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**"Do the new requirements for the use of energy efficient lighting design mean the end of creativity?"**

### **Case studies/analysis of lighting projects**

The author will look into recent projects of a leading UK lighting design practice, where sustainable and environmental criteria have to be fulfilled due to the project requirements, national statutory regulations as well as the practice's own sustainable policies and design approach. Three case studies will be used to illustrate these impacts and lighting design application techniques will be discussed. Additionally, it will be demonstrated how intelligent thinking together with the use of automated and sophisticated lighting control systems, as well as proper energy management, which addresses dimming, switching, scene settings, daylight contribution, use of daylight, and presence detector sensors, can help to accomplish satisfactory results under a variety of conditions whilst meeting the necessary requirements.

The following questions will be focused on:

⇒ How much can be offered/promised to the client in terms of cost savings while ensuring that energy is not consumed unnecessarily and still providing the user with complete flexibility and control over their environment?

⇒ Are there intelligent ways to fulfil the regulations? If so, how these can be accomplished?

More often than not professional lighting designers face the difficulty of how to create energy saving, economical solutions which are both 'sexy' and unique. These issues relate equally to exterior and interior projects. How do we achieve aesthetic designs and user well-being, and meet cost-efficient requirements whilst simultaneously creating carbon neutral designs?

It is easy to provide lighting for the office environment, where efficient fluorescent lighting has commonly been accepted. What about other areas? Three lighting schemes – an external façade of a car park, a five star hotel and an atrium redesign to a building in London's financial district will demonstrate how the lighting approach can resolve the apparent paradox.

### **Car park, Cardiff Bay/UK – New build, feature facade to multi-story building**

Creatively lighting the facade to a car park can be a real challenge. Quite often the owner does not want to invest much in respect to lighting beyond the necessary. However, in this particular case, the client wanted an energy efficient lighting solution, along with an eye-catching result as the building is located in a visible place. The example project is acclaimed by many as "the coolest car park in Cardiff Bay" with waves of blue light washing across the facade. The structure, which measures over 100 metres long and is six storeys high – has become a landmark in the city.

The design goal was to generate a unique feature element for the building that would emphasize the gateway

point of an important regeneration project in the Cardiff Bay district. A car park is first and foremost a functional space, so the lighting designers had to work with the constraints of functional lighting and its high light levels and to consider the feature illumination with the background ambient brightness.

This is a unique scheme that brings with it a wide range of challenges. Namely, to create a special lighting effect by night on what is during the day a dull multi-storey car park structure, and to work with the physical limits of such a complex facade form on a large scale.

The architectural idea of the wave like form was intended to call to mind the spirit of the bay area. The lighting concept response was to achieve a striking night-time effect echoing the movement of the water in the bay and creating visual impact, whilst not undermining the importance of other significant structures and buildings, including the Welsh Assembly on and near the site.

As the whole facade is made of many undulations across the overall span of the whole building, one of the main challenges of the project was calculating the appropriate beam angle of the luminaires as well as the optimum aiming angle depending on the varying distances from the sail-like structure to create an even wash of light.

The position of the individual luminaires was carefully defined. The fixtures were mounted on a special bracket precisely placed so that they followed the contours of the sail-like structure, thus avoiding views of the lamps from the roadway or glare from within the car park.

To extract as much light in the required direction as possible, a twin reflector solution was selected. In some instances, luminaires incorporate a mixture of medium beam for the inner lamp and narrow for the outer lamp. In total, there were twelve specific variations of the same luminaire. It was only possible to define these thanks to a large facade lighting mock-up set up by Base Structure, the facade manufacturer, along with the luminaire manufacturer, who supplied samples with different reflectors. The design team who supported the lighting idea were present and thus able to evaluate the mock-up.

LED light sources would be the standard option for such a decorative application, but unfortunately they are still too expensive for some applications, and due to limited project resources a more cost effective, low-tech alternative was proposed. To maintain the idea of creating a dynamic facade, Light Bureau decided to take a closer look at dual lamp fluorescent technology.

As the facade is external and exposed to weather extremes, Light Bureau recognized that this may create thermal operational issues for fluorescent lamps. With winter temperatures going below zero degrees centigrade and the need for the dimming of the sources to create the dynamic effect, there was concern because fluorescent lamp sour-



**Acclaimed as "the coolest car park in Cardiff Bay" with waves of blue light washing across the facade, the structure measures over 100 meters long, covering the facade of six floors and has become a landmark in the city. Photo: James Newton**

ces tend to 'drop out' when dimming in cold weather environments. By carrying out extensive research studies and lighting calculations, older but more thermally stable T8 lamp technology was applied.

In the end the facade was illuminated using two colours of T8 linear fluorescent lamps, precisely programmed to create a kinetic feature. Front and backlighting techniques were employed to achieve uniformity and helped to minimize the problem of hot spots over the curved facade. Each of the luminaires incorporates a separate blue and white T8 lamp in its own reflector and each fitting uses two separate DALI ballasts to achieve the degree of control necessitated by the concept.

The entire system is currently operated via an astronomical time clock facility based on a DMX protocol interfaced with DALI ballasts. The system switches the lamps one hour before sunset every day, allowing the light sources to warm up before the dynamic cycle starts. The lamps 'warm-down' for half an hour at 11 p.m. These safety measures have guaranteed lack of failure in the operation of the installation to date by greatly reducing thermal stress and, as a result, increasing the service life of the lamps.

Another crucial aspect increasingly taken into account while designing buildings and structures is the natural environment. This is due to the lighting installation being

visible after dark, and its possible negative impact on local ornithology. For millions of years birds evolved under a day/night cycle, where the bright light of the sun during the day was replaced at night by weak light from the stars and sunlight reflected off the moon and planets. This situation ended when humans started to artificially light the night sky, which is especially clear in industrialized areas. Globally, hundreds of millions of migrating birds are adversely affected by the presence of artificial light on a yearly basis; many of these birds do not survive the encounter.

Reactions of local and migratory birds to artificial light are largely determined by the wavelength characteristic of the light source, it is understood that artificial light can negatively influence their behaviour. Birds appear to have excellent colour vision which attracts them to coloured light. According to research, the use of magenta, indigo and blue light have minimal disorienting effects on birds due to the light frequencies.

The lighting designers decided not to use coloured over-sleeves due to service life issues, quantities maintenance, and efficiency. In addition, blue lamps are more efficient than lamps with sleeves. This project is an example of an environment/bird-friendly lighting scheme for tall building and structures in the UK. The designers made sure that the decorative lighting uses the appropriate wavelength of light and is carefully controlled by limiting the hours of illumination during the night.

#### **Verta Hotel, London/UK – New build, 5 star hotel building**

Hotel Verta is the first integrated hotel/heliport in Europe. Everything in the building – from the unique location on the Thames to the stunning architecture, cutting edge technology, as well as the lighting design – is there to ensure that guests, whether business or leisure, have their every expectation exceeded.

The design is inspired by the golden days of aviation, combining location with luxury and style, and classical with contemporary to create modernity relevant to today's needs. The brief was to design a comprehensive lighting solution for exterior and interior spaces that would be sympathetic to the natural environment with minimal carbon footprint (part L-requirements). Additionally, the design was to create an ambience with a unique aesthetic meeting the demands of a luxurious five star hotel and underlining the individual quality and character of each of the areas on the different floors: guestrooms, fine dining, spa, lounge and bar area, conference centre, meeting and office rooms, ballroom, external terraces as well as heliport reception and facilities.

The principles of maximizing daylighting, the use of energy efficient light sources, lighting controls and how to effectively apply them to address sustainable issues to achieve the maximum sustainability potential of this project were considered early on.

The interior lighting scheme comprises both functional and feature lighting components. The lighting designers developed a unique concept for each space, bringing out the specific features designed by London-based interior

architecture practice Richard Daniels Design. The combination of daylight, energy efficient artificial lighting and lighting controls was fundamental to achieving a sustainable design for the building.

The project was particularly challenging, since the client requested the design take into account building regulations (Approved Part L2A document) while designing a lighting concept. Approved Document Part L2A Conservation of fuel and power in new buildings other than dwellings provides a radical new format for delivering the Government's strategy to significantly reduce carbon dioxide emissions from buildings by 2010. It introduces a new compliance method with minimum overall energy performance in terms of a target CO<sub>2</sub> emission, an increased emphasis on ensuring standards are met in practice, and a requirement that the building owner or occupant has sufficient information to run the building efficiently. Compliance with this document is a complex process, which is met by achieving five separate criteria requiring a combination of energy efficient mechanical and electrical services, together with a well designed building envelope.

Efficient lighting and the use of a lighting control system/scene setting offered substantial potential for bringing down emission rates and moderating summer temperatures inside the building. To achieve these goals, the required illumination levels for different areas based on each floor were agreed with the client. This was based on British Standard regulations and good practice. Secondly, the lighting concept was established and signed off by the client; a preliminary design was developed leading into a detailed design. Lighting calculations for the general illumination as well as emergency levels were undertaken to assure the design was meeting the agreed requirements.

Wherever possible, luminaires were emergency converted to reduce their quantity and installation costs, and to create a clean, minimal look for the ceiling. To verify compliance with Part L2A 3 areas, special calculations were made for: general lighting with average initial lighting efficacy not less than 50 lumens per circuit-watt, office lighting with average initial lighting efficacy not less than 45 lumens per circuit-watt and display lighting with average initial lighting efficacy not less than 15 lumens per circuit-watt. These were met accordingly.

In the efforts to provide green solutions, lighting control was proposed throughout the project. The intelligent system was applied to reduce energy use and cost, to provide the opportunity of controlled change according to the time of day, the seasons and the use of the space, to avoid unnecessary lighting during times when daylight levels are adequate, when spaces are unoccupied, or for cleaning reasons, and also to increase lamp life and reduce maintenance. Typically, the interior lighting would be switched/dimmed according to the pattern of activity use in the given space and the time of day. One of the features the client was very keen on, and which will improve business operation, was the possibility of generating energy consumption and maintenance reports via an intelligent control system located in the hotel's management office.

Light sources were largely a mixture of linear and com-



**The clear design and quality of materials of the individual rooms in Verta Hotel is highlighted by sensitive illumination. Downlighting, cove lighting, ambient lighting from floor and table luminaires, lighting integral within wardrobes, bathroom mirrors, wall lights add to the multiple experience of the space. Photo: Von Essen Hotels**

pact fluorescent, cold cathodes, LEDs, and metal halide. A minimal use of low-voltage tungsten halogen lamps was allowed and applied where essential within the dining areas to accent tables, art work and support health aspects in the guest rooms – so as not to interfere with guests' sleeping patterns or disturb their bio-rhythms. These were reduced wattage – 35 watt IRC MR16 and 50 and 65 watt AR-111 lamps (to further conserve energy and extend lamp life). These lamps were also selected for their variety of beams as well as colour rendering stability.

#### **Hotel guest bedrooms and corridors**

The entire seventy hotel bedrooms are located on second through fifth floors and aligned along corridors leading towards elevator lift lobbies. To optically reduce the length of the corridors and the feeling of an enclosed space whilst passing through, the interior architect decided to create interest and variation to the walls by applying different finishes – one wall receiving dark, the other a white colour treatment. Wall-mounted LED luminaires, next to the doors also follow the dark/white finish concept. The downward light distribution highlights the room number and VDA card reader, creating not only a rhythm of lighting while walking along the corridor, but also functional lighting to aid orientation. Small downlights equipped with opal diffusers and compact fluorescent lamps provide general levels of illumination to the space. Further interest was provided by adding accent lighting to artwork on the walls as well as a warm feature LED halo lighting to the lift door reveals.

During the daytime, general lighting is dimmed down to the levels agreed upon with the client. This includes the times when the corridors are not occupied – after approximately thirty minutes of no presence detected. Levels raise to one hundred percent when triggered by minimal-size, ceiling recessed, presence detector sensors (PIR). For the "Late Evening" lighting scene (6 to 10 p.m.) the PIR sensors are not active. It was also important to coordinate lighting with the card reader, to assure that an appropriate

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lighting scene would be called up when entering a room, without having to look for a switch.

Hotel guestrooms are furnished with original artwork and bespoke furniture. The clear design and quality of materials of the individual rooms was highlighted by sensitive illumination. Down-lighting, cove lighting, ambient lighting from floor and table luminaires, lighting integrated within wardrobes, bathroom mirrors, wall lights, and so on, add multiple experiences to the space, where the dark/bright concept of finishes was applied as well. The variety of light sources used (LV TH, LFL, CFL, LED) were controlled to assure ease of maintenance and energy saving.

Each room was equipped with a custom designed control panel which can be used to call up different lighting scenes; this means that the guest can define what kind of lighting is required depending on mood, time of day or task performed. The typical guestroom will consist of the following lighting scenes: Day/Evening/Night/Clean/OFF/Curtains/Bedside Lighting/Night Light, an additional raise and lower button for any adjustments and integrated DND (Do not disturb) button.

#### **Spa Level -1 and -2**

A spa is not a spa without light, especially if it is located below ground level. The main issue facing the lighting designers was how to handle the transition between the open, spacious upper levels of the hotel and the small, enclosed basement with a low ceiling and a lack of daylight penetration, to assure that this limited space does not feel or appear cramped whilst creating a pleasant, memorable experience. Specific illumination levels for different areas, depending on functional requirements as well as change according to time of the day/night, were established to create a welcoming feel and ease of transition for the users.

Measurements of light levels showed that the lux levels here are very low with the addition of accent lighting for orientation. The light levels are still absolutely adequate for the users to feel safe and comfortable in the space.

Successful spas have spatial and functional hierarchies, and series of rooms for relaxation or dynamic application. In this respect, it is important for the lighting to reflect this story in the concept and at the same time create a coherent visual appearance.

The reception area is devoted entirely to preparing the guests for an exciting encounter as soon as they enter the lobby with the sound of a water feature, fragrances and lighting elements, such as ceiling cove lighting, a feature wall at the back of the reception and internally illuminated display cases with special spa products.

A further task of the lighting consisted of making a contribution to the poetic quality of the facilities, and at the same time making a lasting impression on guests, leaving them with a positive memory of their visit. In the Relaxation Room a feature wall made of stone with an integrated water feature and candles on shelves give a soothing impression to the visitor and promote relaxation and rest.

A timber staircase with glass balustrade and small low level wall recessed LED lighting integrated within one side of the wall connects the two spa levels. In addition, the

hydrotherapy pool on Level -2 is virtually glowing with light. This was achieved through the stainless steel surface of the pool reflecting light from carefully positioned underwater spotlights.

In spite of the limited choice of luminaires due to IP rating protection requirements in this wet/damp location, and the regular long hours of daily operation of the lighting system, the designers succeeded in creating an original lighting solution.

The corridor leading to the pool is highlighted with surface-mounted ceiling luminaires, exactly matching the ceiling finish and creating inviting narrow-beam pools of light on the floor.

One of the design principles for the spa lighting levels is the amalgamation of light. Light itself is more important than luminaires, and so where possible luminaires were integrated within the furniture details and architectural elements. Aesthetic, choice of materials, and redefined details with integrated lighting became the most important themes for the organization of the space. Attention was paid to different-quality experiences where colour temperature, intensity and low level accent lighting play an important role. The process from the solution to the completion took two and a half years.

#### **Tower 42 Building, Financial District, London/UK – State-of-the-art redesign and refurbishment of the existing atrium space.**

Tower 42, the tallest, skyscraper in the city of London, has long been a landmark building on the London skyline. Some people hate it, some love it, but what matters is the fact that it was the first skyscraper to be allowed to be erected in an area where low level architecture has been present through centuries. In that sense it is a major achievement.

The tower, originally built for the National Westminster Bank between 1971 and 1979, is 183 metres high and constructed around a huge concrete core, from which floors are cantilevered, giving it its great strength. In April 1993, the IRA detonated a bomb in Bishopsgate, which caused over £1 billion worth of damage. Demolition was considered, but the expense to demolish the building was deemed to be too high, and so it was decided the building would be re-clad and extensive refurbishment work done.

The architects firm Paul Crofts Studio was asked to deliver a new lobby and reception area design. The brief to the design team was "to create an entrance that would take Tower 42 into a new era with a stunning, contemporary welcome area that effectively suggests the five-star levels of service and accommodation that lie inside".

Light Bureau was asked to design a lighting concept for the main glass atrium area – a prominent structure with a great potential for development. It was apparent for the lighting designers working on a project that illumination would play a key role in the success of the scheme in the daytime as well as at night. Good levels of light for safe orientation had to be taken into account as well. There was also the client's desire to enhance the orientation, the structure, the finishes, and the facade of the tower to create night-time interest and to approve visibility. Before

the refurbishment, the building had almost no presence at ground level, generally because there was a complete absence of feature and ambient light.

How does a building attract passers-by, attract potential clients to a restaurant with a view at the top of the building when it is in the middle of a financial district in a very dense, urban fabric? The major scheme was to bring features "back" to the building and limit the permeability of a glazed atrium when viewed from the street, but also when viewed internally. The proposal was to bring into play the volume of the glazed atrium building, including its structure, and to fill it internally with light by using single coloured light treatments to create a ghostly feel and focus at the perimeter.

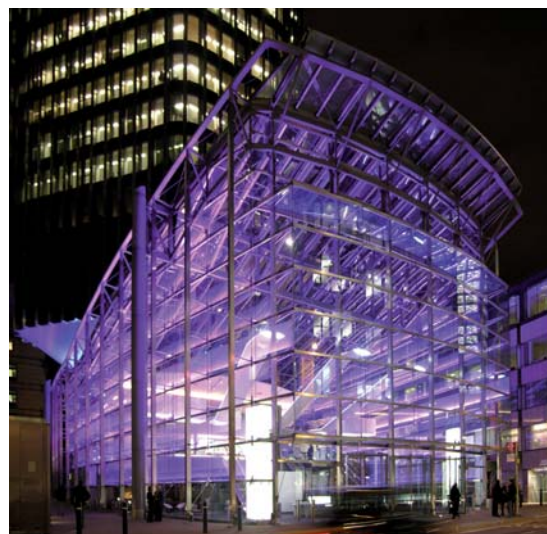
Small-scale linear RGB LED luminaires were introduced at the north and south glazed facades and their locations carefully coordinated with suspended vertical panels made of vinyl. The desired effect was created by applying light to these surfaces. When viewed from inside, LED uplighting to the side windows produces a more enclosed space, without encouraging visitors to look through the building to the adjacent properties and focusing their attention to the routes up through the building to the relevant floors.

The key idea was to create a space that is well-lit for orientation and movement, yet has sufficient drama and mood to enhance the visitor's experience. Close collaboration with the interior designers from the early stages allowed for lighting solutions to be integrated in many ways: into signage towers internally illuminated with cool white light; suspended white fibre glass banners with LED edge lighting; lighting to escalators and concierge desk amongst other solutions. By illuminating these key items, they became feature and functional lighting at the same time, giving depth to the space.

As the visitor progress up through the building, the reception area on the Mezzanine Level becomes a focal point. An harmonious visual image has been accomplished through the explicit application of additional design elements with custom designed integrated lighting features, such as large square feature pendants, which provide accent lighting to the seating area, backlit frontage to the reception desk, and wash lighting to the ceiling canopy.

The ambient lighting comprises the existing projectors mounted on horizontal side beams – re-lamped and re-focused – and new metal halide projectors with narrow and flood beam angles to create different lighting settings. Wide beam angles are used during the day and narrow beams at night. These are controlled by an astrological time clock facility. Wherever possible, long-life/low energy light sources were specified to minimize maintenance implications. Lamp colour appearance is generally white with metal halide and compact/linear fluorescent sources used in preference to low-voltage halogen lamps. This provided good colour rendering and high quality light.

LED light sources with their exceptional lamp life and miniature size have also been specified in the areas where colour is used to change and enhance the mood at different times of day without the luminaires making a large visual impact.



**The lighting proposal for Tower 42 was to bring into play the volume of the glazed atrium building including its structure and to fill it in internally with light and by use of single coloured light treatment to create a ghostly feel and focus at the perimeter. Photo: Paul Traynor**

Early on, the client recognized the value of responsible management resources and environmental conservation based on targets agreed by UK Government to reduce greenhouse gas emission at international (Kyoto) and domestic levels. As a result the building monitors energy use and promotes its efficient use to its customers. Low-energy light sources and a lighting control system (Dyna-lite for the control of architectural lighting), has been implemented, which allows for different light scenes with variable levels dependent on the time of day.

Morning Scene (6:30 a.m. to 3 p.m.), afternoon scene (3 p.m. to 6 p.m.), this scene is controlled by an astronomical time clock facility and should be in operation one hour before dusk) and two distinctive evening scenes (6 p.m. to midnight). The colour LED controls were provided by Architainment.

### Conclusion

Reflecting back on the presented projects one can say, "Yes, there is a future for the lighting design profession itself to create exceptional design." However, success and development in the long term will rely on how much effort we put into the establishment and recognition of the profession today along with the creativity and resourcefulness of a new generation of lighting designers yet to come.

The new energy conservation requirements will keep us on our toes as lighting designers. Having restrictions and new constraints does not have to mean that design cannot be aesthetically pleasing and in line with the functional needs of the client. It is a challenge, especially in the hospitality sector, where a high level of design, including satisfactory technical criteria, is expected. This will force us to work closely with architects and interior designers. We must develop a dialog early on – the integration of lighting

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is key to the success of any project. We should think more clearly about how we design these environments. In our future more and more lighting control systems, scene settings, as well as use of daylight sensors, automatic dimming and the like will be a necessity.

To create a magnum opus of design, it is essential for the client, lighting designer, architect, engineer, and other members of the design team to establish sustainable, environment-friendly principles of design, a clear understanding of a given project brief, concepts for exterior or interior spaces, realizing the different experiences one has in them, and direct, close collaboration between designers and engineers to resolve any problems. For lighting designers it is crucial to analyse each surface, material's reflectivity, texture, colour, contrast with regard to sustainable issues and energy conservation and communicate that information to the design team, to influence possible changes of design and/or materials used; to be in the "loop" when it comes to new scientific research (medicine, biology, environment, etc.) that relates directly or indirectly to the lighting field, to understand the "big picture" approach and any possible negative consequences; and to continue one's own professional development by extending existing lighting knowledge and frequently questioning the design approach towards the interior and exterior projects you as a designer are involved in.

Another very important aspect is a matter of social responsibility and awareness when designing energy-efficient lighting in residential/hospitality environments. What about the influence of artificial lighting on a human's biological clock? Norms and legislation are written by very wise, technically oriented people, but they do not necessarily see the "big picture".

In evolutionary terms, human beings as a species have only recently changed their outdoor, agrarian lifestyle due

to the invention of artificial lighting, with the help of which we can perform our visual tasks and extend day into night (24/7). The consequences of spending our days and nights in a built environment, protected from natural elements such as daylight cannot yet be measured due to the short time scale of this process. Only recently have people started to become increasingly aware of the fact that artificial light cannot substitute daylight due to its lack of full spectral characteristics, which are necessary to regulate a number of biochemical processes in our bodies.

The last couple of years have witnessed a shift in approach towards lighting with a focus of understanding of what defines excellent, environment-friendly and human-oriented lighting design schemes. Clients come to us seeking professional advice – not schemes which are harmful to their bodies. It is not too late to realize that our profession is not only about creating good, aesthetically pleasing ambiances supported by technological solutions. It is about the people and places we exist in.

Lighting designers have the power and necessary knowledge to transform a space to suit any requirement. Almost any environment can be positively enhanced whether retail, hospitality, gallery, museum, theme venue, lecture theatre, boardroom, ballroom and so on. We should be aware of the fact, that we can manipulate artificial light in a manner no one else can, which is almost like "playing God" without knowing it. Are we ready to be lighting experts? We have to accept here and now that we are a recognized profession and understand that our practical expertise can and does make a difference to others' lives, health and the environment, today and for generations to come. The choice is ours.

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**Dr. Marisela Mendoza/UK**  
**Light and identity**

### Visual memory

In a newborn baby, sight is the least developed sense in comparison with all other senses. Although not fully tuned at first, the visual system in newborn babies develops as they grow older and it is believed that by the age of six months their vision is fully developed. Vision may be, from all the senses, one of the prime contributors to developing memory and a sense of space from the early stages of life. As we grow older we accumulate scenes that pertain to visual memory. "Memory is the ability of the mind to store and recall past sensations, thoughts, knowledge, etc."<sup>1</sup> It is possible to store information in our memory from which we can recall places, objects or people as series of images in our minds. Broadly speaking, memory is what our mind sees and stores. It is also from very early stages of life that we experience self identifica-

tion or reflection through our visual system. Self-reflection for Jaques Lacan is a mirror reflection associated with that first mirror identification that a six-month old child will experience. This experience provides the infant with a first glimpse of wholeness or unity.<sup>2</sup> However, this identification, as stated by Lacan, is based on an illusion or misrecognition. It is in the mirror phase that the child first experiences through vision what it must be to be whole. Men and women are not born with an identity. We have to identify to get one. Identity presupposes identification.<sup>3</sup>

Our mind manipulates memory in order to recall an image of the original seen object, place or person. In addition, every time we see an equal or similar image of what is stored in our memory, our mind creates a connection identifying the stored image with the seen one. These mental images contribute to our everyday emotional life