environment[6].

An uneven distribution of brightness in a space causes glare, which results in high discomfort for the visual perceiver. To be precise, glare is caused by areas of high brightness right next to areas of low brightness. As an example, a bare source of light (without shade) kept near the user may provide bright light, but on the other hand it would cause more light to shine directly into the user's eyes than reflecting off the intended surface or object. Such glare will create discomfort in the

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[6] http://www.sleprojects.com/harmonious-distribution-of-brightness.

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user's eyes, and the person won't be able to perform any task efficiently (Figure 10).
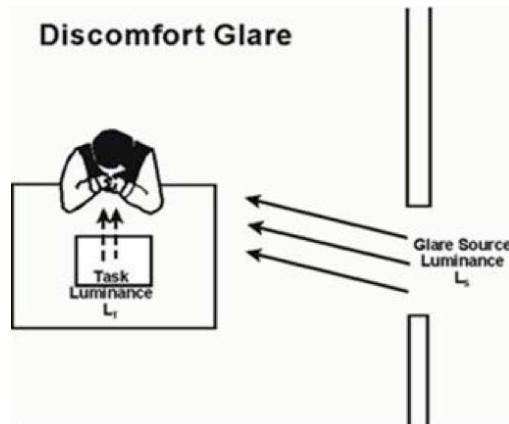
Figure 10: Discomfort glare

A light diffuser, like a shade/translucent material, can keep the light from glaring into the user's eyes and can illuminate the surfaces and space uniformly (Wienold, 2009).

2.2.3. Intensity

An important factor in the use of light colour is personal preference. Light Intensity or Luminous Intensity is the luminous flux (light energy emitted per unit of time) per solid angle emitted or reflected from a point. It is measured in lumen per steradian, or

candela (cd). Luminous intensity and brightness are closely related to each other. Brightness is a subjective attribute of light to which humans assign a label between very dim and very bright (brilliant). Whereas intensity can be measured, brightness is only perceived, when lumens fall on the rods and cones of the eye's retina. The sensitivity of the eye decreases as the magnitude of the light increases (Halsted, 1992).

2.2.4. Direction

Direct and diffused light goes side by side. Basically, the direct light is emitted from a point light source. Direct light is usually emitted when minimum amount of light gets reflected through the surrounding surfaces and maximum light is directly emitted from the source. When the light is reflected away from walls or ceiling, that results in diffused light. Direct light produces strong shadows and reflections. The position and shape of the luminaire predominantly control the direction of light. A light can be distributed directly or indirectly into a space. In artificial lighting, different type of lighting directions can be explained as follows (Gordon, 2003).

Diffused Up-Lighting: To distribute the light uniformly while creating an ambient lighting, light from the source is directed upward, spreading from 80 to 120 degrees. This upward directed light gets reflected from the ceiling and gets introduced into the space indirectly. It is used in spaces to achieve uniform ceiling luminance and low contrast space without glare.

Concentrated Up-Lighting: This is a method of illuminating the space indirectly where the light is directed upwards on the ceiling and is distributed in the area creating a high contrast of light and shadow. The spaces in-between are generally dark as the ceiling gets concentrated illumination. It is usually used to highlight the ceiling portion and avoid glare.

Diffused Down-Lighting: Diffused down lighting creates an ambient space, uniformly lighting the horizontal surfaces below. The light beam is directed 80 to 120 degrees in downward direction. This type of direction is used to create low contrast areas.

Concentrated Down-Lighting: This light direction is used to create concentration of light on the floor. The light beams spreads in 30 degrees in downward direction. It is used to create strong light and shadow contrast where most of the light is focused in downward direction.

Multidirectional Lighting: Multidirectional lighting is used to illuminate the space brightly and uniformly as the light gets emitted in all directions. It creates high stimulating space with very low contrast.

Semi-Direct Light: As the name suggests, the light is emitted in upward and downward directions only to balance the up light and down light in an environment, with 60 to 90% of light directed downwards. This type of direction creates a moderate space of contrast.

Semi-Indirect Lighting: Similar to Semi-Direct light, semi-indirect light emits the light in upwards and downward directions. The major difference remains that 60 to 90 % of light is directed upwards. This direction is used to create moderate contrast and to avoid glare.

Wall Washing: Wall washing is a vertical directional lighting to evenly illuminate the walls or surface area top to bottom. The light sources are placed one-quarter distance away from the surface. Track lights are the most common example of wash washing.

2.2.5. Texture

Texture is another quality of light that represents its diffusion or clarity. The Lighting texture is generally achieved by a filter such as lattice used in Iranian, South Asian and Chinese cultures, that creates strong light and shadow impressions when projected on a surface. The light texture can be soft or hard-edged. The major factors dominating the textures of light are the type of lighting direction, diffusion, the light source and the filters used to create the patterns (Gillette, 1999).

The texture in an environment is created using artificial or natural lighting. Generally natural light is used to create textures using the spatial and architectural integration of light like brickwork design and lattice windows used in Iranian architecture. The light texture can

be considered as a method of intensity control that adds aesthetic feel in an environment. Figure 12 shows the perforated lighting texture created by a wall in the corridor of Rass Haveli Hotel, Jodhpur, India.

Figure 11: Perforated lighting

Figure 12: Strong light and shadow textures

In artificial light, beautiful patterned coloured glass mosaics are also added to create strong textures using patterned filters. Moroccan lamps are the most common example of textured lighting used in interior spaces as shown in Figure 13.

2.2.6. Diffusion

Diffused light is any light that is not distributed directly by the bare light source, but is filtered through a material or emitted by an extensive area. These may be extensive, flat surfaces, such as the sky in the daytime, or, in the field of artificial lighting, luminous ceilings

(Gansland, 1992). In interiors spaces, diffusion of light can also occur when the light gets reflected through the walls, ceiling, or through a diffuser like lampshades or translucent material that covers the light source. Such diffusion produces uniform and soft lighting without producing strong contrasts or shadows and helps illuminate the space evenly. Figure 11 shows two lamps emitting diffused light through a translucent material and a ceramic fixture, diffusing the light through a wall.

Figure 13: Diffused light

The direction of lighting and the position of the lighting fixture play an important role in light diffusion in an enclosed space.

2.2.7. Time

According to Helmut Koster (2004), light synchronized the human biological clock with day, night, and seasonal rhythms. A lack of natural daylight can lead to disorders of the autonomic nervous system, loss of energy, fatigue, a tendency toward self-isolation and metabolic disorders.

According to Philips (2004), the problem often associated with lack of lighting, described as Seasonal Affective Disorder (SAD), affects quite a large number of individuals (a figure of a million has been quoted) and is said to derive from the lack of sunlight during the winter months, from September to April.

2.3. Spatial Integration

Different styles of spatial integration can be observed in Anglo-Saxon, Persian, Chinese and South Asian cultures. These differences are evident in the modern and traditional style of integration

techniques in these cultures, depending upon the utilization of available resources.

2.3.1. Anglo Saxon

Architecturally integrated lighting is usually achieved by integrating the light into the interior architectural structure or trims like cabinets, shelves or under artificially created surface design to produce aesthetic effect with light fixtures (Presciano, 2010). Elements used to integrate lighting are **valences,** which direct light downward and/or upward; **coves,** which illuminate upward; **soffits,** which distribute light downward; and **cornice**, which are used to accent corners.

Valances: This is lighting that is emitted from light sources on a wall, typically above eye level, and is concealed by horizontal artificially created architectural panels. It is generally directed upward and/or downward, highlighting ceilings and walls simultaneously (Presciano, 2010). Figure 14 shows the valence lighting in contemporary Anglo-Saxon architecture.

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Figure 14: Valence lighting

Coves: Cove lighting is a type of valence lighting that illuminates the surface in upward direction and is used for highlighting a ceiling, outlining a space or to create focus on a special architectural design element. Figure 15 shows cove lighting illuminating the wall, concealed under architectural panels.

Figure 15: Cove lighting

Soffit Light: Soffit lights are used for decorative purposes, usually washing the walls in downward direction. Soffit lights are generally used to illuminate horizontal surfaces, especially integrated in kitchen ceiling, bath countertops, wall desks etc. (Hepler, Wallach and Hepler, 2012). Figure 16 shows soffit lighting illuminating the wall in the downward direction.

Figure 16: Soffit light

Cornice Light: is a type of concealed lighting source in the upper wall, to create volume in the corners and overall lighting on the wall (indirect lighting). Some fixtures used in architecturally integrated lighting use angled brackets and reflectors to create a dramatic effect. Sometimes coloured and fluorescent lights are also used for aesthetic

purposes. Architecturally integrated lights provides soft, diffuse ambient light (Presciano, 2010). Figure 17 shows cornice lighting accenting the corners of interiors.

Figure 17: Cornice lighting

Skylights:

Skylights are windows installed in the ceiling of an architecture that allow natural light from above inside the space. This natural light is the light from both clear blue and cloudy skies. Figure 18 shows different styles and shapes of skylights.

Figure 18: Skylights

The climate, time of the year, and time of the day (direction of sunlight), slope of the roof, and orientation of the space (east/west facing) greatly dominate the placement and the shape of the skylights to be installed. The angle of light entrance, depending on the hour of the day, establishes the amount of direct light or indirect light (diffused from the walls/reflected from the surface beneath) that lightens up the space (Kroelinger, 2011). Figure 19 shows how the slope of the skylight impacts the direction of the light inside a space.
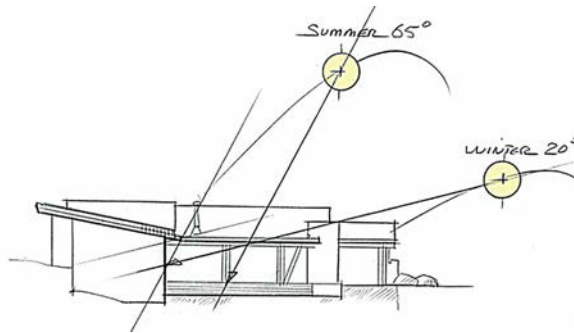
Figure 19: Skylight schematic

Artificial Skylighting:

A new form of light developed by an Italian company called CoeLux imitates the natural sunlight distribution inside the interiors. The fixture has been designed using a thin coating of nanoparticles to accurately simulate sunlight (Zhang, 2015). Figure 20 shows the artificial skylight designed by Coelux.

Figure 20: Artificial Skylighting

2.3.2. Persian

Following are some examples of Persian traditional spatial integration techniques (Ahani, 2011; Tahbaz & Fatemeh, 2009).

- **Light Wells, Roshandaan (Direction):** Ceiling openings in the buildings as substitute of windows. Commonly seen in bazaars and other public places, covered with glass or left open for direct light.

- **Persin (Texture + Diffusion):** Lattice wall, which is built of brick and tile.

- **Lattice Shabak (Texture + Diffusion):** Lattice windows are used to control light by scattering the direct intensity and privacy of interiors. Sometimes glass is also used for lattice doors and windows. In mosques, lattice creates a strong texture of light and shadow, enhancing the spiritual atmosphere (Figure 21)

Light Well (Roshandan)   Persin   Wooden Lattice   Lattice Window Texture
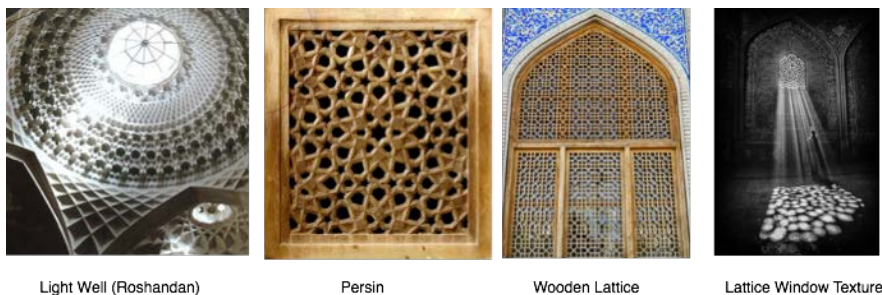
Figure 21: Persian lighting

- **Orosi (Texture + Colour + Intensity Control) :** It is a kind of wooden latticed window with two frames that slide up and down. This kind of window is used in cold regions of the country. Stained glass creates beautiful geometric pattern, controls light and adds colour to the interior (Figure 22).
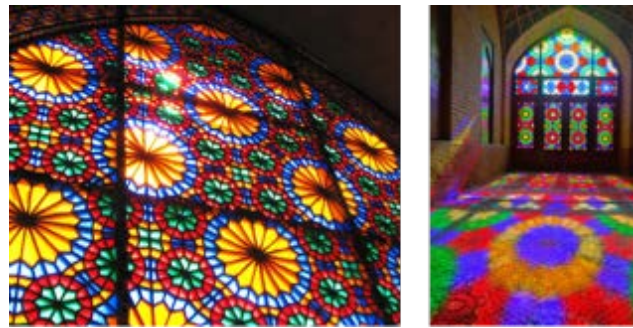
Figure 22: Colourful Iranian Orosi

- **Mugharnas (Refraction + Diffusion + Indirect)** Due to high intensity of sunshine in Iran, traditional architects often refract the light to create aesthetic value by making use of mirror works, mosaic works and reflective material. Majorly seen in honeycomb pattern on ceiling, Mugharnas reflect and refract light and create thousands of lighting effects (Figure 23).

Figure 23: Iranian Mugharnas

2.3.3. South Asian

- **Brick Screens, Jaali (Texture + Intensity):** Used as a substitute to glass and lattice screen, it is a perforated screen made of bricks. The bricks are placed in a peculiar fashion so as to produce tiny regular/irregular openings in the walls. This jali catches light and air and diffuses glare; while allowing for privacy and security.

Figure 24: Hallway of Rass Haveli Hotel, Jodhpur, India

- **Lattice Work: (Texture + Diffusion)**

The art of jali craftsmanship peaked under the patronage of the Mughals, as they shaped sandstone and marble into filigree-like patterns. Introduced by Mughals in 1600s and Persian invaders who introduced Islamic architecture in northern India. Due to similar climatic conditions like Iran in South Asian countries, these lattice screens control light intensity and create mesmerizing patterns. This can also be seen in Hindu architecture in western India (Figures 25 and 26).

Figure 25: Patterns in Sarkhej Roza, Sufi Saint's Shrine in Gujrat, India

Figure 26: Jali Work at Patwon Ki Haveli, Rajasthan, India

- **Courtyards: (Light Direction + Diffusion)**

Traditional South-Indian architecture (similar to Iranian) accommodates light through its courtyard. The open courtyard in homes is called 'Varandah', which is the most elaborate portion. Rooms, alleys and windows are generally facing the courtyard as the major source of light. Narrow courtyards in Rajasthan (western India) control the direct harsh light and heat of the desert, creating a multi-storied compound around it (Figure 27).

Figure 27: Courtyards at Patwon Ki Haveli, Rajasthan, India

- **Stained Glass Work: (Color + Diffusion)**

Stained glasswork, primarily introduced by Mughal architectural style takes different intricate and simple geometric forms in South Asian culture (Figure 28). These can be seen in both Islamic and Hindu architecture in northern India (due to climatic conditions of severe light in summers and cold harsh winters).

Figure 28: Hindu temple, Udaipur & Amer Palace, Jaipur, India

- **Skylights: (Direct +Indirect + Diffused Light)**

Most traditional houses in northern India consist of a grilled skylight, located either towards the middle or at the back end of the house. These skylight openings can range differently in their measurement according to the space of the house. In summer or rainy season, these openings are covered with a translucent material to diffuse direct sunlight or rain. The wall disperses indirect light inside the whole house (Figure 29).

Figure 29: Skylight opening, Punjab, India

- **Grilled plain glass windows: (Direction + Intensity)**

Most of the residential houses consist of an orifice-like plain window with wooden frames, which covers a major part of the wall in drawing rooms. These windows face towards inside wall boundary of the house to keep privacy and safety. Curtains are installed to control the light intensity due to harsh sun for most time of the year (Figure 30).

Figure 30: Orifice style large windows in author's house, facing garden

- **Roshandaan Windows: (Direct +Indirect light)**

Unlike Persian architecture, the north Indian architecture is without domes and consists of flat ceiling. The light wells, hence are on a vertical axis, installed in a wall, or installed above the windows and are kept uncovered at all time of the year. These allow direct sunlight to enter the house and get refracted by matte wall textures in the whole living area (Figure 31).

Figure 31: Vertical Roshandaan (left) and Horizontal Roshandaan (right)

- **Varandah Alley: (Indirect + Reflected light)**

Most houses leave a small space between the main door entrance and the living area, with another set of installed doors. Light enters through this large area, lighting up major section of living rooms. The marble polished floors, installed for durability in the outer section acts as strong reflectors, producing glare and indirectly lighting the alleyway to the inside door (Figure 32).

Figure 32: The well-lit entrance alley way at author's house

2.4. Types of Lighting Style (Light layers)

Generally three types of lighting styles are used in interior spaces; they create layers of lighting and are used according to the personal preference of the user (Presciano, 2010).

2.4.1. Ambient lighting

Ambient lighting is used to illuminate the space evenly, creating a well-lit harmonious ambience. This lighting is generally provided by recessed lamps or overhead fixtures (depending upon their size) and is considered to be the first layer of lighting in interior spaces. Figure 33 shows recessed lighting, evenly illuminating the space.

Figure 33: Recessed lighting

2.4.2. Task Lighting

The second layer of lighting is task lighting that provides intense light and helps the user to focus on the task like cooking or reading. It can be created using a simple study lamp or architecturally integrated lighting in trims like kitchen shelves. As the task light is concentrated lighting, fixtures are designed to eliminate the direct glare into the users eyes. Figure 34 shows task lights, installed over the kitchen shelf.

Figure 34: Task lighting

2.4.3. Accent Lighting

The third layer of light is accent light, generally considered as mood lighting. This type of lighting is used to accentuate certain decorative features in interiors like an artwork or painting to highlight the aesthetic element in an environment. Accent lights should concentrate five times more light on the focus area as compared to the ambient lighting and directed away from the direct view of the user (Presciano, 2010). Sometimes simple clamp lamps are used to accentuate design elements in interiors as an economically viable solution. Figure 35 shows accent light, highlighting the artwork in a space.
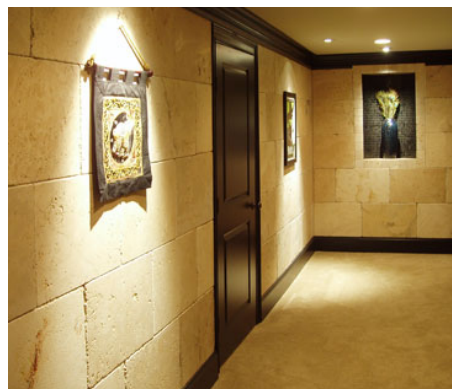
Figure 35: Accent light

2.5. Space

2.5.1. Proxemics

This is a concept of interaction between user and the space. The term 'Proxemics' was defined in 1963 by researcher Edward Hall to study this interaction in a spatial as well as inter-personal form and how variety in space triggers different reactions and emotions in different people. This theory can also be perceived as non-verbal communication (Moore 2010). According to Hall, the value in studying proxemics comes from its applicability in evaluating not only the way people interact with others in daily life, but also the organization of space in their houses and buildings, and ultimately the layout of their towns (1963).

Proxemics theory features four different areas (Lyman & Scott, 1967):

- **Public territory:** Interaction with public spaces temporarily owned by user e.g. libraries;

- **Interactional territory:** Spaces for informal interactions e.g., gardens;

- **Home territory:** Spaces with personal interaction due to the user continuously owning the space e.g., residential space;

- **Body territory:** Space immediately surrounding the person.

The variation factors in the proxemics are use of the colour and lighting in a physical environment and ethno-cultural behaviour in personal territories. The concept and measurement of proxemics differ from culture to culture as different ethnic communities interact with physical and interpersonal spaces in a vast difference, e.g., there is a huge difference in interpretation of personal communication between Middle Eastern, European and Asian cultures (Sheppard, 1996). Shepard also states that cultural differences and the use of colour in our physical environment can have a great impact upon our interactions with others (*ibid*).

2.6. Culture

2.6.1. Cultural Anthropology

Cultural Anthropology is a branch of anthropology that focuses on the study of different cultures of humans and their evolution, resulting in specific beliefs, social behaviours, and cultural inclinations in a defined geographical area. It also focuses upon differences from person to person in the same culture. As cultural anthropology is human centered, it requires the researcher to acquire first hand experience of direct interaction with the individuals of the culture being studied. (Cultural Anthropology, n.d.)

2.6.2. Cultural Nostalgia

Nostalgia can be defined as sentimental emotions for a certain place, surroundings and time that prevail in the mind of a person in the form of a happy memory. Often manifesting as anecdotes about the good old times, nostalgia is most prevalent in individuals away from their homeland and ethnic surroundings that generate the bittersweet

emotions from past memories. In an article, Svetlana Boym refers to immigrants' stories as one of the best narratives of nostalgia (2001).

In contrast to early observations, nostalgia has been considered a positive phenomenon by contemporary researchers like Batcho (1998, 2007), Kaplan (1987), and Havlena & Holak (1998). Davis (1979) states that nostalgia is never infused with negative sentiments.

The stimulus that triggers nostalgia ranges from environment to a product as Havlena & Holak (1991) state that, old products that are brought back for a new generation, could elicit nostalgia in them. As the research project is design oriented, theory of personal nostalgia provides a strong base to understand the psychological context of the issue and the human centred design approach as a supporting element.

2.6.3. Positive Psychology

Positive Psychology Centre at the University of Pennsylvania describes it as the scientific study of the strengths that enable individuals and communities to thrive. The core vision of positive

psychology focuses on the belief that people want to lead meaningful and fulfilling lives, to cultivate what is best within themselves, and to enhance their experiences of love, work, and play (Positive Psychology Center, 2015).

The idea of positive psychology can differ from culture to culture but the basic factor is to lead a more satisfactory and peaceful life while interacting in relation to society or personal affiliations on an intellectual level.

Since this project focuses on the requirement of design solution for immigrants with cultural nostalgia, the problem solving approach can be related to positive psychology on a logical level. This concept interconnects with Human Centre design approach (to understand what makes user happy and satisfied), Cultural Anthropology (with relation to different cultures) and Cultural Nostalgia (elements of nostalgia - culture that trigger positive emotions).

2.7. Summary

This section reviewed some concepts used in this study categorizes under cultural significance of lighting, light qualities, spatial integration lighting styles and culture. These concepts form the framework for designing the data collection instruments and processes as described in Section 4. The next section highlights a few exemplar lighting designs from contemporary practice.

3. Some Exemplar Lighting Designs

Three projects are reviewed below, which are cultural expressions of lighting design that evoke emotional reactions.

3.1. Project 1-Intersections - Anila Quayyum Agha

'Intersections' is an installation exhibited by Pakistani born artist Anilla Agha Quayyum in 2015.

Figure 36: Intersections - 1

The installation is a 6.5 square feet cube wooden frame with intricate laser cutwork patterns (Figure 36). The patterns and form of

the lighting was inspired by her visit to Alhambra, Granada, Spain where Islamic ornamental patterns on the wall of palace, made her nostalgic of her culture as she reflected upon her childhood in Lahore, Pakistan, where women were excluded from the mosque. The effects of sharp shadows are created using a single 600-watt light bulb (Jobson, 2015).

Methodology: Started initially with complex design patterns, consisting of secondary and tertiary levels of shadows to illustrate an abundance of life, she simplified the design during conceptualization. After design finalization, she transferred the patterns onto large wooden panels with a small laser-cutting machine. The design process can be seen in Figure 37 (Chung, 2015).

Figure 37: Intersections - 2

Project Success: This installation won ArtPrize 2014, a $200,000 Public Grand Prize as the choice of 41,109 registered voters who cast 398,714 votes over 16 days to pick the winner from a field of 1,536 entries (Kaczmarczyk, 2014).

3.2. Project 2- Al Aziz Mosque - Abu Dhabi - LUCEM

LUCEM Germany with APG Architecture and Planning Group has created a light omitting concrete, using LEDs installed behind the facade panels known as 'Rohformatplatte' (Figure 38). The facades are weather proof and sustainable in extreme weather of Abu Dhabi. The facades are of warm sand colours that merge in the environment; yello during daytime, during sunset it gets a more earthy tone, while at night and in the morning it looks grey as the lighted calligraphic panels dominate shining through the concrete. The mosque was opened for public in Ramadan 2015.

Figure 38: Al Aziz mosque -1

Methodology: The 515 sq. metre external facade consists of 207 unique elements inspired by Arabic calligraphy and displays 99 different names of Allah on an average panel of 1800 x 1400 mm. The letters were first drawn by an experienced calligrapher and then digitized and distributed across different elevations of the building using AutoCAD. The letters were engraved using sandblasting technique and protrude 30 millimetres from the panels, which weigh 300 kilograms each. The close up of panels can be seen in Figure 39. The blocks were installed using 16 undercut anchors to fix each panels to a channel-based substructure system fixed to the concrete structure of the mosque (Grozdanic, 2015).

Figure 39: Al Aziz mosque-2

3.3. Project 3- The Ànima by Estiluz

The new Ànima model by Estiluz is a pendent lamp designed by Roger Vancells. Its was inspired by Hitodama, a Japanese folklore where Hitodama means human soul, represented as balls of fire floating low in the middle of night (Soner, 2009). It is believed that the souls of the recently deceased float in the air taking on the shape of a bright flame.

The polyurethane foam shade combines with the cloth cable in black to create a contemporary organic form (Figure 40).

Figure 40: The Anima - 1

Technology: LED technology illuminates the design form of the product as well as casts a direct beam of light, spreads a homogenous lighting space.

Technical description: Pendant made of polyurethane foam, direct and indirect light, and textile cable.

- Dimension: 500 mm height x 585 mm width.
- Lamps: LED 10W.

The technical drawing demonstrating front and side view of the lamp can be seen in Figure 41 (Estiluz, 2015).
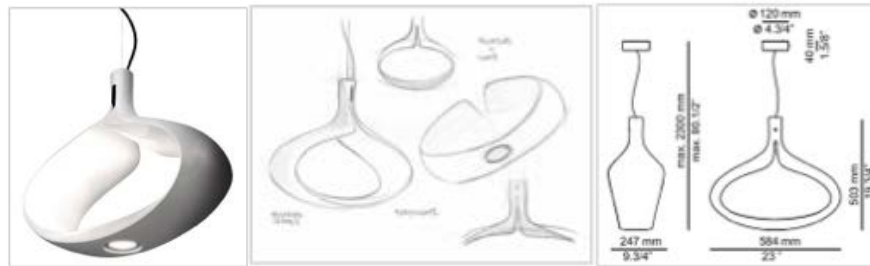
Figure 41: The Anima - 2

3.4. Contemporary Lighting

Market research of contemporary lighting was conducted at Royal Lighting[7] on Avenue Road in Toronto, Canada. The following lamps were identified as having some characteristics relevant to the research such as form, technology, flexibility and visual appeal.

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[7] http://www.royallighting.com/

Figure 42: Contemporary lighting - 1
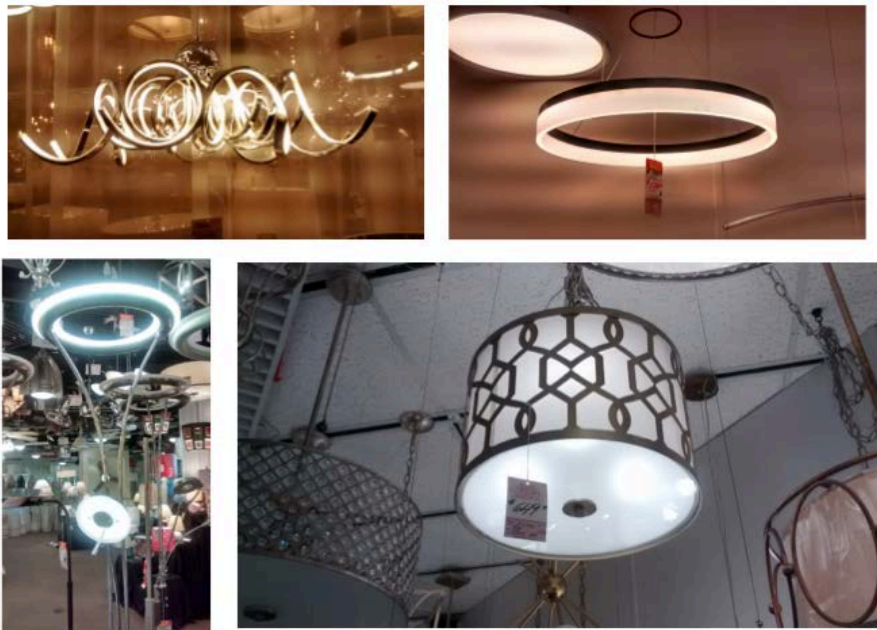
Figure 43: Contemporary lighting - 2

4. Exploring Immigrants' Cultural Preferences

4.1. Introduction

This research consisted of an exploratory study that examined the lighting preferences and implicit/explicit cultural expression of 15 immigrants in their living spaces. Using design considerations based on the findings, three 4-in-1 culturally inclusive lighting designs were conceptualized. The primary methods used for data collection were a questionnaire survey and contextual interview in the participants' residences. The data collected were both descriptive and numeric and were analyzed using context analysis and descriptive statistics.

4.2. Recruitment

Participants were recruited from weak ties in the researcher's social network through online invitations. During the recruitment process it was ensured that participants did not feel unduly obligated to participate in the study. It was also ensured that participants

understood the nature of the study and consented to participate voluntarily.

4.3. Consent Process

An invitation letter and consent form were sent to potential participants through email. The invitation letter described the nature of the study, participants' rights, and researcher's contact information in case participants had any questions about their rights or the study. The consent form sought participants' consent for participating in the study and for the researcher to take photographs of lighting, artefacts and spaces in their residence. Participants filled in an electronic or print version of the consent form and returned a copy to the researcher. After the consent form was received from each participant, a questionnaire (as given in Appendix A) was emailed for the participant's preliminary review.

4.4. Questionnaire and Contextual Interview

In keeping with the human-centered design approach adopted by the study, the questionnaire contained closed and opened ended questions aimed at obtaining the participants' demographics, lighting and colour preferences, aesthetic sensibilities, inclination towards their native or other cultures and how they interact within their living spaces.

After an appointment was fixed with the participant, the researcher went to the participant's residence. All participants had consented to photography by the researcher. Still, a second verbal permission was obtained after reaching their residence.

The researcher completed the questionnaire through dialogue with the participant in their residence with additional contextual questions to understand the ambience and environment in detail. Points of implicit nostalgia expressed in the form of colour/lighting/spatial orientation or cultural artefacts were also noted.

Observations during the interview sessions were documented spontaneously in text format and analyzed later.

4.5. Data Analysis and Synthesis

Data collected from the 15 participants were organized according to the participants' respective cultures using CMYK colour format as a data sorting index (Figure 44).

Figure 44: CMKY colour codes for questionnaires

To ensure confidentiality of the data and privacy of the participants, each participant's questionnaire was given a colour and text code as in Table 1. Data was associated with that code while it was being analyzed.

Table 1: Participant codes

Cultures	No. of participants	Identity Codes
Persian	3	P01, P02, P03
South Asian	6	SA01, SA02, SA03, SA04, SA05, SA06
Chinese	3	C01, C02, C03
Anglo-Saxon (Canadian)	3	AS01, AS02, AS03

Findings and insights from the research are presented in the next section.

5. Observed Cultural Preferences in Lighting

5.1. Research Findings

Findings are presented under the following categories:

1. Lighting (Colour, Intensity, Texture, Diffusion, Direction & Spatial Integration)
2. Light and Space
3. Color
4. Color and Space
5. Aesthetics

5.1.1. Lighting

Natural Light

Natural light was the most preferred amongst majority of participants from all the cultures. These participants saw natural light as the source of positive emotions and happiness. A participant from Persian culture (P01) stated, "Natural light (sunlight) gives me positive energy and I feel good in natural light. In Iranian culture, natural light

is highly valued". Another participant from South Asian culture; SA01 stated, "It (natural light) makes me feel fresh and opens my day to nature. I feel healthy, positive, and it saves cost and energy."

One of the major insights found during the interview sessions was that majority of participants were inclined towards natural light and that's why majority of them wanted their artificial lights to imitate natural light's qualities, especially the colour temperature and brightness.

Artificial Light

With respect to artificial light, the basic preferences of lighting and its qualities emerged different for each culture.

1. All of the Persian participants preferred mixed light (white + off-white light) that imitates a sunny day's ambience. An important reason for such mixed preference was quoted as the climatic conditions of Iran. Coincidently, all three Persian participants grew up in Tehran,

which has a hot, arid climate (similar to other central parts of Iran) with a very long summer touching temperatures around 109 °F (43 °C).

2. Most of the participants from Chinese culture prefer soft yellow light or off-white light, depending on their different moods at the time (indicated by 66.5% of participants). Similar to Persian participants, Chinese participants also prefer artificial light that mimics natural sunlight's different colour temperatures. Participant (C01) stated, "I use yellow-white bright light that looks like natural light. In Chinese culture, houses are designed to utilize maximum of natural light, so I want to use the lighting that is near to (visually) the natural light."

3. Majority of the Anglo-Saxon participants reported a preference for off-white light and white light. Although in the questionnaire 100% indicated preference for off-white light, during the interview in their spaces, it was observed that Anglo-Saxon participants were also inclined towards yellow lights (as shown in Figure 45).
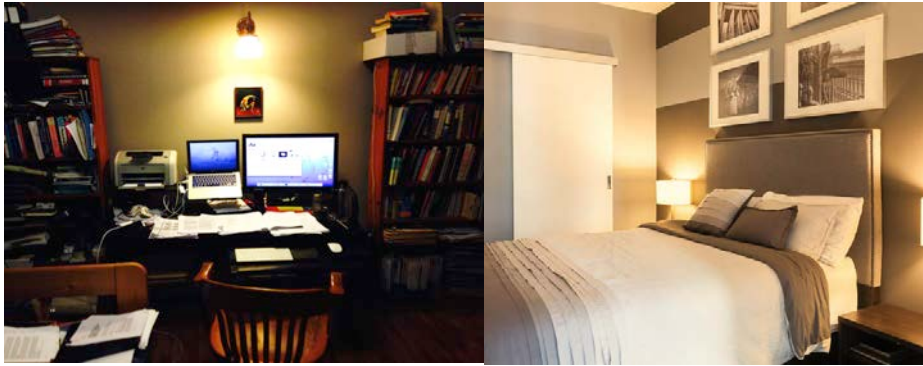
Figure 45: Yellow lighting in the houses of AS02 (16a) and AS03 (16b)

4. All the South Asian participants (100%) preferred white/bluish white light and did not prefer yellow light at all. A participant, SA04, who moved to Toronto in 2010, stated, "I like bright white light, like that of tube light we used to have in India. I dislike yellow light as it makes me feel very depressed. I hate this chandelier's light (pointing towards a chandelier with dim yellow light); it makes me gloomy." Out of all the 15 participants from four cultures only 26% were inclined towards multi-colored lighting (depending on the mood or occasion). A participant, SA06, from South Asian culture stated in her questionnaire, "I like all kinds of lighting, especially themed lighting with colourful ambience. I like lights that

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communicate with me." Another participant from Anglo-Saxon culture, AS01 used colourful string lights in her living area to add colourful ambience (Figure 46).

Figure 46: Multi-coloured string lights in AS01's house

On the other hand, all three Chinese participants expressed their dislike for coloured lights. One of the Chinese participants (C01) stated during the interview, "I really don't like colourful lights, like those in the clubs (lounges), especially low colourful lights." Another participant C02 stated, "I don't like low colourful lights, like in discos. They give me headache and nausea." All three participants also said

that they don't like even blue-white lights and only preferred yellow and off-white lights.

Figure 47: Visual representation of lighting colour preferences

Conclusion: To sum up, with regard to lighting and colour temperature preferences, it can be seen that the preferences of the four cultures ranged from yellow, to off-white, to white and bluish-white lighting. A visual representation of these findings can be seen in Figure 47.

Intensity and Brightness

Most of the Persian participants preferred high intensity (bright) lights in their spaces. Participant (P02) stated, "I like bright-bright

lights! My least preferred lighting is the dim lights. It gives me bad feelings". Another participant; P01 stated, "I like bright white and off white lights, like daylight!" This inclination towards bright mixed lights was apparent in their living spaces as well (Figure 48).

Figure 48: Persians' preference for bright lights - P01 & P02

Amongst Chinese participants, 66.5% preferred bright lights (off-white and yellow) in their living areas. Participant C02's living room was lighted up with high intensity bright lights (Figure 49).
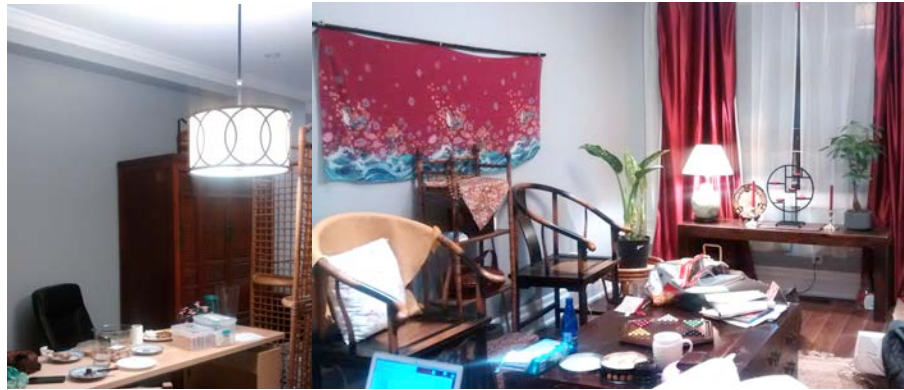
Figure 49: Bright lights in Chinese living rooms (C02)

Similarly, 83.33% of South-Asian participants preferred bright (white, bluish white) lights in the kitchen, living and dining areas. Photographs documented during the residential visits provide the evidence for this finding (Figure 50).

Figure 50: South Asian living, kitchen and dining areas - SA04, SA05, & SA01

Whereas all of the Anglo-Saxon participants preferred flexible light intensity (depending on the mood), 33.33% specifically preferred low intensity lighting for most of their time spent in their space. Figure 51 shows the intentional preference of participant AS01 to low intensity lighting in her residence to create a relaxing ambience.

Figure 51: Anglo-Saxon preference for low-intensity lighting - AS01

Intensity Control: Most of the participants expressed their desire to have light intensity control option. Participant AS01 changed her entire lighting system to get intensity controllers installed with each light in their residence. Figure 52 shows the newly installed intensity control switches (left), the controlled low intensity effect (middle), and the controlled high intensity effect (right) in her residence.

Another participant from Chinese culture, C02 stated, "I would like to have a control switch option ... with remote control or may be connected to my iPhone application, so that I can control the lighting in my bedroom according to my mood without making much effort."

Figure 52: Anglo-Saxon (AS01) home intensity control system

Texture

Textured lighting was highly uncommon in living spaces of all the participants except one South Asian (SA06). Although textured light is reportedly common in Persian and South Asian Culture, the intentional addition of lighting texture was missing in most of the participants' residences. However, the unintentional texture created by the shade and other materials like crystals in the lighting fixtures was highly appreciated by the residents (Figure 53).

Figure 53: Textured lighting - SA06 & SA01

Finishing techniques like 'Antique silver finish' in a plain glass shade and mosaic style stained glass (at SA06's space) created a soft texture on the adjacent wall. Figure 54 (left) shows texture created on the wall by 'antique silver finish' from the lamp shade and the stained glass mosaic ceiling light creating soft colourful texture (middle) at SA06's living area. On the extreme right is a small crystal chandelier projecting texture on the ceiling above at SA01's residence.

Anglo-Saxon participant AS01 pointed a simple projection of a light ring on the ceiling in their dining space as an unintentional but interesting pattern created by light and shadow (Figure 54).

Figure 54: Ring texture projected on the ceiling by a pendant lamp shade

Diffusion

Lighting diffusion differed across all 15 participants' houses. Most of the Anglo-Saxon and Chinese participants preferred diffused lighting in all of their spaces as compared to South Asian and Persian participants. The documented photographs show the various styles of light diffusion in different cultures. Figure 55 shows light diffusion in different Anglo-Saxon participants' spaces. 1. Mushroom lamp at AS01's living room corner. 2. Diffused lighting at AS01's bathroom. 3. Lighting at AS02's bedroom. 4. Diffused soft lamps installed in AS03's bedroom. 5. Pendent lamps with diffused lights in AS03's dining area. Figure 56 shows light diffusion in Chinese participant (C02's) dining area (left), bedroom (middle) and corner of living area (right).

Figure 55: Lighting diffusion in different Anglo-Saxon houses

Figure 56: Diffused lighting in Chinese homes

It was observed that lighting diffusion also varied according to the space in each residence. As an example, the use of diffused lighting was observed mostly in the bedrooms of Persian and South Asian participants rather than in living spaces. Participant P01 stated, "I like soft lighting near my bed...helps me to relax" (Figure 57).

Figure 57: Diffused light in Persian houses

Similar to Persian participant's preferences, diffused lighting was used in the bedrooms of South Asian participants as well. An additional accessory (rice paper shade from an unused lamp) was added in a South Asian participant's (SA06) one-bedroom apartment to diffuse the harsh direct light (Figure 58). The middle picture shows ceiling light installed in SA01's bedroom and the table lamp with soft light (right), intentionally used near the bed to create a calm ambience.

Figure 58: Diffused lighting in the bedroom of South Asian houses

Conclusion: Diffused lighting is used in all the four cultures where most of the participants preferred its use in their bedrooms to create a relaxing mood. However, South Asian and Persian participants did not prefer to use diffused lighting in their living spaces, unlike Anglo-Saxon and Chinese participants.

Direction

Multidirectional lighting was observed in the living spaces of most of the participants in the form of ceiling lights and chandeliers, emitting light in all directions. Images in Figure 59 from left to right and top to bottom are: 1. Equal distribution of multi-directional lighting in SA01's living area. 2. Uniform multidirectional lighting created by small chandelier in SA04's dining area. 3. A pendent lamp creating uniform lighting in C02's dining area. 4. Pair of pendent lamps diffusing multi-directional light in AS02's living room. 5. Installed ceiling light lighting the living area in P01's apartment.

Figure 59: Multidirectional lighting in different cultures

However, diffused indirect up lighting and down lighting was used in Anglo-Saxon participants' bedroom and dining areas. Figure 60 shows diffused down lighting integrated into ceiling fan in AS01's kitchen/dining area (left) and diffused indirect up lighting at AS02's bedroom (right).

Figure 60: Diffused indirect lighting in the house of AS02/AS01

Concentrated down lighting was also used in Anglo-Saxon participants' (AS01 & AS02) living rooms, creating a high contrast space, with 90% of the light projected in the downward direction. Figure 61 shows concentrated down lighting at AS02's living room (left) and pendant lamp with concentrated down-lighting focusing on a table (middle) as well as front view of the pendant lamp creating strong contrast in space (right) in AS01'S living area.

Figure 61: Down-lighting in the house of AS02/AS01

Semi-direct lighting was used in Persian participant P01's small living area with 90% downward direction illuminating the apartment's entrance (Figure 62-left). Semi-indirect lighting was only observed in Chinese participant C02's living room with the maximum lighting

projected in the upward direction, resulting in in-direct diffusion of light through ceiling (Figure 62-right).

Figure 62: Semi-direct (P01) and semi-indirect lighting (C02)

The documented preference of Anglo-Saxon and Persian participants for accent lights was evident in their spaces. Fixtures like table lamps, floor lamps, track lights and clamp lights were used as accent lights (focused to accentuate artefacts) and also as an inexpensive source to create 'wall washing' effect, illuminating a corner or a vertical wall (Figure 63).

Figure 63: Wall-washing effect in the houses of AS02/AS01

Figure 64 shows a table lamp and floor lamp (left) used as accent light to highlight a traditional painting (middle) in Persian participant P02's study area. The track lights (right) were used as accent lights to highlight paintings of old Iran as well as to create a 'wall-washing effect, indirectly illuminating the narrow hallway.

Figure 64: Accent lighting in P02's house

Conclusion: South Asian participants were inclined towards multidirectional lighting that illuminated their spaces uniformly. Strong visual directions of the lights were preferred by Anglo-Saxon and Persian to accentuate specific spaces or artefacts that had an emotional value in participants' lives. The flexibility in the design of a lighting fixture is imperative that can enable the users to explore and customize the lighting according to their preference.

Integration and Style

Architectural integration of lighting was observed in ambient, accent and task lighting in Anglo-Saxon and Chinese participants' residences only. LED pot lights (Figure 65) were integrated in ceilings of different spaces to create uniform ambient lighting. Interestingly, ambient lighting resulting from these lights created different ambience according to the height of the space.

Figure 65: LED pot light at AS.C01's basement living space

As an example, Chinese participant C02's living space was illuminated differently (moderately) as compared to the living space of Anglo-Saxon participant AS01's low ceiling basement living room, which got illuminated strongly with pot lights, creating bright glare and strong overhead shadows. Figure 66 shows integrated ambient lighting moderately illuminating the living area of C02's residence (left), uniform but strongly lit corners of AS01's basement living room (middle), and strong overhead shadows created by low ceiling integrated lights (right).

Figure 66: Variety of ambient lighting

AS01 intentionally installed intensity controllers in her basement space to avoid strong shadows and to customize the lighting according to her tasks or mood, "I prefer overhead bright light that creates shadows...especially in the evening, I like ambient light that can be used as a task light".

The task lighting above the cooking stove in AS03's kitchen was another form of integrated lighting used in contemporary condo interiors. Soffit lights integrated in the ceiling, aligned over the kitchen shelf was used as dual lighting; ambient + accent, that diffused light through its adjacent wall into the dining space as well as highlighted the kitchen shelf below. Figure 67 shows integrated task lighting over

cooking stove (left) and Soffit lights used as ambient + accent lights to highlight kitchen shelf of Anglo-Saxon participant AS03's condo (right).

Figure 67: Integrated lighting in AS03's kitchen

Conclusion: The artificial integration of lighting was observed in contemporary/recently renovated interiors of the participants. Major forms of integration were observed in the form of Ambient, Task and Soffit style of lighting. The position of the integrated lights can create multiple styles of lighting and can affect the ambience, mood and task performance in a space.

5.1.2. Light and space

Anglo-Saxon participants expressed their preference for a separate space created by lighting for their study area. This preference was also observed in their study areas and the location of bookshelves inside their residence. As an example, participant AS01 stated, "I keep my books near this lighting (pointing towards an overhead floor lamp)...it creates a nice warm space for me to enjoy the reading on my favourite couch."

Implicit inclination towards a separate study space created by lighting was also observed in AS02's residence, where semi-direct light focuses on the study table creating a warm coloured space. Figure 68 shows semi-direct lighting over Anglo-Saxon participant AS02's study area (left) and overhead floor lamp creating a study space in AS01's residence (right).

Figure 68: Study areas in Anglo-Saxon houses AS02 & AS01

South Asian, Persian and Chinese participants used bright lights on their dining tables, where as Anglo Saxons preferred dim and soft lights in the dining/kitchen areas. Figure 69 clearly shows the difference in lighting in dining areas in the residences of AS01, AS04, C02, SA03.

Figure 69: Lighting in dining areas (AS01, AS04, C02, SA03)

South Asian, Persian and Anglo-Saxon participants integrated their spaces with natural light: i.e. dining and living areas are centralized near large natural light sources like wide windows. Figure 70 shows orientation of living spaces integrated with big windows as a natural light source.
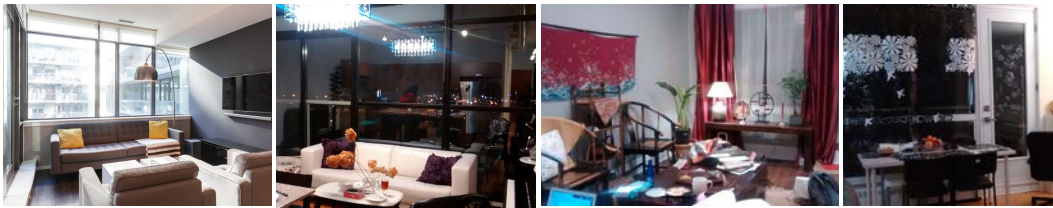
Figure 70: Integrating space with natural light source

High light/shadow contrasts were only observed in the study areas of participants. Most of the participants used adjustable study lamps to flood the study table with light as well as an accent lights.

Most of the participants preferred bright lights in their living areas and soft lights in bedrooms. Chinese participant C02 stated, "I want a calm environment in my bedroom...it's a place to relax, so I use these soft lights." (Figure 71)

Figure 71: Soft lighting in participants' bedrooms

5.1.3. Colour

Black, white, grey and neutral colours (beige, wood, earthy) are the most popular amongst all 15 participants in the context of their living spaces. During the interview, a Persian participant P01 was asked if she added any colour in her living space and if yes, why she chose that particular colour. She seemed quite pleased to reply, "I added dark grey in my living area. I especially got this dark colour and painted this whole wall (pointing towards a wall in her living area) to create a balance between white, blank walls, my white furniture, my turquoise rugs and the wooden floor." She continued, "I even painted this table myself in white colour to equalize the colour scheme in such a small apartment. It gives me peace." Figure 72 shows the dark grey coloured wall and white table painted by Persian participant P01 in her living

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area (left), and the colour balance created with neutral and earthy colours in the apartment (right).
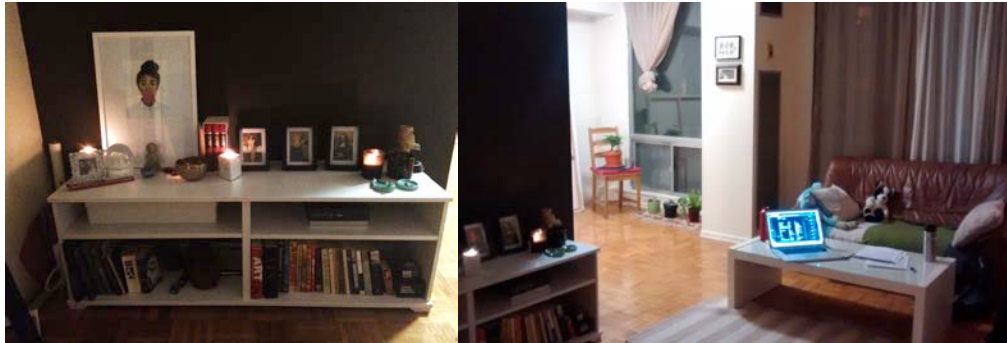
Figure 72: Painted wall in P01's apartment

Another Persian participant P02 stated, "I love white (color) especially in my furniture, furnishings and accessories. Black, white and dark colours are a great mixture." Other participants from South Asian, Chinese and Anglo-Saxon cultures also expressed a strong inclination for theses colours and classified them as classic and evergreen.

A participant from South Asia SA05 decorated her apartment in black and white theme. When asked the reason for the chosen colours, she stated, "I wanted to give my apartment a unique vintage look with classic colours!" Figure 73 shows the black and white theme of a South

Asian participant SA05's apartment (left) and the neutral coloured screen (right), used to create space and privacy.

Figure 73: Black & white and neutral colour themes in SA05's house

Similar colour preferences were observed in Chinese and Anglo-Saxon participants' residences. "Chinese culture is highly inclined towards natural and organic material," stated Chinese participant C02. Pointing towards a finely woven jute rug and bamboo artefacts in his living room, he continued, "Chinese culture is inclined towards nature and simplicity…that's why most of us like neutral colours like beige and wood. It's the essence of art and philosophy." P02's preferences were clearly evident in the dining area. Figure 74 shows the organic, earthy

furnishings (left) and neutral wall colours with wooden furniture (right) in participant C02's living area.

Figure 74: Organic, earthy finish in C02's house

Similarly Anglo-Saxon participant's spaces, automatically express their preferences towards natural and neutral colours. Anglo-Saxon participant AS01 stated, "I like earthy tones in my space like white, dark brown, black, natural wood colour…. that's why we removed the carpet from our floor to bring out the natural wood. It adds neutral colour to the ambience."

Another Anglo-Saxon participant AS03's condo interiors as well as furnishings contained similar colour pelleted of white, dark/light grey, and neutral colour scheme. Figure 75 shows the neutral colour

scheme in Anglo-Saxon participant AS03's living area (left), bedroom (middle) and kitchen & dining area (right).
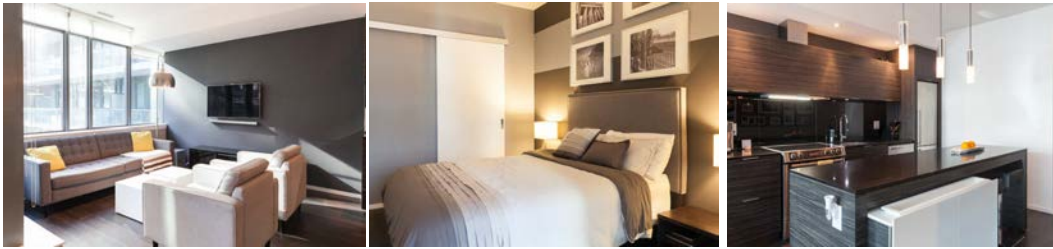
Figure 75: Neutral colour scheme in AS03's house

The spatial colour palettes preferred by participants from different cultures were amazingly similar. The following colour pallets were derived from documented photographs of participants' living spaces (Figure 76).
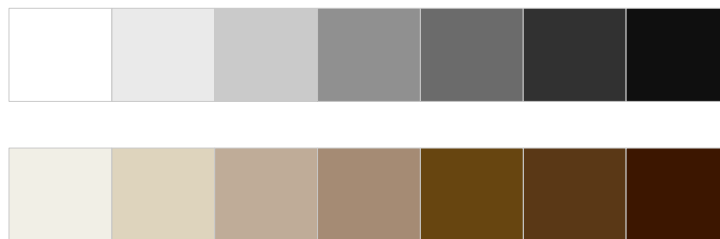
Figure 76: Emerging spatial colour palette for all participants

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Identified Cultural colours

Participants documented different colours that are used in their traditional architecture, religion, artefacts and rituals. "Turquoise, white, black, dark blue, golden, red, and many colours can be seen in traditional Persian architecture and interiors" stated a Persian participant P02 in her interview. Another South Asian participant SA04 stated, "Our culture (Indian) is full of beautiful vibrant colours … and we decorate our home during festivals like Diwali and Holi with the colourful lighting, lamps, and even our traditional clothes are so colourful…India is all about colours". During the interview with Chinese participant C01, she stated, "I know China is represented by red colour, but it is not the case! The real Chinese culture prefers more neutral, natural colours like beige and black…the red, yellow, golden, etc. are used in traditional rituals like weddings or according to religious beliefs."

As per data gathered through the questionnaire and interviews, the following cultural colour palettes began to emerge, one for each culture (Figure 77).

i. Persian Color Palette

ii. South Asian Color Palette

iii. Chinese Color Palette

iv. Anglo-Saxon Color Palette
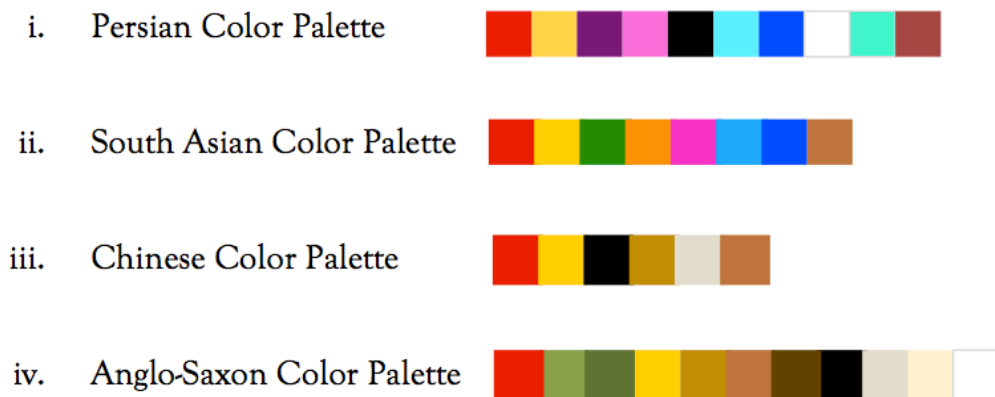
Figure 77: Cultural colour palettes for the four cultures under study

Fixture colours

White, black, beige and metallic colours are the most common in lifestyle products. Participant AS03 added yellow coloured lamp to match with the yellow furnishings saying, "I like to highlight things, so I added yellow cushions and lamp in my neutral coloured interiors." Persian participant P02 stated, "I chose the grey metallic colour for my lamps to match the black and white interiors." South-Asian participant

SA06 had a red lantern unused in her kitchen area. On enquiring if the lamp was being used or not, she said, "I like red colour in general, so I bought it. I never use it in my living room with other neutral coloured (lighting) fixtures." Figure 78 (left) shows the yellow lamp added by AS03 to match the yellow furnishings in his condo, (middle) the metallic coloured lamps in P02's study space and (right) the unused red lantern stocked in SA06's kitchen.

Figure 78: Multi-colour lamps and their cultural significance

Red was added in the interiors of Persian, Chinese and South-Asian participants to add mood and to acknowledge traditional beliefs. "I love red colour, actually the combination of red and white, that's

why I installed red curtains on white walls," explained South Asian participant SA06 (Figure 79). Another participant SA04 added red and light yellow colour in her guest bathroom to create bright space, "I added red and off white colour so that guests should feel that its an 'Indian' bathroom (laughs)." (Figure 79)

Figure 79: Use of red colour by South Asians and Chinese

Addition of red colour was also observed in Chinese participant C02's living room. "I don't like the colour, but it is auspicious and said to ward off evil spirits from the house...actually our parents insisted on addition, so we added red curtains." (Figure 79)

Conclusion: All the participants prefer neutral colours in their living areas to give a natural and classic look. Similarly, black, white and

metallic colours are most preferred in fixtures amongst all the participants. Their personal preference of colour is expressed by adding small amounts of colour (like accessories and furnishings) in the living room. Red colour is common in South-Asian and Chinese spaces to acknowledge their traditions and express cultural inclination.

5.1.4. Color and Space

Most participants added black, white, dark grey, beige/wooden colours to balance the colour and add a modern and contemporary look. As previously discussed Persian participant P01 added dark grey colour to give a modern look and balance in the colour scheme (Figure 72), similarly South Asian participant SA04 added black colour in her bathroom to add a contemporary look, "I especially bought black paint because I wanted to try a new look … just like black and white walls in condo's interiors … so I started with small space in the bathroom and tried a trendy look. Now my smaller bathroom is traditional and colourful and bigger one is modern and trendy!"Another Persian participant P02 stated, "You will see my first preference is white colour

... from furnishings to furniture ... and the black colour highlights and adds the perfect balance. Its classic but very modern." (Figure 80)

Figure 80: Black, white and grey to appear trendy

Figure 80 shows black painted walls highlighted with white frames in SA04's bathroom (left) and black and white frames (right) added to painted wall to add clean modern look in P02's entrance alley.

i. As previously discussed under Cultural colours, the personal colour preferences of participants were expressed by adding their favourite colour in small amounts in their spaces. As an example, Persian participant P02 stated, "I love purple colour...deep purple actually, that why I bought these cushions and the floor

rug. They look beautiful with the white sofa." (Figure 81-left).

Similarly Anglo-Saxon participant AS03 explained, "I like yellow

and grey combination, grey and yellow highlight each other...I

simply added yellow cushions and one yellow lamp to match."

(Figure 81-middle). Another South-Asian participant AS04

added red and black cushions to her black and white bathroom.

(Figure 81-right)

Figure 81: Cushions of different colours added for personal touch

Strong multi-coloured contrasts were avoided in large

areas/amounts in spaces. Only neutral colours were added by most of

the participants in a larger space. As discussed previously, red and

yellow colours were added in the smaller bathroom space of AS04's

residence, "I wanted bright colours in smaller bathroom only ...

contrasts in small spaces is interesting, and can create space ... this small bathroom looks big now." (Figure 79) Similarly Persian participant P01 added dark grey colour to her wall (Figure 72).

Conclusion: Black, white, dark grey, beige/wooden colours are the most popular colours to add a modern look in the living spaces of all 15 participants. Amongst immigrant participants (South Asian, Persian and Chinese), exhibited an inclination towards having these neutral colours added to give a contemporary look and traditional colours to add a cultural mood. This showed implicit plural identity of the participants.

The personal preference towards a colour is generally expressed in small amounts only i.e., by adding a small accessory or furnishing product to highlight the space (instead of adding huge amounts of the preferred colour). The space in the participant's interiors played an important role in the choice of the colour to be added, i.e. strong colourful contrasts were seen only in small spaces like bathrooms, and

the large spaces like living rooms were mostly balanced with addition of neutral colours.

5.1.5. Aesthetics

Most of the participants possessed traditional artefacts from their cultures and expressed their cultural inclination by exhibiting them in their living areas. Artefacts like traditional furniture, candle stands, paintings, carpets, tapestry, religious sculptures and even traditional and multi-cultural kitchenware were documented during the visit. Persian participant P02 shared her admiration of the traditional black and white Persian floral chair, and pictures of traditional architecture in her living area and hallway (Figure 82 and 83).

Figure 82: Traditional Persian artefacts in P02's apartment

Figure 83: Persian architecture and traditional rug (P02)

Another Persian participant P01 explained her favourite artefact, wooden with inlayed camel bone work called 'Khatamkaari'. She stated, "I love this intricate work, made by traditional hands. It shows that even small things can give happiness, it shows someone's effort and love and dedication". A pair woollen socks with geometric motifs was described as beautiful by P01.

Figure 84: P01's 'Khatamkaari' artefacts (left), traditional socks (right)

Apart from the artefacts, all three Persian participants shared the arts and handicraft of Iran, that respresented their culture and made them nostalgic. Aesthetic elements like the use of 'Paisly' and floral intricate patterns of rugs and geometric Islamic ornamentation were mentioned by P02 in her questionnaire. P01 mentioned some beautiful crafts like 'KhatamKari', Mirror Mosiac work at Shah Cheragh Mosuque in Shiraz, Iran, floral and geometric ornamentation in Ishfahan mosques, lattice windows, beautiful brickworks called, 'Ajarkari', coloured window glass mosiacs at Nasir-ul-Mulk Mosque, Shiraz, Iran (Figure 85). Beautiful geometric tile work at Imam Mosque, Kerman (left), geometric tessellation in Friday Mosque, Isfahan (middle) and ceiling at Timche-Ye Amin Od-Dowleh, Kashan, (right) in Iran (Figure 86) were specified by participants. The textured light created by lattice designs and colourful windows was also identified by both P01 and P02 as a strong element of Persian ornamention in a space. P02 stated, "The light that falls from the windows creates beautiful texture, especially in mosques.....they create beautiful floral

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and geometric shadows in the day....certainly adds intersting factor in a room. Almost divine."

Figure 85: Mirror-work, window mosaic work, Shiraz, Iran

Figure 86: Geometric Patterns in Persian Mosques

Participant P03 also expressed his multicultural inclinations towards Chinese philosophy of YinYang, and Egyptian and Japanese artefacts.

Similarly South Asian participants possessed beautiful religious and cultural artefacts. Traditional earthen oil lamps, idols of Hindu Gods, decorative hangings, traditional utensils and Chinese artefacts were documented with SA05 (Figure 87) & SA01 (Figure 88).
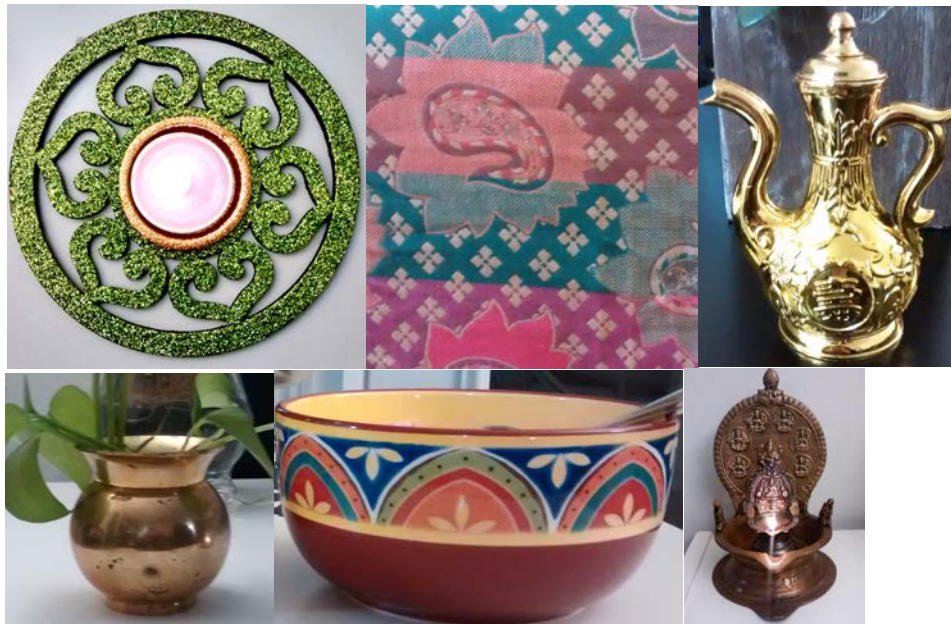
Figure 87: Artefacts in SA05's residence

Figure 88: Artefacts in SA01's living room.

The motifs of henna, colourful geometric patterns of 'Rangoli' and Mughal architecture with latticework were mentioned by the participants as the most common aesthetic elements,. "I love henna designs...they are beautiful and feels like a festival", said SA06. SA04 stated, "Rangoli is very important in our culture. It brings prosperity and festivity." (Figure 89) Multicultural lighting like Turkish lamp with coloured glasswork was also seen in SA06's apartment (Figure 53).

Figure 89: Henna pattern, geometric Rangoli design and lattice window

Chinese participants possessed wooden, ceramic artefacts with organic shapes and geometric design elements. Participant C02 stated, "We love philosophy like Taoism, Yin Yang and nature. Natural material like wood, jute, bamboo even traditional lamps have rice paper as diffusers, so round and geometrical shapes automatically comes in." (Figure 90)

Figure 90: Artefacts at P02's residence

Similar to Chinese participants, Anglo-Saxon participants also expressed their love for nature and wood with clean and geometric forms. Participant AS01 stated, " I love mid-century modern designs with strong clear cut shapes. It has a geometrical oneness in itself that contains the whole beauty in itself." She continued, (pointing towards a lamp), "I love this diffused mushroom shaped lamp. It is natural yet very contemporary, and my favourite one is the small wooden rack...my friend made it for me, look at its clean structure but rough wooden beauty." (Figure 91) Another participant AS03 stated, "My condo is very neutral with geometric shaped lighting fixtures and clean cuts in the architecture. (Figure 92)

Figure 91: Contemporary forms in AS01's residence

Figure 92: Contemporary aesthetic elements in AS03's condo

Conclusion: Although, majority of participants displayed their traditional artefacts in their spaces, they also possessed strong inclination to the decorative elements like patterns, motifs, shapes, art and architecture. Whereas Persian and South Asian participants identified intricate floral and geometric patterns in architecture and traditions (because Islam is a common factor), Chinese and Anglo-Saxon participants identified clean geometric and round forms as their cultural representative. The participant's inclination towards other cultural artefacts and philosophies showed their openness and admiration of other cultures as well. These identified, and documented

aesthetic preferences are used to draw form and aesthetic inspiration in the finalized design concepts in Section 7.

5.2. Some Interesting Insights

1. Most participants preferred contemporary style of lighting, with majority expressing their admiration for other cultures' lighting as well. It was observed that Persian and South Asian participants were the most inclined towards contemporary style of lighting, whereas Anglo-Saxon and Chinese participants were inclined towards a mixture of contemporary and traditional style.
2. Ambient lighting was preferred by the majority of participants from all cultures.
3. Amongst the Persian participants, accent and track lights were popular.
4. All participants prefer balanced organic + geometric forms.
5. Maximum participants prefer combination of contemporary style with a touch of traditional mood.
6. Cultural colours preferences are very different from interior colour preferences.
7. All participants scored scale 3 and above on mood.
8. Amongst immigrants, preferences in same cultures vary according to the age of participant and the year they moved to

Toronto. Example South Asian above 35 years prefer natural light and below 35 like artificial light (they hate sunlight).

9. Participants did not make any effort to change the lighting, no matter how much they dislike the current ones.

10. Anglo-Saxon participants did not show inclination to a certain culture. They felt inclined to their own family's culture or where they grew up. That in fact is nostalgia!

11. Most participants showed signs of implicit nostalgia in their behaviour and spaces.

12. South Asian participants were the only ones to use task lighting to save energy and cost (money). Chinese prefer to buy lighting that is cheap in cost.

13. A textured lighting is considered more interesting as a lifestyle product than a simple lighting.

14. Most immigrants expressed their cultural inclination with the collection of traditional artefacts from their native and other cultures.

15. Religion dominates most of South Asian and Persian participants aesthetic sensibilities.

16. Muslim participants from South Asia relate to mosques and Islamic art and architecture of Persian culture.

17. Persians participants prefer fire and t-lights because of Zoroastrian roots.

18. Stained glass is popular in South Asian, Persian and Anglo-Saxon cultures.

5.3. Expectation vs. Reality
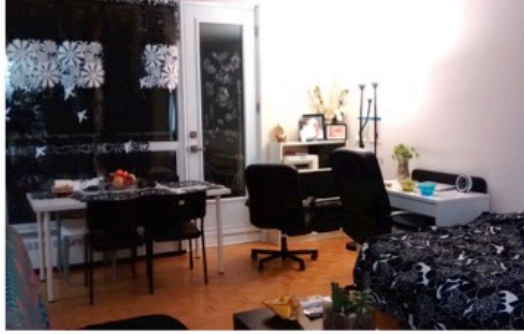
Given below are some differences observed between expected situations and actual reality in participants' living spaces, lighting and artefacts.

Figure 93: Living spaces: South Asian culture

Figure 94: Lighting: South Asian culture
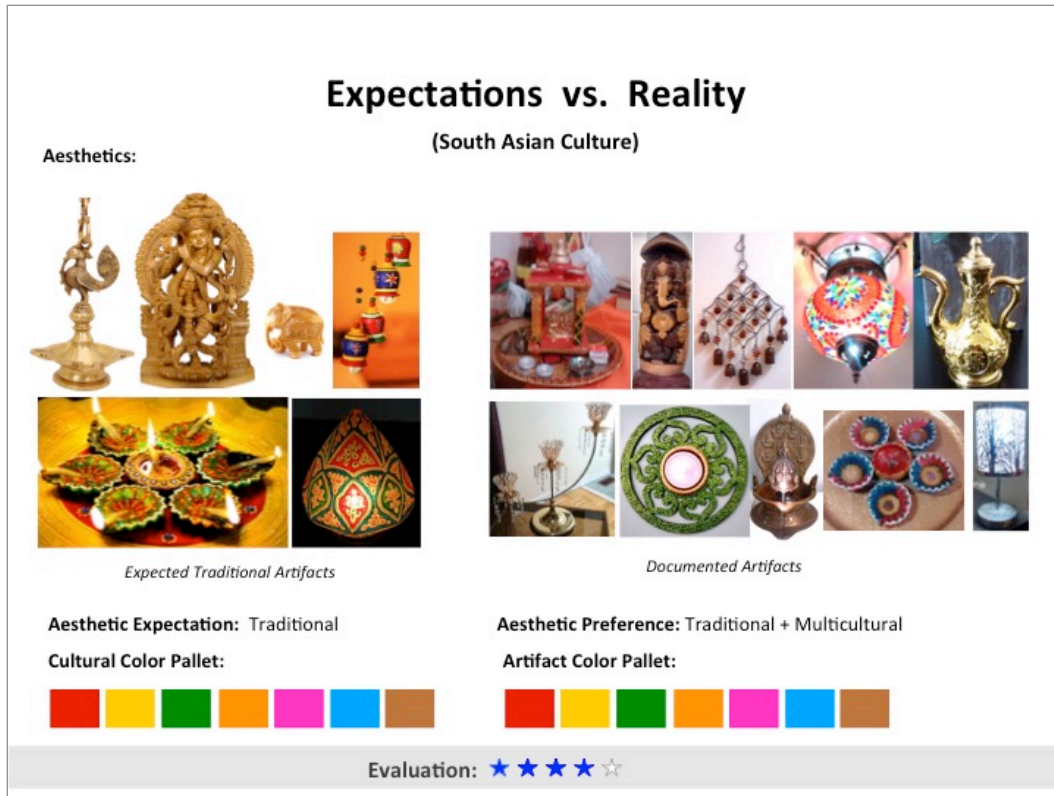
Figure 95: Aesthetics: South Asian culture
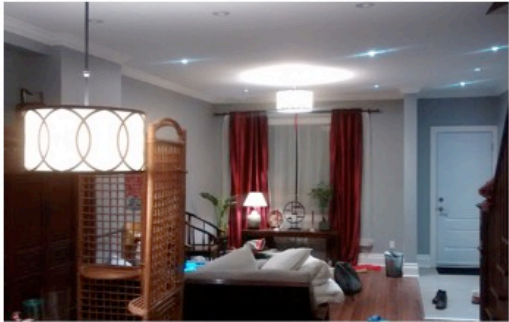
Figure 96: Living Spaces: Chinese culture
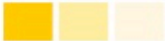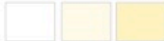
Figure 97: Lighting: Chinese culture

Figure 98: Aesthetics: Chinese culture
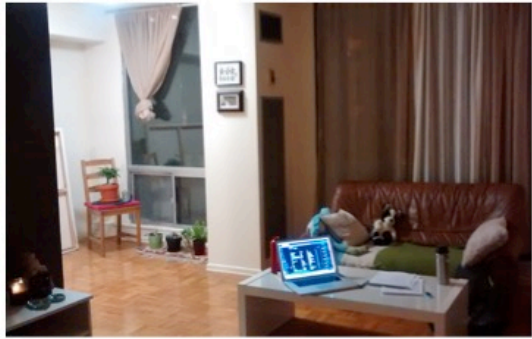
Figure 99: Living Spaces: Persian culture
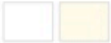
Figure 100: Lighting: Persian culture
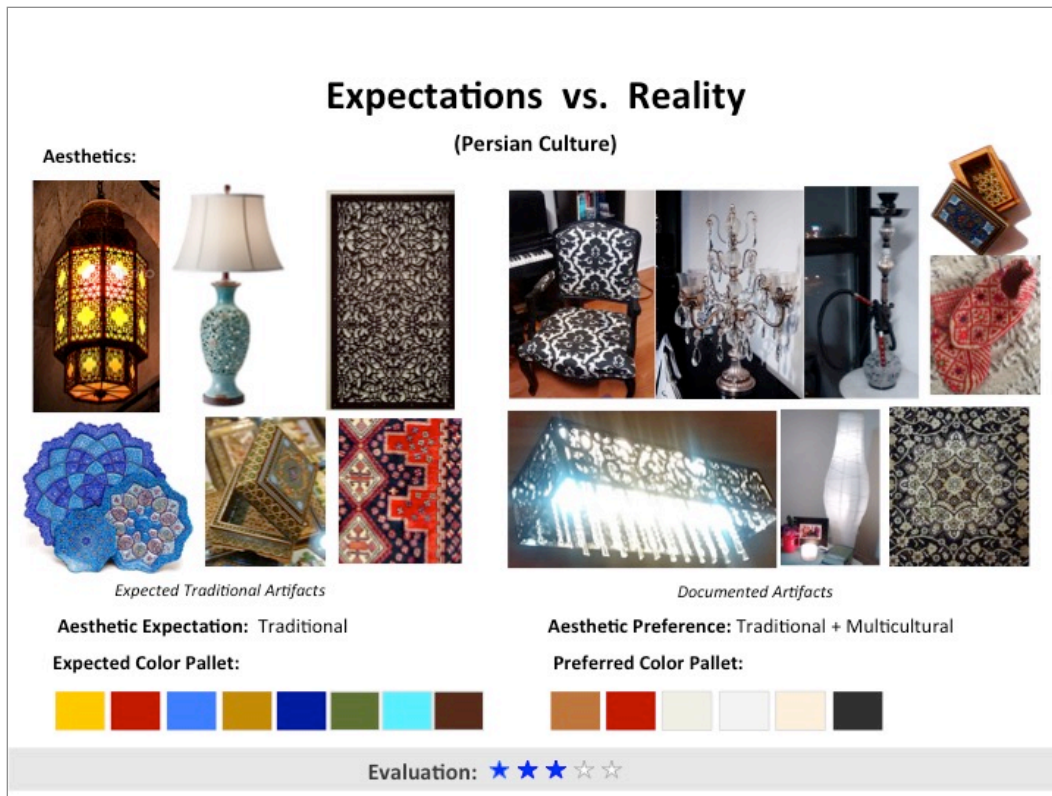
Figure 101: Aesthetics: Persian culture

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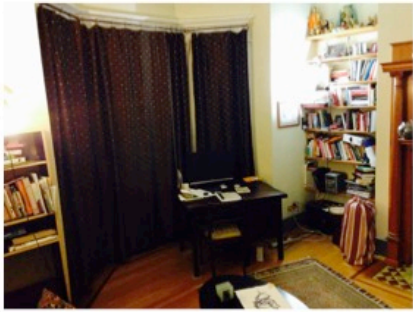
Figure 102: Living Spaces: Anglo-Saxon culture
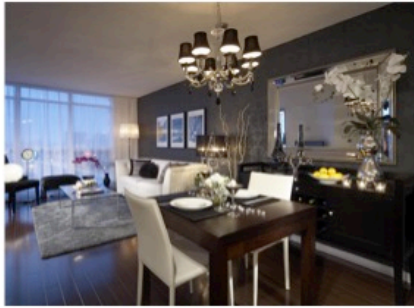
Figure 103: Living Spaces - Condos: Anglo-Saxon culture
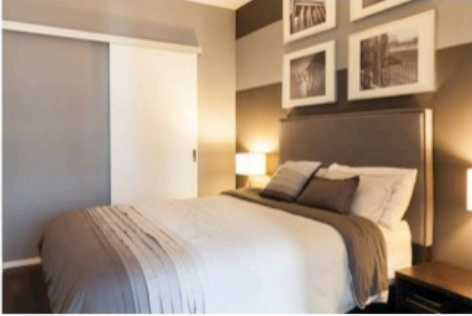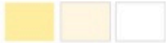
Figure 104 Lighting: Anglo-Saxon culture
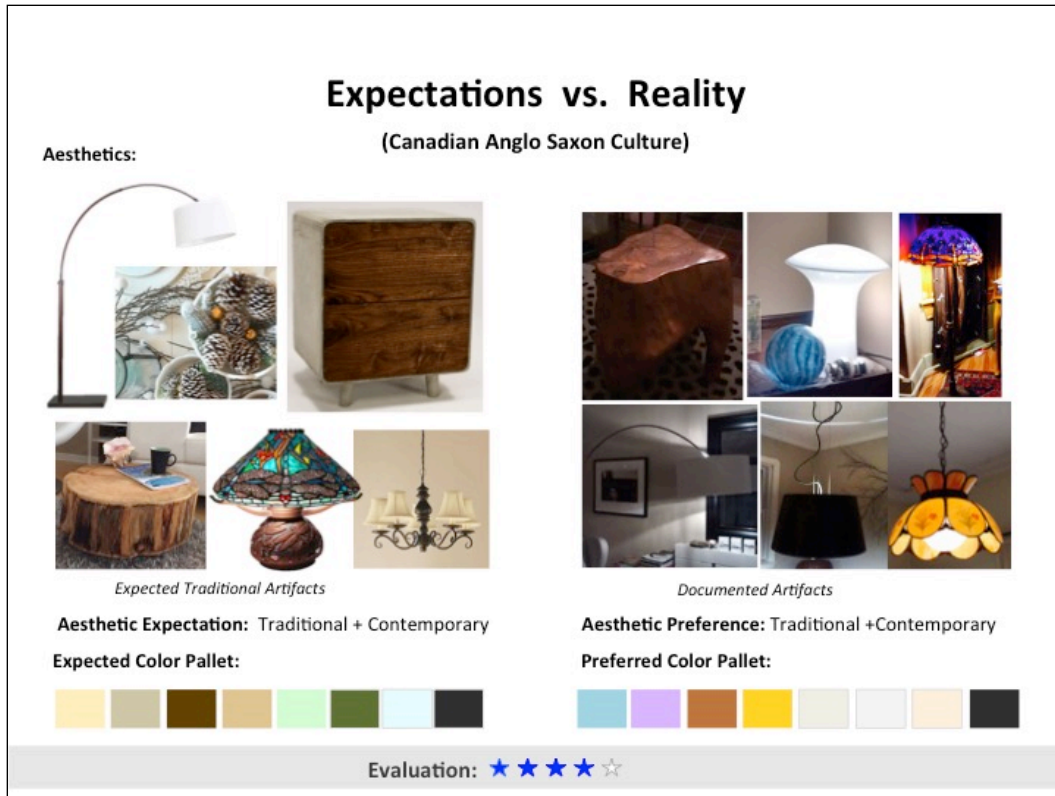
Figure 105: Aesthetics: Anglo-Saxon culture

5.4. Summary
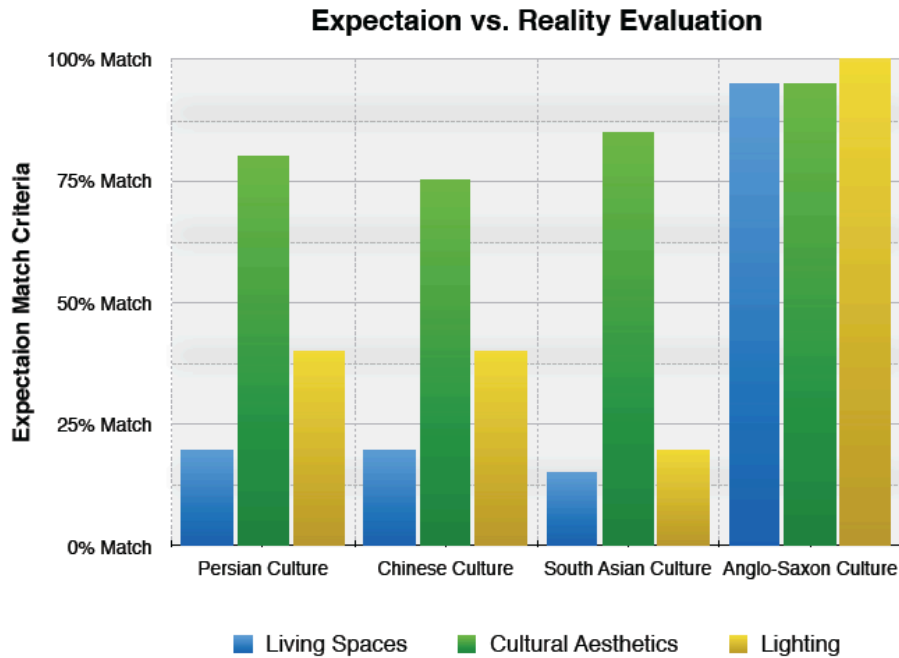
Figure 106: Expectation vs. reality in immigrant spaces

1. Reality of living spaces and lighting preferences greatly differ from the expectations (assumptions) from Persian, Chinese and South Asian Culture.

2. Nostalgia in immigrant cultures (implicit/explicit) is expressed through superficial artefacts only, as the living spaces and lighting contradict the culture's spatial and lighting sensibilities. (Figure 106)

3. Contemporary Canadian spaces do not fully address the lighting sensibilities and requirements of Persian, Chinese and South Asian Immigrants.

4. Superficial expression of cultural aesthetics has been elaborated by immigrations themselves by possessing traditional artefacts only. (Figure 107)
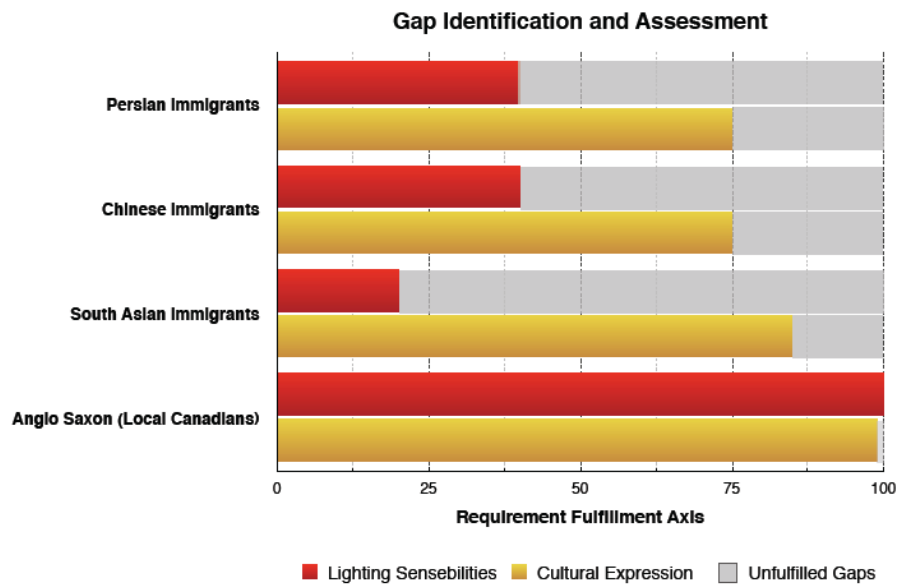
Figure 107: Gap identification and assessment

6. An Inclusive Lighting System

6.1. Design Considerations from Research

6.1.1. Multicultural Preferences

The appreciation of multicultural art, aesthetics and philosophies amongst participants, described in section 5.1.5 is a major inspiration for the design concepts. The documentation of cross-cultural appreciation, such as Chinese artefacts in SA05's artefact collection (Figure 87) and Turkish coloured mosaic lamp in SA06's living room (Figure 53) highlight the requirement of aesthetic inclusion of all the cultures into one lighting design.

6.1.2. Lighting colour option

The lighting colour preferences described in Figure 47, range from warm yellow to bluish white, i.e., colour temperature 2700K-5700K (Figure 8). As the lighting preference varies amongst participants from the four cultures documented in section 5.1.1, there is a need of

customizable lighting system that lets the user change the colour temperature according to their personal preference, mood or activity.

Additionally, some of the South Asian, Persian and Anglo-Saxon participants also showed their admiration for colourful ambience.

6.1.3.   Flexible Light Intensity

The preference of light intensity varies amongst the participants as documented in the 'Intensity' segment of section 5.1.1. The intensity controllers installed in AS01's living area (Figure 52) and statement by Chinese participant C02, "I would like to have a control switch option ... with remote control or may be connected to my iPhone application, so that I can control the lighting in my bedroom according to my mood without making any effort", prompt the need of intensity control option in the design, to enable users from any culture can customize the lighting intensity anywhere between bright to low.

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6.1.4. Lighting Quality

Difference preferences from diffused to textured light are observed in the interiors of participants' residences, as documented in section 5.1.1. Whereas diffused and direct lighting were used in most of the participants' interiors, it also differed according to the spaces (Figure 55, 56, 57, 58). Textured lighting was observed in South Asian participants' living spaces (Figure 53). Moreover, the textured lighting is an important aesthetic representation of Persian culture, as stated by P01 and P02 in section 5.1.5. These findings enhance the requirement of flexibility in lighting diffusion and textures, so that the user can choose either soft or diffused light, or direct light, creating textures or both simultaneously.

6.1.5. Shapes and Forms

The aesthetic inclination of participants from four cultures can be segregated into floral, geometric and organic forms. Participants from South Asian and Persian cultures identified a combination of

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floral and geometric forms in their artefacts as well as cultural ornamentation in section 5.1.5 (Figure 82, 83, 84, 85, 86, 87 and 88).

On the other hand Chinese and Anglo-Saxon participants identified clean geometric and organic forms in their artefacts and spaces in section 5.1.5 (Figure 90 and 91). Due to above identified range of style preferences, a combination of geometric, organic and floral forms was noted as an essential factor to be considered and interpreted in the structure as well as in the lighting quality of the design concept, like textures and patterns, that are generated in the space. However, contemporary and multicultural style of lighting is preferred by most participants, which widens the horizon of design exploration and brings an opportunity to inculcate both traditional and modern styles into one inclusive design concept.

6.1.6. Materials

Wood and metal are the most preferred materials amongst all the participants (Figure 78, 90, 91). Acrylic and etched glass were also

observed as diffusers used by South Asian and Anglo-Saxon participants' lighting fixtures in section 5.1.1 (Figure 58 and 60). The material preferences expressed by participants in section 5.1.5, as well as documented during the interview session, point to the choice of wood, metal, acrylic and glass as the main materials in the design concept.

6.1.7. Colour

As described in Figure 76 in section 5.1.3, black, white, metallic, neutral and earthy colours are the most preferred colours of all participants. These are the colours preferred for the outer structure of design fixtures.

Conclusion: The findings, data synthesis and observations highlighted from section 5.1 to 5.3, resulted in the above-mentioned design considerations that direct the design inspirations, forms, lighting style and technology in the three design concepts that were finalized. These design considerations could be considered as guidelines to make

customizable and inclusive 4-in-1 lighting fixtures that provides the user personalization in aesthetics as well as beautiful positive feeling with flexible lighting experience.

6.2. Inspiration and Mood Board

The above research and design considerations help in channelling down the major aesthetic and cultural elements identified by 15 participants from the four cultures. These elements create a set of visual inspirations that is represented in the form of the Inspiration Board shown in Figure 108.

Figure 108: Inspiration Board

The lighting experience preferred and/or aspired by all the participants can be considered as the 'mood' of the overall lighting in a space. These preferences, as documented in 5.1.1 to 5.1.5, create an aspiration to be achieved in the design concepts and can be visually represented in form of a Mood Board as shown in Figure 109.

Figure 109: Mood board

7. Sketches and Design Concepts

Three design concepts – 'The Balance', 'Mosaic' and 'Interactions' – were finalized after understanding the plurality of identity and personal preferences of the users. All the concepts are multicultural in nature, although the first look and structure is chosen to be contemporary in style to complement the modern interiors.

7.1. Design Concept1 – 'The Balance'

Abstract: 'The Balance' is designed on the Chinese philosophy of Yin Yang that acknowledges the balance of plural identity of 15 participants (their original ethnic identity and acquired Canadian identity). This lighting design is philosophical in nature with a contemporary aesthetic appeal to complement the Anglo-Saxon interiors of Toronto.

- **Inspiration:** Chinese Yin Yang/Contemporary Light forms (Figure 110).

The Balance

Figure 110: 'The Balance' - Inspiration Board

- **Fixture Style**: Installation

- **Lighting Quality**: Diffused/ Direct and Textured

- **Direction**: Multi-Directional/Customizable

- **Materials:** Wood, Metal, Acrylic

- **Fixture colour:** Neutral (White, Metallic and Wooden)

Design Concept: This lighting is designed to achieve a contemporary look (as preferred by most participants) that fits right into any Anglo-Saxon interior such as a condominium or an apartment. The lighting comprises two separate parts equally balanced in shape and volume like Chinese Yin Yang (Figure 110). The circular form is enhanced by addition of metal and wood arches (as both materials are desired by most of the participants).

In Chinese culture, metal is Yin, representing female, rigidity, persistence, strength, determination, and minimalism. To balance Yin, Yang has been added as wood, representing masculinity, growth, aggression, and sensuality (Schiesser, 2016).

Design Process (Rough Sketches)

Figure 111: 'The Balance' - rough sketches

Mechanism: The semi-circular parts of the fixture get separated by an extendable rim concealed from the front view that open up to 5 mm, emitting direct light from the crack.

The opening and closing mechanism is controlled by a mobile application that helps the user change the overall structure of the

fixture, i.e., it can be used as one single form or can be displayed as two separated balanced segments. The metal and wood arcs flow with the Persian (upper-metal side) and South Asian (lower-wooden side) with geometric and floral patterns from the architectures of respective cultures (Figure 113).

Lighting: The fixture emits diffused lighting from its maximum surface area (front and back). The circular rim, however, emits direct light creating strong Persian and South Asian vertical textures in a room. This allows the user to add some amount of controlled texture in the space along with the diffused light.

The Balance

Suspenders

Textured light-off mode

Front view with
diffused light

Textured light-off mode

Neutral Front view with partition
(Off mode)

Neutral Front view with partition light
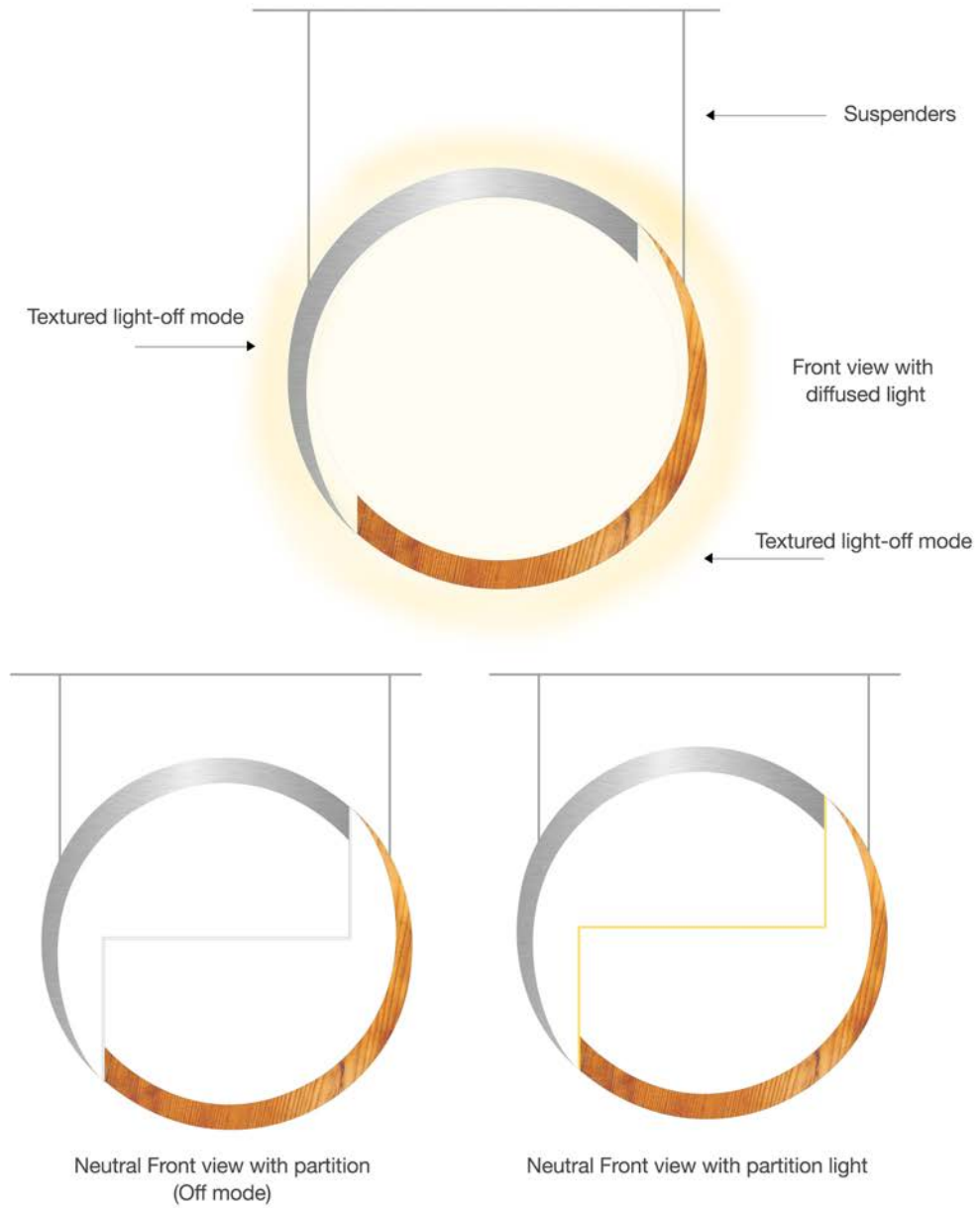
Figure 112: 'The Balance' - finalized sketch

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The Balance- 2

Persian Pattern

South Asian Pattern

3D View

t/ Textured light
ed by Persian Pattern

Direct/ Textured light
created by South Asian
Pattern
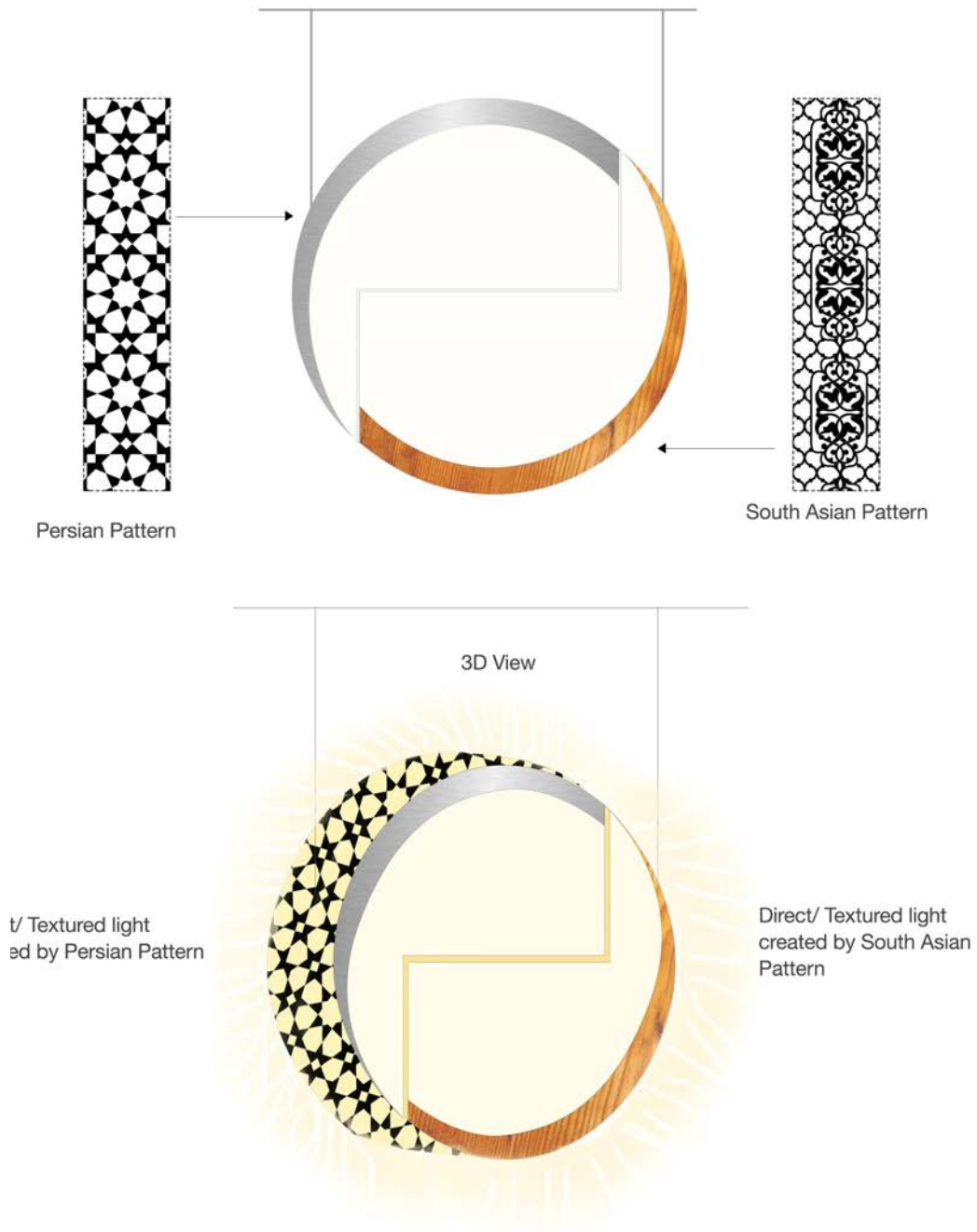
Figure 113: 'The Balance' - detailed drawing

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The Balance-3

Direct/ Textured light created by Persian pattern

Diffused Light

Direct Light Beam

Diffused Light

Direct/ Textured light created by South Asian pattern

Light Distribution

Side View Frame

Top View Frame

3d Frame Structure
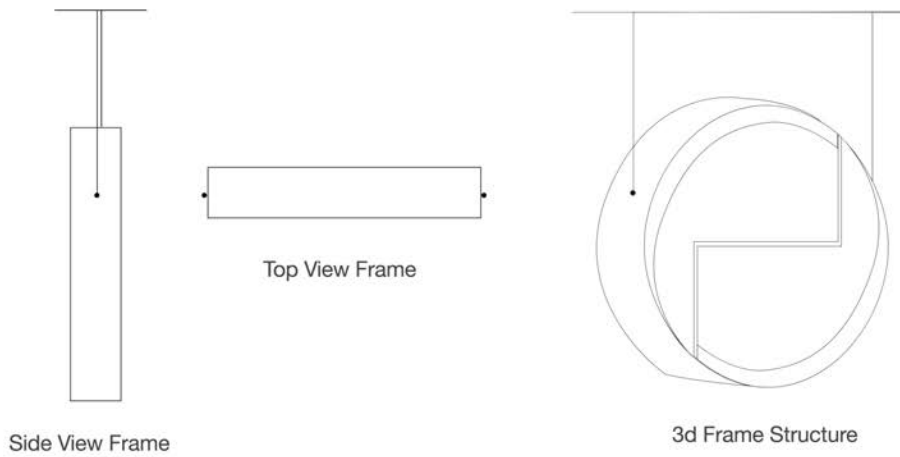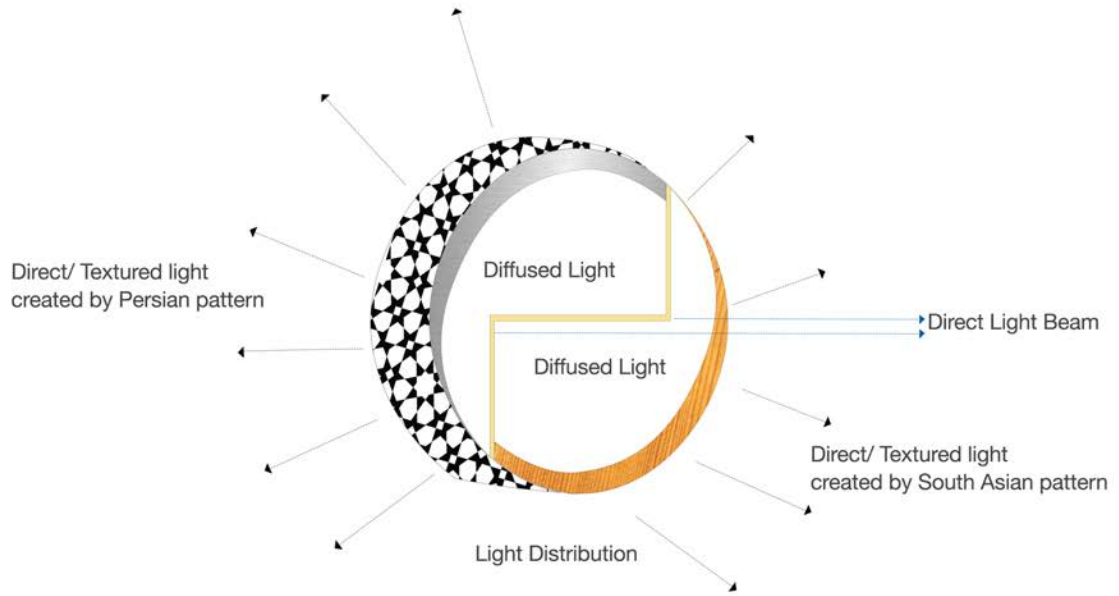
Figure 114: 'The Balance' - technical structure

Technology: Three sets of light sources are used in this design. Two of them provide direct lighting for the Persian and South Asian patterns on the circle's rim. 'Phillips Hue', which is controllable in intensity, power and colour by the user, is installed in these direct lighting segments to give intensity and colour personalization (Philips Lighting B.V., 2016).

The LED lighting strip added to the edge of both the connecting parts (the central cracked partition) emits strong light from the central gap. A third set of lights in the form of low intensity LEDs aligned back to back on a sheet lightens up the front and back of the circular surface area installed in both the parts providing a uniform diffused lighting.

Conclusion: The balance brings philosophical, aesthetic and technical inclusion of the visual and experiential elements from all the cultures and creates a 'balanced' lighting experience.

7.2. Design Concept 2 – 'Mosaic'

Abstract: The term 'Canada is a cultural mosaic' (Palmer, 1976) has been literally transformed and made into this lighting concept, where the diversity of four different cultural elements and lighting preferences blends together as one. The fact that all the multicultural participants are now residents in Toronto and are a part of Anglo-Saxon culture shapes the overall structure of this design concept: 'Mosaic'.

Inspiration: "Canada is a Cultural Mosaic"

The concept in itself is a mosaic of different inspirations from the lighting direction observed in participant's living spaces as well as geometrical mosaic elements from all the cultures. These elements come together to inspire this design concept and can be visualized as in the Inspiration Board in Figure 115.

Mosaic

Figure 115: 'Mosaic' - Inspiration Board

- **Fixture Style:** Chandelier

- **Lighting Quality:** Diffused and Direct and Textured

- **Direction:** Semi Direct/ Customizable

- **Material:** Metal and Acrylic

- **Fixture colour:** Black + Off White

Concept: This lighting includes a mosaic of patterns and aesthetic elements of three cultures – Persian, South Asian and Chinese – under

one main body of Anglo-Saxon frame. It is a combination of contemporary lighting design style (geometric and clean cuts) with traditional geometric mosaic tessellation as inspiration used in windows in Persian culture (Figure 85) and a South Asian cultural ritual of creating geometric colourful pattern mosaic on the floor called 'Rangoli' on religious and festive occasions (Figure 89). These two elements combine with Chinese geometric mosaic forms used in architecture especially in window frames (Figure 115).

All of the three cultural sections come under one roof (main body) of Anglo-Saxon contemporary style structure with geometric forms and geometric shapes, inspired by different lighting directions observed in all the participants' houses in section 5.1.1.

The four sides of the Anglo-Saxon body displays\ different light directions as interpreted in geometric abstract form (Figure 116).

Design Process (Rough Sketches)
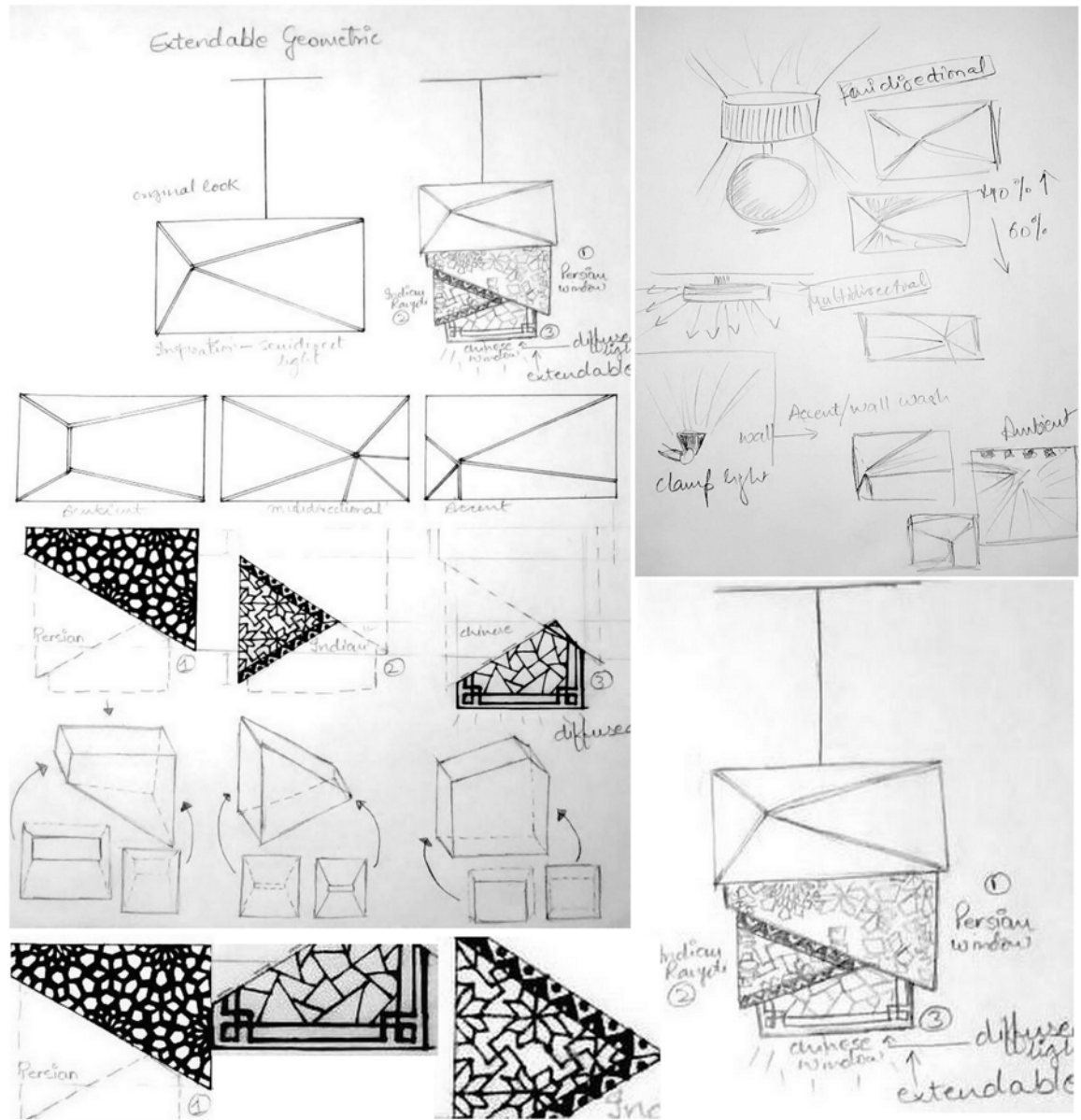
Figure 116: 'Mosaic' - Design Process and rough sketches

Mechanism: The Mosaic is designed with an extendable mechanism, which lets the individual structure of Persian, South Asian and Chinese frames move in upward and downward directions. This extendable mechanism provides the flexibility of using only the Anglo-Saxon look (main body) keeping the lower three frames of Persian, South Asian and Chinese elements hidden in its frame. The users can also use Anglo-Saxon and any one or two or all three cultural frames at the same time. (Figure 117 and 118)
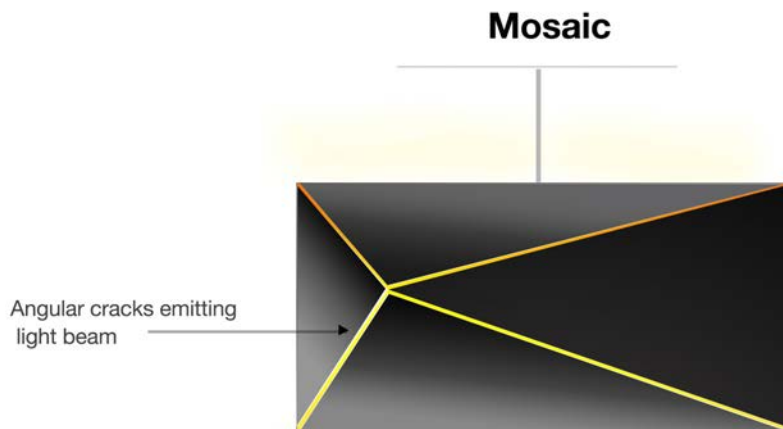
Figure 117: 'Mosaic' – compact form

Mosaic

Angular cracks emitting
light beam

Extendable and
Retractable section

Direct/ Textured light
created by South Asian Mosaic

Direct/ Textured light
created by Persian Mosaic

Diffused light created by Chinese
Ice Crack Mosaic.

Front View

Four side geometric patterns
Inspiration: Lighting Direction
(Main body)

1 Semi-Direct

2 Ambient

3 Multi-directional

4 Wall Wash/Accent

Figure 118: 'Mosaic' – fair sketches - 1

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Mosaic 3D Structure

Anglo-Saxon Frame

1

2

3

4

3D Frame of main body

Top View of Chandelier

1

4

2

3

Light Source

Persian Frame

South Asian Frame

Chinese Frame

3d frame

Side View
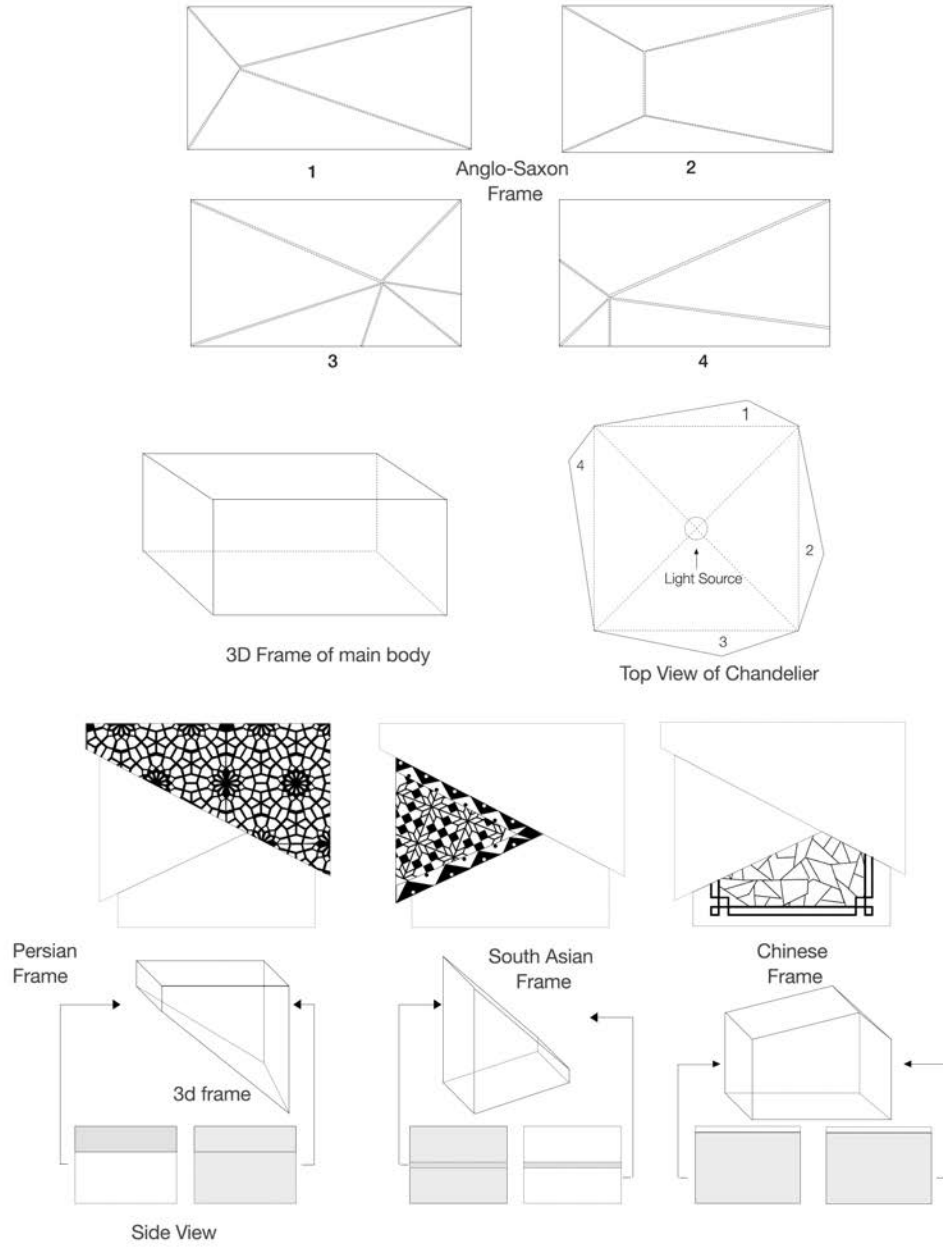
Figure 119: 'Mosaic' – fair sketches - 2

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The intersecting points of the geometric cracks protrude outside and meet at an angle in surface area of four sides in the main body, as shown in the top view of Figure 119. The three frames of Persian, South Asian and Chinese structures vary in their respective size and can fit into each other as well as the main Anglo-Saxon body. This is possible due to Anglo-Saxon being largest size as the main body, followed by Persian, South Asian and Chinese frame in descending order (Figure 118).

Lighting

As an inclusive design, 'Mosaic' consists of direct, textured and diffused lighting option where direct-textured light is emitted from the South Asian and Persian sections through their hollow patterned frames as well as through the geometric cracks from Anglo-Saxon main body. The Chinese frame, however, is covered by acrylic diffuser and provides diffused soft light.

As mentioned previously in section 5.1.1, Anglo-Saxon participants prefer diffused light; the bottom section of Chinese frame

(that covers the light source from below) automatically produces diffused lighting to complement the contemporary look of the Anglo-Saxon frame.

Technology: The use of Phillips Hue provides flexibility and control of colour, temperature and intensity through a mobile application usable on any smart phone. This gives all users the freedom to customize the lighting according to their requirement.

As the over all structure is made of metal, with laser cut hollow patterns on South Asian and Persian frames, the extending and retracting mechanism is controlled by a mobile application that lets users choose the required frames individually or the length of vertical (visible) size of the frames as desired.

Conclusion: 'Mosaic' fulfills the personal and cultural preferences of all participants and directly acknowledges the plurality of identity of users as a part of Toronto's Anglo-Saxon culture whilst providing flexibility to respect and interact with the elements of others' and one's own cultures. Mosaic is the portrait of the user's own self.

7.3. Design Concept 3 – 'Interactions'

Abstract: Thinking about light fixtures as metallic products makes us retract our hand to avoid risky direct interaction with electrical sources. Generally, we buy beautiful light fixtures, install them, use them everyday but never think about them, unless the light source stops working! This design concept breaks that barrier and opens up the horizon of the user interacting with the nature of light and shadow.

Inspiration: South Asian brickworks, Persian tileworks (Ajarkari), Anglo-Saxon geometric forms (pixels) and traditional Chinese tessellations and abacus.

The traditional brickworks and tile works in South Asian and Persian cultures, integrated in the architecture, create beautiful patterns of different shapes and light intensity while interacting with natural light. Light entering through this architectural interface gets emitted in a pixelated form, creating beautiful light and shadow designs on the

floors and walls. These elements are the design inspiration for 'Interactions' (Figure 120).

Interactions
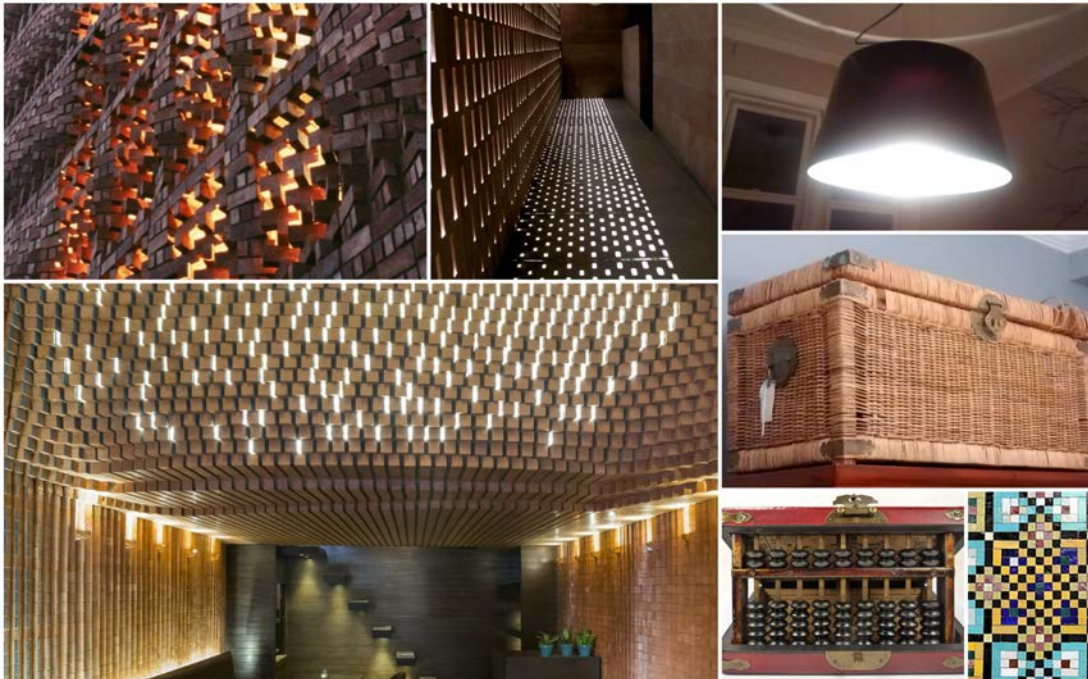
Figure 120: Inspiration Board for 'Interactions'

- **Fixture Style:** Low Hanging Chandelier/Pendent Lamp
- **Lighting Quality:** Diffused and Direct and Textured
- **Direction:** Multidirectional/Customizable
- **Material:** Wood, Acrylic/PVC
- **Fixture colour:** Natural Wood

Concept: The concept of this lighting design emerged through the observation that most participants did not make any efforts to change the lighting in their spaces even if they disliked the colour, intensity and style, as mentioned in section 5.2, observation 9. During the visits, multiple participants shared their dislike about at least one lighting fixture in their house and admitted that they use it daily but dislike the style, colour and/or quality. Anglo-Saxon participant AS02 stated, "I absolutely hate the lighting in my house, it's boring and uncomfortable, but as the house is old, it's a lot of effort to change and rewire." Chinese participant C02 stated, "I really don't like this huge pendent lamp, it is simple and just hangs in there… (laughs)" pointing towards the huge low hanging lamp. Another South Asian participant SA04, pointing towards a standard high chandelier, with direct light source stated, "We moved into this new place some months ago, and I desperately want to change this depressing yellow light and install something nice with patterns emitting bright white light!"

These expressions by multiple participants from different cultures became the driving force to bring in the design element where users can actually interact with the light source and understand the innate quality of light. The name 'Interactions' came from the nature of surface design of this low hanging chandelier/pendent lamp, that creates beautiful patterns and lets the user control the light intensity by using the technology as well as allows them to explore new patterns and forms of light intensity by manual interaction.

The structure of the design is in cuboid form with square base and rectangular sides. Different geometric patterns inspired by above-mentioned elements from four cultures, come as 3D cube, cuboid and 'I' shape as individual forms (depending on the selected inspirational pattern of each culture). These elements are chosen a single piece of element at a time and are created with wood. These individual elements are drilled through the middle (like hole in a bead) and are strung together using transparent thin wires (similar to Chinese abacus layout), creating a pattern (visual structural arrangement) that lets light

pass through its openings (Figure 121 and 122). The vertical string connecting series of these elements allows them to rotate on a vertical axis. This rotational flexibility allows the user to explore new shapes of textures created by the projection of direct light from inside into the outer space through the openings according to the intensity of light and texture created by the blocking patterns at various positions at a time (Figure 122).

Design Process (Rough Sketches)
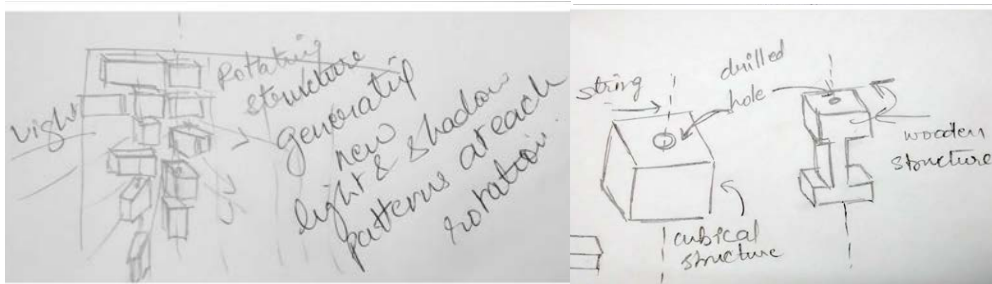
Figure 121: 'Interactions' - rough sketches – 1
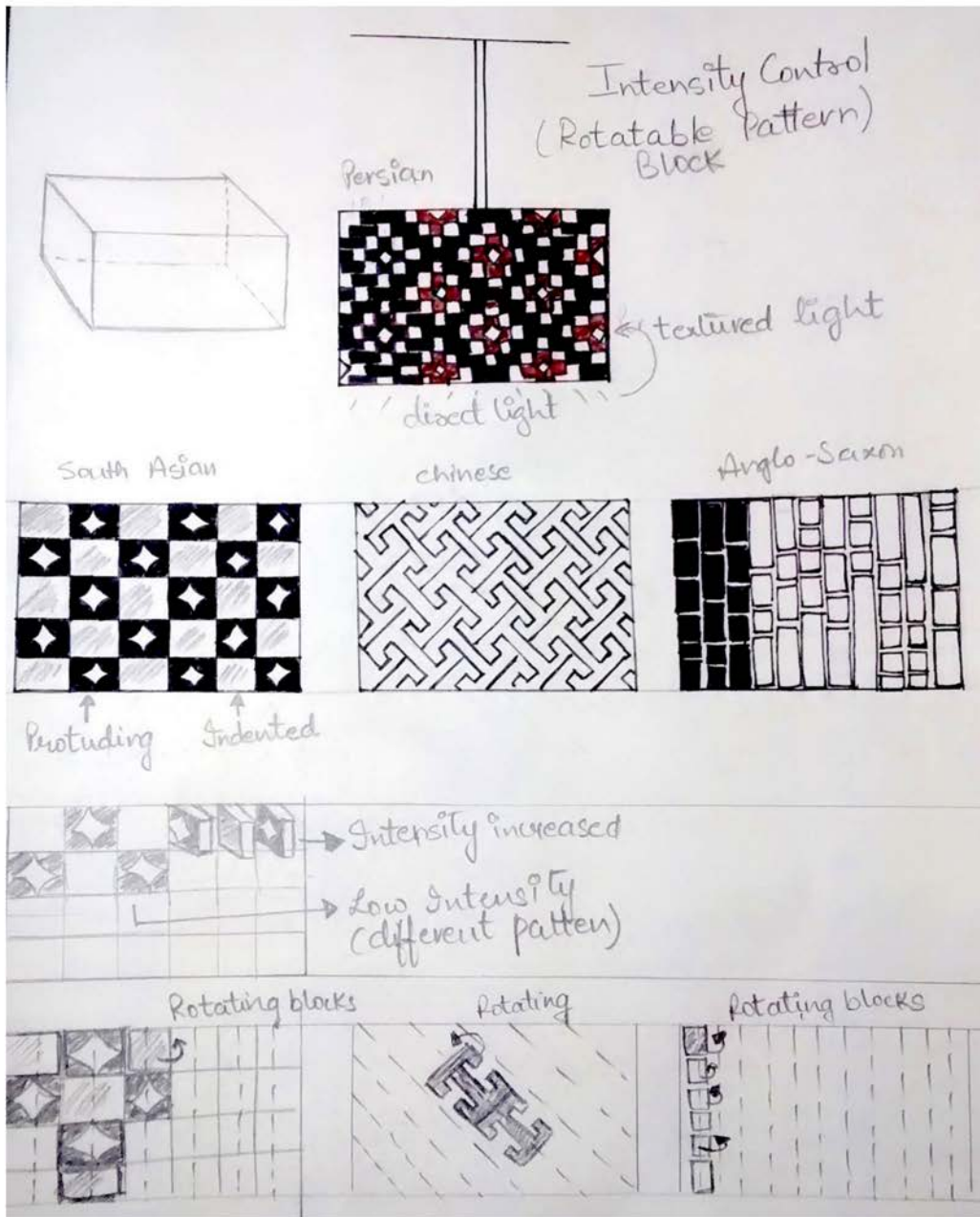
Figure 122: 'Interactions' - rough sketches - 2

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As can be seen from Figure 122, the transparent strings on the surface of the frames are aligned in a vertical direction for Persian, South Asian and Anglo-Saxon sides, but are diagonal for the Chinese side, to create a different aesthetic experience.

Interactions

Direct/ Textured light
created by Persian Frame

Diffused lighting from the base

Persian Frame

3D Form of structure

2

South Asian Frame

South Asian Element
(structure + rotation)

3

Chinese Frame

Chinese Element
(structure + rotation)

4

Anglo-Saxon Frame

Anglo-SaxonElement
(structure + rotation)
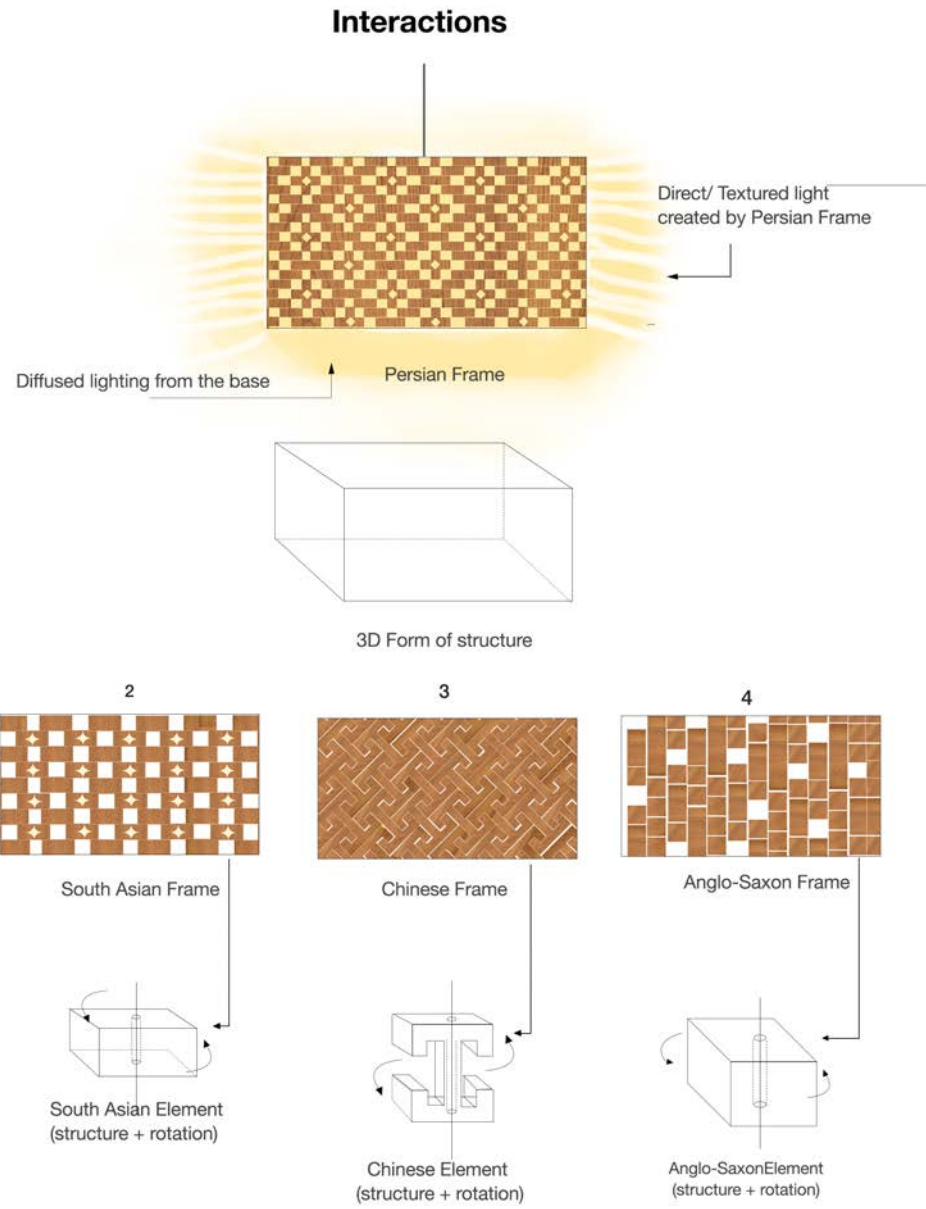
Figure 123: 'Interactions' - Final sketches

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Mechanism: The 'Interactions' acknowledge the participants' inclinations towards wood, and simple natural forms. The look and the mechanism of this design acknowledge the idea of 'back to simplicity and nature' and encourage human interaction with elemental lighting qualities. As the overall structure is made of wood, the light and shadow patterns created on the walls by various rotational positions of the wooden elements at a given time are controlled and transformed by the manual touch of the user on each block. This simple design lets the user rotate each element with a push of finger, which can change the light intensity, direction and the whole ambience, in the space.

Lighting: A mixed form of lighting, i.e. direct, textured and diffused, is created in this design. The side walls project direct and textured light, directly passing from the light source inside through the openings in the decorative patterns. Diffused light gets emitted from the square base that is covered by white acrylic or PVC sheet.

Technology: Although, a manually interactive design concept, 'Interactions' provides its user the flexibility in lighting colours,

intensity and temperature through a mobile application with Phillips Hue as the main light source.

Conclusion: The concept of 'Interactions' acknowledges the positive psychology of the participants, where most of the participants from different cultures expressed their preference for natural material, forms and natural light itself. Although, this lamp design produces an artificial light, its low hanging structure encourages the user to play and interact with the fixture, as well as allows the user to explore the nature of artificial light and its powerful unexplored qualities of transforming an ambience with just a tap on the wood.

8. Conclusion

8.1. Contribution to Lighting Design

This project worked on designing a customizable, culturally inclusive lighting system that could have a positive effect on people from different cultures, particularly South Asian, Chinese, Persian and Anglo-Saxon. In standardized residential environments such as apartments and condos, lighting systems of this type could help residents express their different cultural and personal preferences and personalize their environment. The use of latest technology, customizable lighting options as well as multi-cultural aesthetics added by the lighting designs in their contemporary environment, stimulate the users' nostalgic feelings and enhance their positive emotions, creating an incandescent home away from home.

8.2. Contribution to Inclusive Design

The design exercise in this project followed the three dimensions of inclusive design[8] as explained below:

Dimension 1 – Recognizing the diversity and uniqueness of users: Participants from four difference ethnicities were invited to freely share their views and preferences relating to lighting design and cultural artefacts. Their choices were used to create one-size-fits-one configurations through the conceptualization of flexible or adaptable lighting systems.

Dimension 2 – Inclusive processes and tools: By involving users in the design dialogue, an inclusive, human-centered design was achieved. The survey and interview processes were conducted in a user-friendly fashion following approved ethical protocols.

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[8] http://idrc.ocadu.ca/component/content/article/48-library-of-papers/443-whatisinclusivedesign.

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Dimension 3 – Aiming for a broader systemic impact: This research produced empirically based lighting product designs based on primary data gathered from users of four difference ethnicities to cater to all their tastes individually and collectively. It is possible that this design would have a broader impact and emerge as a new form of lighting design that embraces the contemporary without losing the flavour of ethnicity.

8.3. Future Work

Due to time constraints, the project could only produce sketches of the design. Future plans include development of a prototype and testing the same with users from different cultures as conceived in this research, finally leading to a full-fledged product.

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Supporting Links

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http://www.slideshare.net/eadahl/culture-design-11386677

http://www.e-architect.co.uk/abu-dhabi/al-aziz-mosque-in-abu-dhabi

Appendix A: Survey Questionnaire

Date:

Lighting Design and Cultural Expression

Questionnaire

Method: Questionnaire

Student Researcher: Deepshikha Sharma, Graduate Studies – Inclusive Design, OCAD University, Toronto

Faculty Supervisor: Prof. Job Rutgers, Professor of Design, Principal Researcher - Ambient Experience Lab at OCAD University.

Introduction:

This questionnaire has been designed to identify the preferences of the participant immigrant to his/her culture in the context of lighting products. It might take around 20 to 30 minutes to answer the questions. Immigrants from Persian, Chinese and South Asian Culture, presently living in Toronto, Canada will be invited to respond to this questionnaire. The aim of the research is to design a lighting product that consists of customizable aesthetic and cultural elements from the

above-mentioned three cultures that gives a positive nostalgic feeling to the user.

Participant Information

Name:

Address:

Ph. number:

Email ID:

1. What is your age group?

☐ 18 – 30 years   ☐ 31 - 50 years

☐ 51 - 65 years   ☐ 65 and above years

2. Which country you were born in?

3. Which ethnic culture do you identify with?

☐ Persian

☐ Chinese

☐ South Asian

4. When did you move to Toronto?

Year

5. What is your residence type?

☐ Condominium

☐ Apartment

6. Ownership status:

☐ Owned

☐ Rented

7.1) How long have you been living in your residence?

months   years

7. Have you bought/ included/changed any lighting fixture in your living space?

☐ Yes   ☐ No

If yes, then please specify which one(s) and why?

8. What is your lighting preference?

☐ Daylight/ Natural Light

☐ Artificial Light

☐ Depending on task

☐ Depending on mood

☐ All of above

8.1) From above options

a) Your most preferable lighting is (favorite)

Please specify why?

b) Your least preferable lighting is

Please specify why?

9. What is your preference in artificial lighting?

☐ Bright   ☐ Low

☐ Soft   ☐ colourful Ambient

☐ Depends on mood or occasion

☐ None

10. Does the lighting in an environment affect your mood?

☐ Yes   ☐ No

10.1) On a scale 0-5, how much does the lighting effect your mood?

(0 being 'Minimum' and 5 being 'Strong' effect)

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

11. Did you add/remove/alter any colour in your living space, e.g. Wall paint/ Floor/ Curtains/ furniture colour etc.?

☐ Yes ☐ No

11.1) If marked Yes, please specify what colour and why?

12. What is your colour preference in lighting?

☐ White   ☐ Off-White

☐ Bluish-White   ☐ Yellow

☐ Red   ☐ Blue

☐ Purple   ☐ Pink

☐ Multi-colored   ☐ Other

If marked other, then please specify:

13. From following options, what is your most preferable in interior lighting style?

   a. Ambient Lighting ☐

   (Provides overall illumination for a room and create a uniform light level throughout a space.)

   b. Task Lighting ☐

   (Targeted to a particular area of a room for a specific function. For example kitchen counters where food will be prepared, living room seating areas where reading will take place, under-cabinet lighting provides task lighting for a countertop)

   c. Accent Lighting ☐

   (Also called highlighting, draws attention to a particular object, such as artwork, sculpture, plants or bookcases etc.)

14. What is your aesthetic preference in lighting products?

   ☐ Traditional (traditional style of lamps or lighting from your culture)

☐   Cross- Cultural Style (traditional style of lighting from other cultures)

☐   Contemporary and Trendy style

☐   All of above

☐   Other

If marked Other, please specify

15. What are some visual, cultural or religious elements (patterns/ architecture/monuments/style/ motifs/art forms) that remind you of your ethnic and cultural heritage? (Example Calligraphy, Tessellations, Yin Yang, Mandala, Rangoli: traditional colourful floor patterns, Arabesque etc)

16. What are some colours that define your culture? Specify 3-4 colours.

17. Is lighting a part of your culture's festivity?

☐ Yes   ☐ No

18.) If yes, which is the most prominent festival (religious, cultural or social celebration) of your culture that includes traditional or modern lighting?

19. Do you possess any object (painting/ lamp/ wall hanging/ lifestyle product/ artifact/ craft that define your inclination to Persian, Chinese or South Asian Culture?

19.1) Why do you like that product? Please specify.

20. Would you use a customizable lighting fixture inspired by the ethnic elements of your culture?

☐ Yes ☐ No

20.1) If yes, in which section of your apartment/condo interior would you prefer to use it and why?

Appendix B: Image Sources

Figure No.	Image Source
1.	http://www.cic.gc.ca/english/resources/statistics/facts2014/permanent/index.asp#figure1a
2.	Canadian Magazine of immigration. March 24, 2016 (http://canadaimmigrants.com/immigrants-in-toronto/)
3.	Author's own work
4.	Author's own work
5.	Graphics by author
6.	Author's own work
7.	Graphics by author
8.	http://www.lights4learning.org/latest-news/choosing-right-lightbulb
9.	http://www.sleprojects.com/harmonious-distribution-of-brightness
10.	http://what-when-how.com/energy-engineering/daylighting-energy-engineering
11.	https://in.pinterest.com/pin/272467846179157657/
12.	http://www.moroccanbazaar.co.uk/lighting/wall-lights-and-sconces/fine-wall-lights/sconces/MWL301-AB.html
13.	http://www.thegreenhead.com/2007/10/drop-4-floor-lamp.php http://www.futurelighting.com.hk/product4.php?nid=63&id=387
14.	http://www.lrc.rpi.edu/patternbook/equipment/architectural.asp
15.	http://truelight-led.designshuffle.com/portfolio/led-cove-light-effect/led-cove-light-1/
16.	http://www.designyourinteriors.com/soffit-lighting/
17.	http://www.invitinghome.com/molding_crown/cornice-molding.htm
18.	http://therooflightsuperstore.blogspot.ca/
19.	http://www.greenbuildingadvisor.com/articles/dept/green-building-blog/exploiting-elements-passive-design
20.	http://petapixel.com/author/michaelczhang; http://news.buzzbuzzhome.com/2015/02/artificial-skylight-mimics-daylight.html
21.	//www.iust.ac.ir/index.php?slc_lang=en&sid=89
22.	http://islamic-arts.org/2014/wood-glass-geometry-stained-glass-in-iran-and-azerbaijan/
23.	http://masajid.tumblr.com/page/2
24.	https://in.pinterest.com/pin/272467846179157657/
25.	http://www.outlooktraveller.com/trips/sarkhej-roza-ahmedabads-acropolis-1007045
26.	http://www.bcmtouring.com/forums/threads/royal-rajasthan-conquered-in-royal-enfield.28787/page-6
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42.	Pictures taken by the author during market research with consent
43.	Pictures taken by the author during market research with consent
44.	Author's own work
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46.	Pictures taken by the author at participant's residence with consent and REB's approval
47.	Graphics by author
48.	Pictures taken by the author at participant's residence with consent and REB's approval
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