Lighting effects on unconscious human behaviors

Kobayashi Shigeo
Prof. of Tokyo City University
skoba@tcu.ac.jp
Lighting Effects on Human Beings

Visibility

Physiology
- Melatonin, Body temperature,
  Sleep-wake cycle

Psychology
Light and circadian system

- Light can alleviate seasonal depression.
- Light can increase the length and quality of sleep.
- Light can improve performance of night-shift workers.
- Light can consolidate sleep/activity patterns in Alzheimer's Disease patients.
- Light can improve weight gain in premature infants.
- Light regulates melatonin.
- Light has a direct impact on cortical brain activity.
Patients were exposed to at least 3,000 lx at their eye levels to adjust their sleeping patterns.

National Institute of Mental Health:
National Center of Neurology and Psychiatry
Bio-Brite light visor helps fight against seasonal depression. Great for jet lag. Try the sunrise alarm and wake up naturally.

The Bio-Brite light visor is a breakthrough in convenience, efficiency and utility of bright light therapy. Wearable - this bright light source that is light weight, adjusts to fit comfortably around your head and is powered by a rechargeable battery pack that leaves you free to move about. Delivers safe, gentle glare-free light. Super efficiently because the light is fixed close to the eyes.
The Power of Kraft Light Therapy in the Sun Room

The sun room is enhanced with high quality, medical light therapy devices that combat stress, prevent seasonal depression (SAD), regulate blood pressure and blood sugar levels, create vitamin D and improve quality and duration of sleep.
Just relax in a dark room
Certainly, body temperature or secretion of melatonin is measured.

However, can you recognize how much you relaxed correctly?

The physiology response is generally too fundamental.

There is a certain distance in our physiology response and emotion.

Delicate emotion is recognized sensuously.
Osgood's **Semantic Differential** was an application to measure the semantics or meaning of words, particularly adjectives, and their referent concepts.
Finds out about a subject's idea through an interview
Come to the surface:
They can be expressed in language
Sometimes stereotypical way of thinking

behavior observation

Unconscious:
They cannot be expressed in language
They never went to sleep intentionally.

A difficult topic, darkness, and a slow lecture invited them to sleep.

The effect of light appears in behavior.
Interpersonal Communication

- Interpersonal relationship
- Sex
- Personality

- Speaking volume
- Personal distance
- Facing direction
- Eye contact

- Surrounding Environment

Lighting

- Interpersonal relationship
- Sex
- Personality
Lighting Effects on Speaking Volume
General lighting
Table: 800 lx  Ambient: 500 lx

Spotlighting
Table: 50 lx  Ambient: 1 lx

Table candle
Table: 3 lx  Ambient: 0.1 lx

Subjects: 20 pairs, 40 people
Speaking volume (one minute example)

**Subjects only**

- General Lighting: Blue line
- Spotlighting: Red line
- Table candle: Yellow line

**With a stranger**

- General Lighting: Blue line
- Spotlighting: Red line
- Table candle: Yellow line
Average Speaking volume

dB(A)

<table>
<thead>
<tr>
<th></th>
<th>General lighting</th>
<th>Spotlighting</th>
<th>Table candle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subjects only</strong></td>
<td><img src="chart1.png" alt="Bar chart" /></td>
<td><img src="chart2.png" alt="Bar chart" /></td>
<td><img src="chart3.png" alt="Bar chart" /></td>
</tr>
<tr>
<td><strong>With a stranger</strong></td>
<td><img src="chart4.png" alt="Bar chart" /></td>
<td><img src="chart5.png" alt="Bar chart" /></td>
<td><img src="chart6.png" alt="Bar chart" /></td>
</tr>
</tbody>
</table>

- **Internal Control Subjects**
- **External Control Subjects**
Locus of Control refers to an individual's perception of what are the main causes of events in life. More simply put, do you believe that you control your destiny or that it is controlled by others or fate? "A locus of control orientation is a belief about whether the outcomes of our actions are contingent on what we do (internal control orientation) or on events outside our personal control (external control orientation)." (Zimbardo, 1985)

**External Locus of Control**
Individual believes that his/her behavior is guided by fate, luck, or other external circumstances

**Internal Locus of Control**
Individual believes that his/her behavior is guided by his/her personal decisions and efforts.
Speaking Volume

• Generally, people speak loudly in bright environment and speak quietly in dark environment.

• In extremely non-uniform lighting, speaking volume vary depending on speaker’s personality.

• People speak somewhat quietly, when sharing a space with unfamiliar person.
Lighting Effects on personal distance and facing position
Where do people stay under non-uniform lighting?
Almost uniform

Wide angle spotlight

Narrow angle spotlight

400 lx

30 lx
Personal distance and facing position

Monitoring subjects’ behaviors by an infrared video camera
I  General lighting

II  Wide Spotlighting

V  Narrow Spotlighting

Subject  ■Male  20 people
          ○Female  20 people

Long distance  <  >  Short distance

Positions of conversation and direction of their faces
Wide Spotlighting => Changes darkly

Facing angle

Men shorten personal distance

Women change direction of the bodies

Facing angle

Man-man
Woman-woman
Man-woman
Lighting Effects on Seating posture, eye contact and conversational frequency
Observation of Behavior in Public Space

Targeted space: Open air café in Tokyo Daytime and Nighttime in Summer
## Posture

<table>
<thead>
<tr>
<th>Angle of the backbone</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 degrees back</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lean back</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 degrees forward</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Lean forward</td>
<td></td>
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</tbody>
</table>

## Eye contact

<table>
<thead>
<tr>
<th>Eye contact time</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
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<tbody>
<tr>
<td>~20%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20%~40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40%~60%</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>60%~80%</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>80%~</td>
<td></td>
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</tbody>
</table>
Daytime (Man-man pair)

Nighttime (Man-woman pair)

Example of subjects
Total 288 people
Posture

<table>
<thead>
<tr>
<th>Day-time</th>
<th>man-man pair</th>
<th>woman-woman pair</th>
<th>man-woman pair</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0% 20% 40% 60% 80%</td>
<td>0% 20% 40% 60% 80%</td>
<td>0% 20% 40% 60% 80%</td>
</tr>
<tr>
<td>Night-time</td>
<td>0% 20% 40% 60% 80%</td>
<td>0% 20% 40% 60% 80%</td>
<td>0% 20% 40% 60% 80%</td>
</tr>
</tbody>
</table>

Lean back  Lean forward

- Man-man pair: Lean back in their chairs
- Woman-woman pair: Lean forward in night-time
Man-man
## Eye-contact

<table>
<thead>
<tr>
<th></th>
<th>man-man pair</th>
<th>woman-woman pair</th>
<th>man-woman pair</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day-time</strong></td>
<td><img src="#" alt="Graph" /></td>
<td><img src="#" alt="Graph" /></td>
<td><img src="#" alt="Graph" /></td>
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<tr>
<td><strong>Night-time</strong></td>
<td><img src="#" alt="Graph" /></td>
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### Observations

- **Man-man pair:** Rare eye-contact especially in night-time.
- **Woman-woman pair:** Frequent eye-contact in night-time.
Woman-woman
### Conversational Time

<table>
<thead>
<tr>
<th></th>
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<th>woman-woman pair</th>
<th>man-woman pair</th>
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</thead>
<tbody>
<tr>
<td><strong>Day-time</strong></td>
<td><img src="day-time_graph" alt="Graph" /></td>
<td><img src="woman-woman_day_graph" alt="Graph" /></td>
<td><img src="man-woman_day_graph" alt="Graph" /></td>
</tr>
<tr>
<td><strong>Night-time</strong></td>
<td><img src="night-time_graph" alt="Graph" /></td>
<td><img src="woman-woman_night_graph" alt="Graph" /></td>
<td><img src="man-woman_night_graph" alt="Graph" /></td>
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</tbody>
</table>

- **Man-man pair**: little conversation
- **Woman-woman and Man-woman pair**: Conversation longer, especially in night-time
Man-Woman couples
Cultural difference
Comparison of the eye contact in Japan and the U.S.

<table>
<thead>
<tr>
<th>Bright</th>
<th>Las Vegas (116 persons)</th>
<th>Tokyo (158 persons)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Man</td>
<td>Woman</td>
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<td></td>
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<tr>
<td></td>
<td>%</td>
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Dark

|        | | | | | | | | | |
|--------| | | | | | | | | |

[Diagram showing eye contact rates in Las Vegas and Tokyo, comparing men and women under bright and dark conditions.]
Investigation in an Active Cafe
Illumination and BGM volume are changed at a 30-minute interval.

Café apartment, Koenji in Tokyo
Men tended to have frequent eye contact only in a dark and loud condition.

Women tended to have frequent eye contact under every condition. When dark, it increases further.
THE EFFECTS OF ILLUMINANCE AND LOUDNESS OF THE BACKGROUND MUSIC ON CONVERSATIONAL BEHAVIORS IN A CAFE

1. Women tended to have more frequent eye contact than men under every condition, especially in dark and noisy environment.

2. Men tended to talk more under low illumination, and women tended to talk more under low BGM volume.

3. Men tended to bend forward under high illumination, and women tended to bend forward under low illumination.

4. Specific people and activity were appropriate only in bright and quiet condition.
The effect of the color of light on conversational behavior

✓ Colored light does not affect short-time conversation behavior.
✓ Men cannot talk easily under red light and women cannot talk easily under green light.
✓ Warm color light is suitable for the conversation accompanied by eating and drinking.
✓ Slight red lights show food deliciously and excite people's emotion.
These researches were applied to the Sharp’s new LED lighting which is going to offer "health" using a pale red light.

According to the experimental results, we can be healed and slept deeply by "Sakura Color".
Natural white light

Incandescent color light

Light of the Sakura color
Lighting design to promote appropriate communication

✓ Departure from the visibility and impression by language.
✓ Consideration with interpersonal relationship, interpersonal conscious and sex difference.
✓ Lighting design combined with seat configuration.

✓ What type of communication is desired in the space?
Lighting effects on outdoor behaviors
The Pedestrians’ Avoidance Behaviors toward a Stranger on the Nighttime Streets
Hirase onsen, Gifu Pref.

To repair the street lights, pedestrians' routes and uneasy places were investigated.
The layout of light sources

Small lights are arranged where pedestrians tended to avoid
The new lights were fixed along the street. Dark, energy efficient, no light pollution, and safe lighting were created.
Couples staying along the river

what affects their romantic behavior?

They stay in a line at almost equal intervals.
How is their behavior evaluated?

✓ Lighting (Brightness)
✓ Interpersonal distance
✓ Neighbor’s attribution
## Evaluation criteria of a couple's behavior

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<tbody>
<tr>
<td>1</td>
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</table>

- **Separated**
- **Gets close**
- **Hold hands**

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<table>
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<tbody>
<tr>
<td>4</td>
<td>5</td>
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</table>

- **Over the shoulder**
- **Hold each other**
- separated
- gets close
- reach over her shoulder
- hold hands
- hold each other
- People who are not couples
Lighting may contribute not only to activate public space, but also to recover from the declining birth rate.
Conscious

Interview and questionnaire

Position and distance
✓ Action of arms and legs
✓ Voice and speech pattern
✓ Direction of eyes
✓ etc.

Unconscious

Observe behavior

Physiological reaction
We should not use strong lighting which moves people’s emotion.

We should not search for the common effects to all people.

The effect of lighting is delicate.

The delicate lighting adjusted by delicate individuality should be examined.
Lighting can be adjusted at any time,

The delicate environmental design
is going to be
correspond to the purpose,
sex and age, interpersonal relations,
physical condition,
a season and time, emotion, etc.

unconsciously.