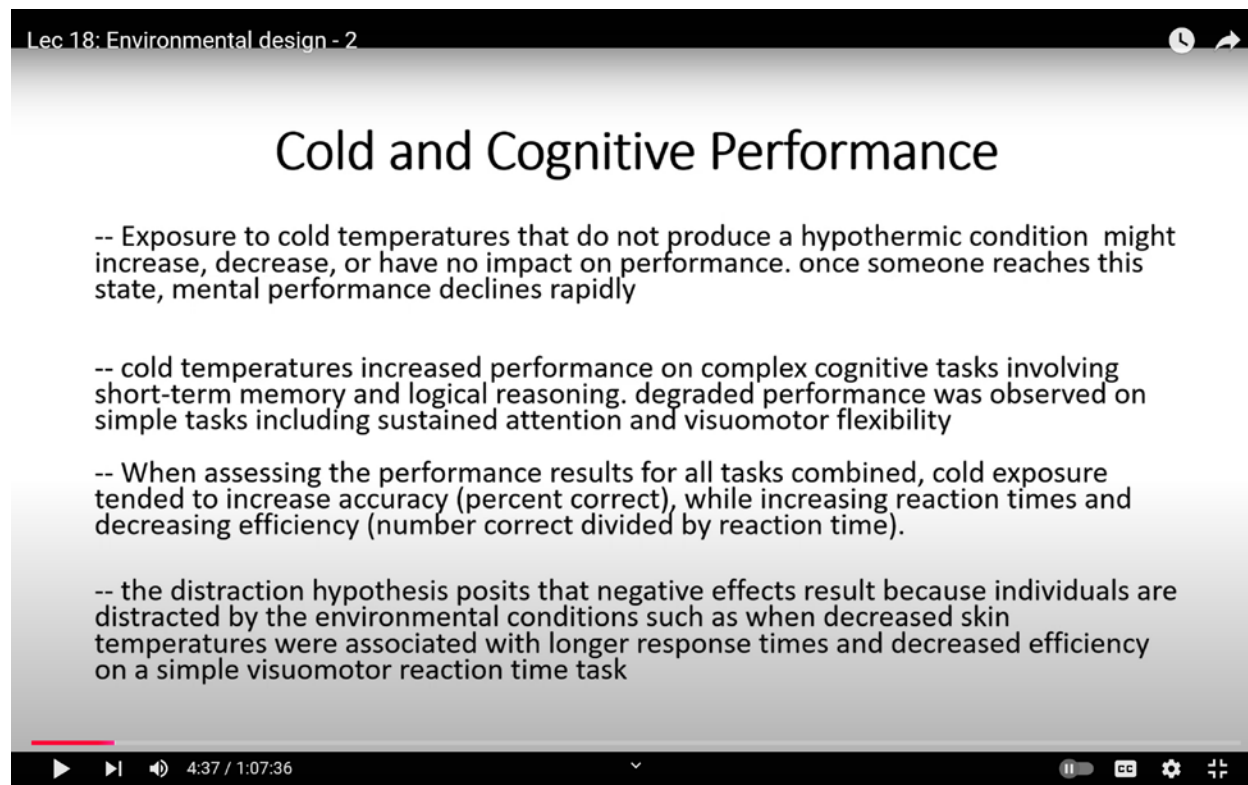


Engineering Psychology
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
Indian Institute of Technology, Guwahati
Week-07
Lecture-18
Environmental design - 2

This is the second lecture on the role of the environment and environmental design on performance and how studying these aspects leads to a better work environment. This, in turn, promotes better interaction between humans and machines, resulting in greater performance and higher efficiencies for workers. In the last class, we explored several environmental factors, including how temperature is defined and the various measures of temperature.

(Refer Slide Time: 04:37)



The screenshot shows a video player interface. At the top, a black bar contains the text 'Lec 18: Environmental design - 2' on the left and a clock icon on the right. Below this is a large white area with the title 'Cold and Cognitive Performance' in a large, bold, black font. Under the title, there are four bullet points, each preceded by '--'. The first bullet point discusses exposure to cold temperatures and its impact on mental performance. The second bullet point discusses the effect of cold temperatures on complex cognitive tasks versus simple tasks. The third bullet point discusses the overall performance results for all tasks combined. The fourth bullet point discusses the distraction hypothesis. At the bottom of the slide, there is a black bar with a red progress bar on the left, a play button icon, a volume icon, the text '4:37 / 1:07:36', a dropdown arrow, a closed caption icon, a settings gear icon, and a full screen icon.

Lec 18: Environmental design - 2

Cold and Cognitive Performance

- Exposure to cold temperatures that do not produce a hypothermic condition might increase, decrease, or have no impact on performance. once someone reaches this state, mental performance declines rapidly
- cold temperatures increased performance on complex cognitive tasks involving short-term memory and logical reasoning. degraded performance was observed on simple tasks including sustained attention and visuomotor flexibility
- When assessing the performance results for all tasks combined, cold exposure tended to increase accuracy (percent correct), while increasing reaction times and decreasing efficiency (number correct divided by reaction time).
- the distraction hypothesis posits that negative effects result because individuals are distracted by the environmental conditions such as when decreased skin temperatures were associated with longer response times and decreased efficiency on a simple visuomotor reaction time task

4:37 / 1:07:36

We discussed how temperature, humidity, and air velocity combine to form the heat index and

how heat exchange occurs through radiation, convection, conduction, and evaporation, achieving a thermal equilibrium between the human body and the environment. Additionally, we examined the impact of clothing, humidity, and airflow on adaptation to climatic conditions within the work environment, as well as the processes of acclimation and acclimatization. I concluded that class by discussing how cognitive performance is affected by heat exposure, explaining that while simple tasks are impacted by heat, complex tasks show little to no effect.

In today's class, I will focus on how the sensation of cold affects cognitive performance. Similar to our previous discussions on how heat influences cognitive abilities, the feeling of cold also has an impact on our mental functions. The definition of cold varies across different regions of the world, but it is generally accepted that there exists a range of temperatures that can be classified as cold. It is commonly believed that cold temperatures do not significantly impair performance; however, I will elaborate on how cold temperatures can affect manual dexterity and tasks that require limb movement.

Certain higher-order cognitive processes, such as planning and executive functions, are minimally affected by cold sensations. Research indicates that most mental processes are only slightly influenced when temperatures drop below a certain level, resulting in individuals feeling cold. Exposure to cold temperatures that do not lead to hypothermia may either increase, decrease, or have no impact on performance. However, once an individual reaches a state of hypothermia, mental performance declines rapidly. The threshold at which cold temperatures begin to impair cognitive ability aligns with the onset of hypothermia.

During hypothermia, various body parts may freeze, leading to an inability to move the limbs. The overall body temperature can drop significantly below 0 degrees Celsius, resulting in temporary shock that hampers both physical and cognitive tasks. However, temperatures that fall below the normal body range but remain above hypothermic levels can affect mental performance in either a positive, neutral, or negative manner. Interestingly, cold temperatures can enhance performance on complex cognitive tasks involving short-term memory and logical reasoning, while performance degrades on simpler tasks, including sustained attention and visual-motor flexibility.

In experiments where participants were exposed to varying degrees of temperature drops below normal body temperature, researchers observed that tasks requiring higher-order cognition showed

little to no adverse effects. In fact, some higher-order cognitive tasks resulted in improved performance. Conversely, simpler tasks, such as maintaining vigilance and executing basic motor activities, suffered due to decreased limb responsiveness in lower temperatures. This is evident as the limbs slow down in their movements due to the cold. Although the brain can signal the limbs to perform an action, the limbs take additional time to adjust and execute the movement.

When evaluating performance results across all tasks, cold exposure generally led to increased accuracy, measured as the percentage of correct responses, while also increasing reaction times and decreasing efficiency, which is calculated as the number of correct responses divided by the reaction time. Therefore, when assessing performance on various cognitive tasks combined, exposure to cold temperatures was found to enhance the accuracy of responses, though participants took longer to complete tasks compared to those in normal temperatures, ultimately leading to a decrease in overall efficiency. Overall efficiency is defined by the ratio of correct items performed to the total reaction time taken to complete the task.

Thus, while cold temperatures may improve the accuracy of responses, they tend to reduce reaction times and overall efficiency. The distraction hypothesis posits that individuals perform at lower levels due to environmental distractions, such as decreased skin temperatures, which are associated with longer response times and reduced efficiency on simple visuomotor reaction tasks. As body temperature drops below a certain threshold, the skin becomes more sensitive to temperature changes, leading to decreased efficiency. Consequently, while the brain may initiate commands for action, the execution of these commands via the limbs is delayed due to longer response times.

This delay is attributed to the lower temperature, which is consistent with what the distraction hypothesis suggests. So far, we have examined how climate affects people's performance. We have analyzed the impacts of both heat and cold on not only physical performance but also cognitive performance. In addition to climate, several other environmental variables also influence people's performance. We will investigate some of these variables next.

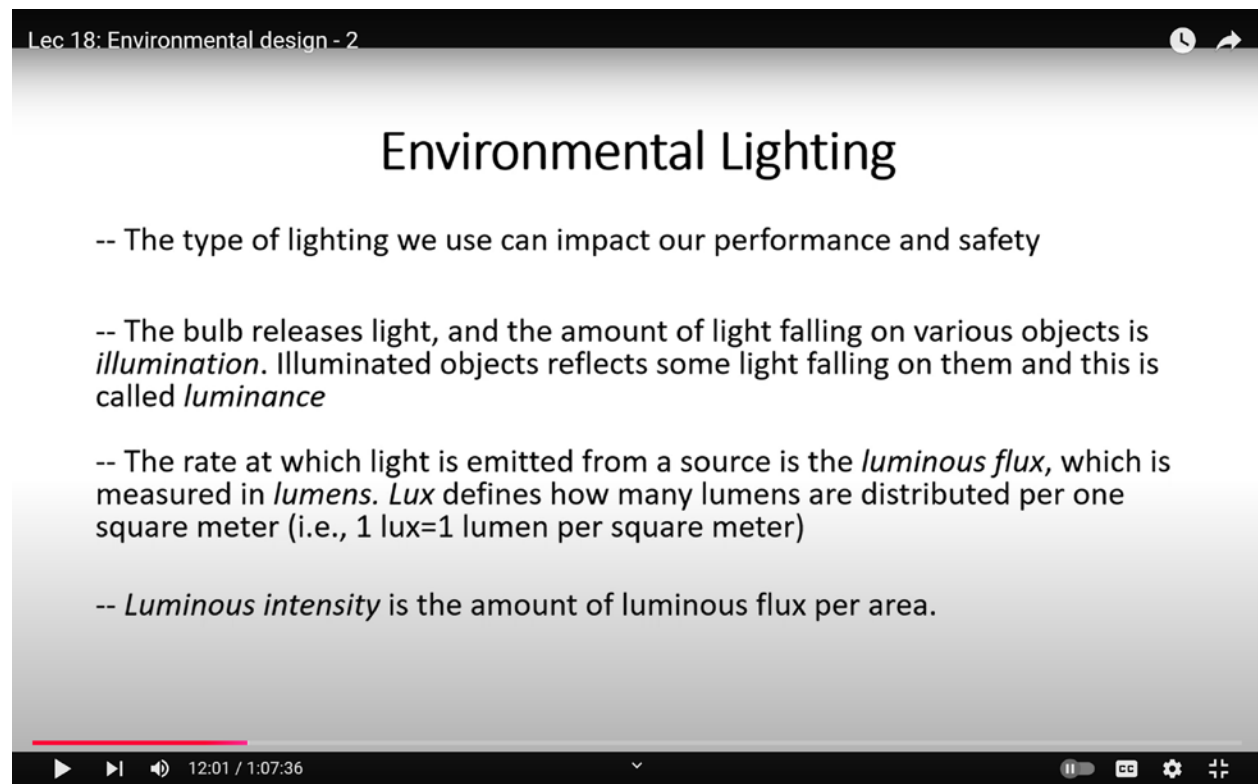
One significant variable that has been extensively researched in both ergonomics and industrial and organizational psychology is the effect of lighting. It is believed that artificial lighting can enhance performance to levels comparable to natural light. Consequently, after World War II, many companies concentrated on ways to improve lighting in workspaces. Numerous studies were

conducted to demonstrate how lighting can enhance performance on factory floors. Let us examine in detail the effects of lighting on performance.

The type of lighting we use can significantly impact our performance and safety. For instance, when reading, one may require more light since a book lacks its own light source. In such cases, bulbs or incandescent lamps produce light that is reflected by the printed words and the background of the page, allowing our eyes to perceive the contrast between the light reflected by the words and that of the page's background. This process enables reading.

Conversely, when reading from a computer monitor, less additional light is needed because the monitor itself emits light. Thus, the environmental light required for comfortable reading is diminished. Therefore, various types of lighting affect performance in different ways. Let us explore how light is produced.

(Refer Slide Time: 12:01)



The screenshot shows a video player interface. At the top, a black bar contains the text 'Lec 18: Environmental design - 2' on the left and a circular icon with a right-pointing arrow on the right. Below this is a large white title 'Environmental Lighting'. The main content area has a light gray background and contains four bullet points, each preceded by two dashes. The first bullet point is 'The type of lighting we use can impact our performance and safety'. The second bullet point is 'The bulb releases light, and the amount of light falling on various objects is *illumination*. Illuminated objects reflect some light falling on them and this is called *luminance*'. The third bullet point is 'The rate at which light is emitted from a source is the *luminous flux*, which is measured in *lumens*. *Lux* defines how many lumens are distributed per one square meter (i.e., 1 lux=1 lumen per square meter)'. The fourth bullet point is '*Luminous intensity* is the amount of luminous flux per area.'. At the bottom of the video player, there is a black bar with a red progress line on the left, followed by play, next, and volume icons, then the time '12:01 / 1:07:36', a dropdown arrow, and finally icons for full screen, closed captions, settings, and a list.

Lec 18: Environmental design - 2

Environmental Lighting

- The type of lighting we use can impact our performance and safety
- The bulb releases light, and the amount of light falling on various objects is *illumination*. Illuminated objects reflect some light falling on them and this is called *luminance*
- The rate at which light is emitted from a source is the *luminous flux*, which is measured in *lumens*. *Lux* defines how many lumens are distributed per one square meter (i.e., 1 lux=1 lumen per square meter)
- *Luminous intensity* is the amount of luminous flux per area.

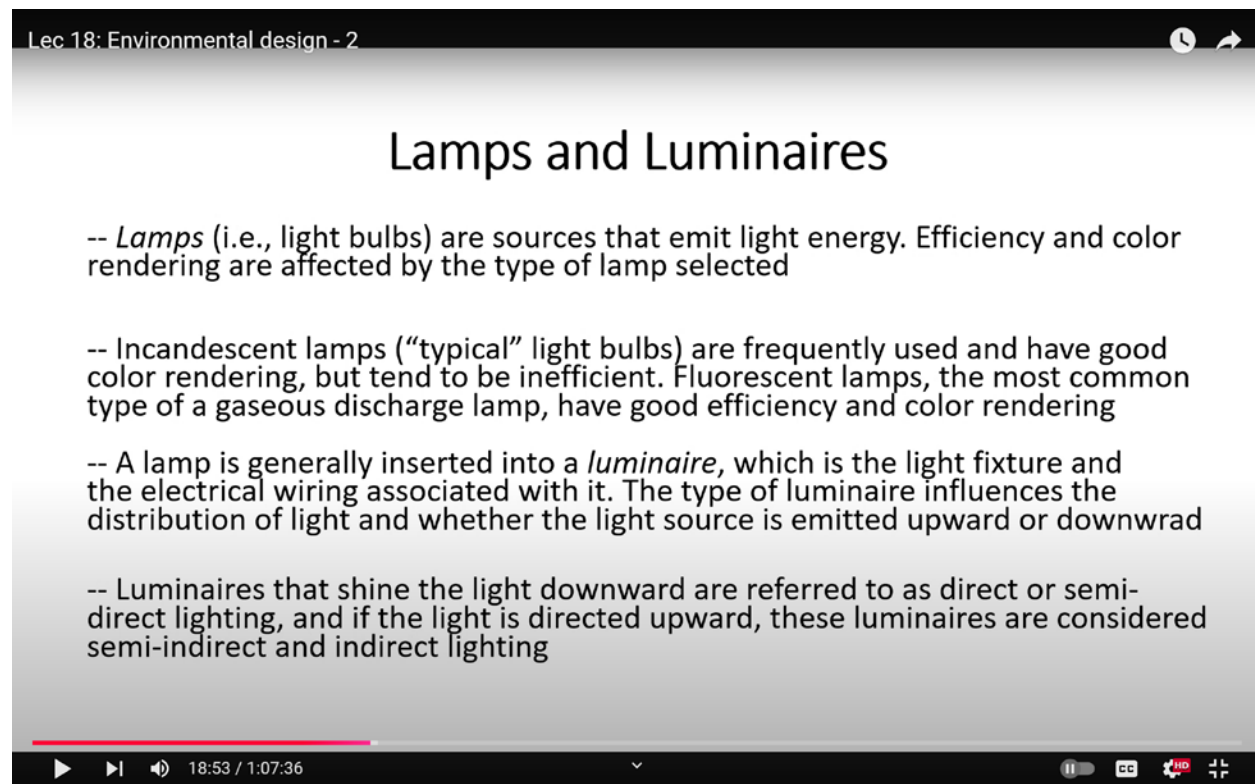
The bulb, a common source of light, emits light, and the amount of light falling on various objects is referred to as illumination. Illumination is defined as the act of light falling on certain objects.

When an object is illuminated, it absorbs some light while reflecting the rest; this reflected light is known as the luminescence of the object. Thus, illuminated objects reflect the light that falls on them, which is termed luminescence.

How do we measure light? The rate at which light is emitted from a source is called luminous flux. The amount of light a source releases is measured in terms of flux and quantified in lumens. The measure of lumens is lux, which defines how many lumens are distributed per square meter. Therefore, the unit for measuring lumens, which represents luminous flux, is expressed in lux as the SI unit and foot-candles per meter as the American unit of measurement.

To clarify, 1 lux is equivalent to 1 lumen per square meter or the luminous flux from a bulb with a strength of 1 lumen over an area of 1 square meter. Luminous intensity refers to the amount of luminous flux per area, indicating how bright an object is based on the number of lumens it reflects relative to the area receiving that luminous flux. It is also important to note that selecting different types of light sources can lead to variations in light quality.

(Refer Slide Time: 18:53)



The image is a screenshot of a video lecture slide. At the top, a black bar contains the text 'Lec 18: Environmental design - 2' on the left and a circular icon with a right-pointing arrow on the right. The main title 'Lamps and Luminaires' is centered in a large, black, sans-serif font. Below the title, there are four bullet points, each preceded by a double hyphen '--'. The text is in a black, sans-serif font. At the bottom of the slide, there is a black bar containing a red progress bar on the left, followed by a play button icon, a volume icon, and the text '18:53 / 1:07:36'. To the right of this are several small icons: a downward arrow, a CC icon, a red icon with a white 'X', and a full-screen icon.

Lec 18: Environmental design - 2

Lamps and Luminaires

- *Lamps* (i.e., light bulbs) are sources that emit light energy. Efficiency and color rendering are affected by the type of lamp selected
- Incandescent lamps ("typical" light bulbs) are frequently used and have good color rendering, but tend to be inefficient. Fluorescent lamps, the most common type of a gaseous discharge lamp, have good efficiency and color rendering
- A lamp is generally inserted into a *luminaire*, which is the light fixture and the electrical wiring associated with it. The type of luminaire influences the distribution of light and whether the light source is emitted upward or downward
- Luminaires that shine the light downward are referred to as direct or semi-direct lighting, and if the light is directed upward, these luminaires are considered semi-indirect and indirect lighting

18:53 / 1:07:36

Two key aspects should be considered when selecting a light source: efficiency and color rendering. When choosing a bulb or light source, individuals should consider how efficient the bulb is, specifically, how much light it produces relative to its energy consumption. For example, compact fluorescent lamps (CFLs) are more efficient than traditional incandescent bulbs, as they produce more light while consuming less power.

Efficiency measures the number of lumens produced per watt of electricity. Color rendering refers to the light source's ability to accurately replicate the colors of natural objects. It is essential to evaluate how well artificial light reproduces the true color of objects compared to natural light, as some artificial lights may distort colors, making them appear too red or too dark. A light source that can accurately produce natural colors is often preferred, especially in fields like food, apparel, clothing, and medicine.

In consumer psychology, I teach about how to influence customer behavior as a shop owner, and lighting plays a significant role in this. For example, low-level lighting can enhance the ambiance and promote purchasing behavior for certain high-end or aesthetically appealing items. Thus, lighting can be strategically used for such purposes.

Thus, lamps, commonly referred to as light bulbs, are sources that emit light energy. The efficiency and color rendering of these lamps are influenced by the type of lamp chosen.

Bulbs produce light, but the type of bulb determines its efficiency and color rendering capabilities. There are two primary types of light sources: incandescent lamps and fluorescent lamps. An incandescent lamp is a typical light bulb that contains a filament connected to two poles of electricity: the anode and the cathode. As current flows through the filament, it heats up. The filament is enclosed in a vacuum, and as it heats, it generates energy, producing light. This defines a standard incandescent lamp.

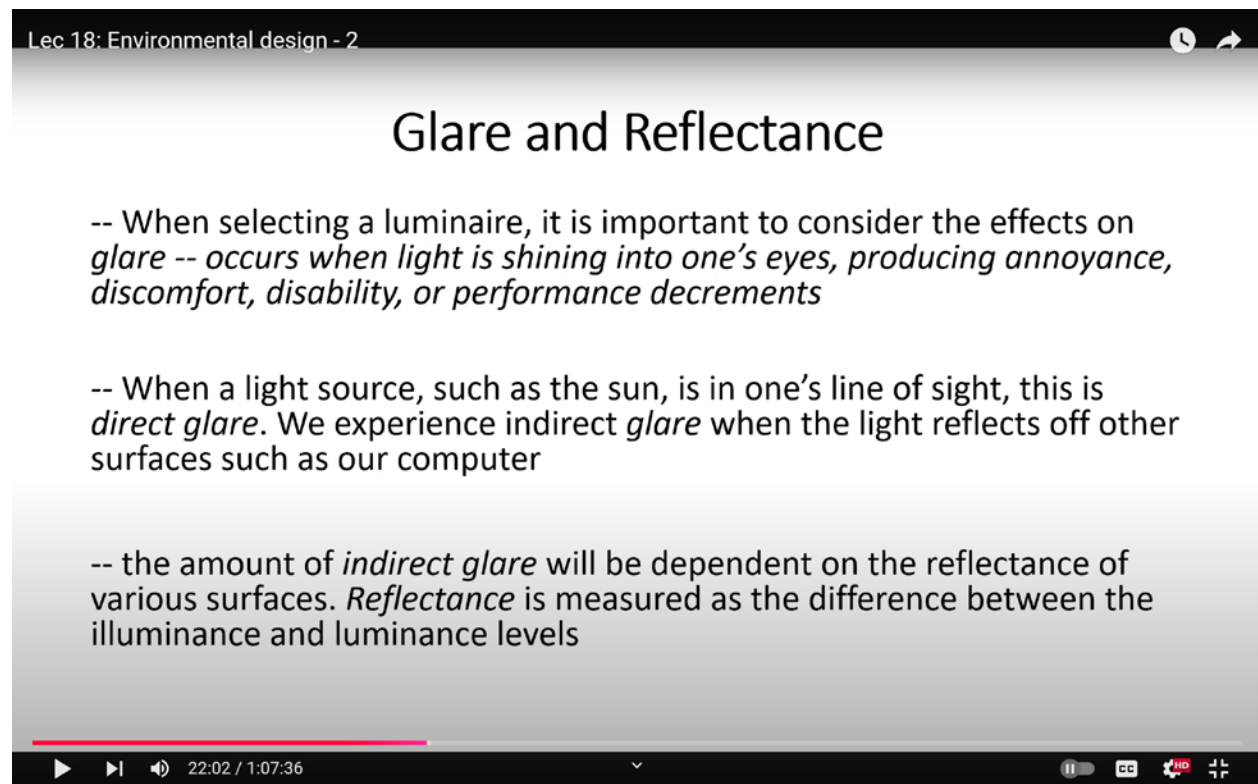
Incandescent lamps are frequently chosen for their excellent color rendering, but they tend to be inefficient. Although these bulbs provide good reproduction of natural colors, they require more energy to generate light. In contrast, fluorescent lamps, which are the most common type of gaseous discharge lamp, offer good efficiency and color rendering. Compact fluorescent lamps (CFLs) exhibit both good efficiency and good color rendering, depending on the specific type of

CFL being utilized.

Typically, the lamp is inserted into a luminaire. A luminaire is the apparatus that houses the lamp, supplies electricity to it, and includes all the connections that bring electricity from the wall outlet to the bulb. This entire assembly is referred to as the luminaire. Therefore, a luminaire encompasses the light fixture and its associated electrical wiring; the type of luminaire influences the distribution of light and whether the emitted light is directed upward or downward. For instance, table lamps feature different shades on top of the bulb, and the various shapes of these shades determine where the light will be focused.

The design of a shade on a lamp dictates the focal point of the light. Luminaires that direct light downward are categorized as direct or semi-direct lighting, while luminaires that direct light upward are classified as semi-indirect or indirect lighting. Consequently, the shape of the luminaire determines whether the lighting is direct or indirect. Another factor that affects performance in relation to light is glare. When selecting a luminaire, it is crucial to consider the effects of glare.

(Refer Slide Time: 22:02)



The screenshot shows a video player interface. At the top, a black bar contains the text 'Lec 18: Environmental design - 2' on the left and a clock icon on the right. Below this is a large white title 'Glare and Reflectance'. The main content area has a light gray background and contains three bullet points, each preceded by '--'. The first bullet point discusses the importance of considering glare when selecting a luminaire and defines glare. The second bullet point explains direct glare and indirect glare. The third bullet point states that indirect glare depends on surface reflectance and defines reflectance. At the bottom, a black bar contains a red progress bar, a play button, a volume icon, the time '22:02 / 1:07:36', a dropdown arrow, a full screen icon, a CC icon, a red 'HD' icon, and a settings icon.

Lec 18: Environmental design - 2

Glare and Reflectance

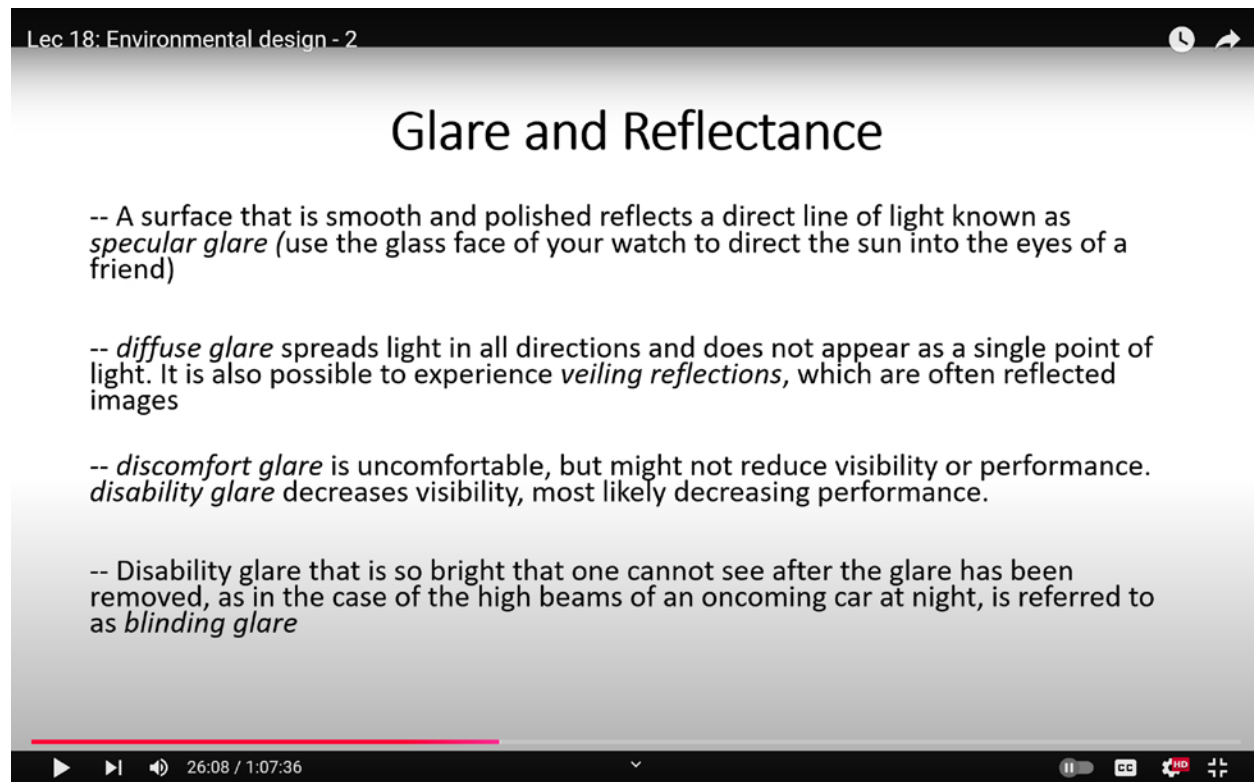
- When selecting a luminaire, it is important to consider the effects on *glare* -- occurs when light is shining into one's eyes, producing annoyance, discomfort, disability, or performance decrements
- When a light source, such as the sun, is in one's line of sight, this is *direct glare*. We experience indirect *glare* when the light reflects off other surfaces such as our computer
- the amount of *indirect glare* will be dependent on the reflectance of various surfaces. *Reflectance* is measured as the difference between the illuminance and luminance levels

22:02 / 1:07:36

What is glare? Glare occurs when a light source directly illuminates someone's eyes, leading to temporary visual impairment and difficulty focusing on objects. This phenomenon can result in annoyance, discomfort, disability, or a decrease in performance. Therefore, glare is something individuals typically strive to avoid. There are different types of glare, which we will discuss.

When a light source, such as the sun, is within one's line of sight, it produces what is known as direct glare. For example, looking directly at the sun or an incandescent bulb creates direct glare. Conversely, indirect glare occurs when light reflects off other surfaces, such as a computer screen. If light first falls on your computer screen and causes discomfort in your eyes, this is referred to as indirect glare. The extent of indirect glare depends on the reflectance of various surfaces; more polished surfaces will yield greater indirect glare.

(Refer Slide Time: 26:08)



The screenshot shows a video player interface. At the top, a black bar contains the text 'Lec 18: Environmental design - 2' on the left and a clock icon on the right. Below this is a large white title 'Glare and Reflectance'. The main content area has a light gray background and contains four bullet points, each preceded by '--'. The first bullet point discusses specular glare with an example about a watch. The second discusses diffuse glare and veiling reflections. The third discusses discomfort and disability glare. The fourth discusses blinding glare. At the bottom, a black bar contains a red progress bar, a play button, a volume icon, the time '26:08 / 1:07:36', a dropdown arrow, a full screen icon, and a red 'HD' logo.

Lec 18: Environmental design - 2

Glare and Reflectance

- A surface that is smooth and polished reflects a direct line of light known as *specular glare* (use the glass face of your watch to direct the sun into the eyes of a friend)
- *diffuse glare* spreads light in all directions and does not appear as a single point of light. It is also possible to experience *veiling reflections*, which are often reflected images
- *discomfort glare* is uncomfortable, but might not reduce visibility or performance. *disability glare* decreases visibility, most likely decreasing performance.
- Disability glare that is so bright that one cannot see after the glare has been removed, as in the case of the high beams of an oncoming car at night, is referred to as *blinding glare*

26:08 / 1:07:36

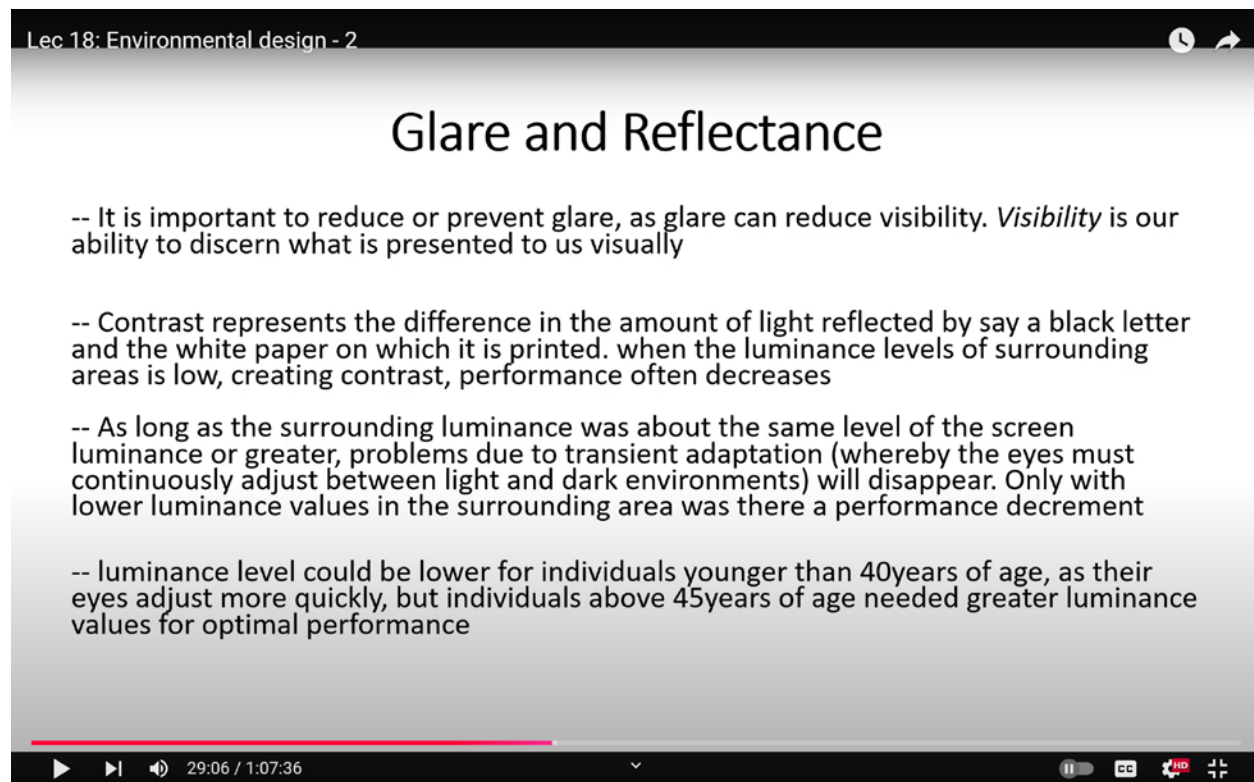
Reflectance is measured by the difference between luminescence and luminance levels. A smooth and polished surface that reflects light in a direct line creates a specular glare. For example, using a watch to focus sunlight into someone's eyes results in specular glare. In contrast, diffuse glare

occurs when light disperses in all directions and does not appear as a single point of light. In cases of diffuse glare, the light may spread in such a way that its source is unclear.

We also encounter veiling reflections. Often, older CRT computer monitors are polished to the extent that they reflect objects behind the viewer clearly. This phenomenon is known as veiling reflections, which consist of reflected images of objects on polished surfaces that create glare. Discomfort glare causes unease but may not significantly reduce visibility or performance. In contrast, disability glare impairs visibility and likely decreases performance.

Glare can be further classified into discomfort glare and disability glare. While discomfort glare does not significantly impact cognitive performance on tasks, disability glare can swiftly incapacitate individuals and diminish cognitive performance. For example, disability glare is so intense that individuals struggle to see even after the glare has been removed.

(Refer Slide Time: 29:06)



The screenshot shows a video player interface. At the top, a black bar contains the text 'Lec 18: Environmental design - 2' on the left and a clock icon on the right. Below this is a light gray header with the title 'Glare and Reflectance' in a large, bold, black font. The main content area is white and contains four bullet points, each preceded by '--'. The first bullet point discusses the importance of reducing glare to maintain visibility. The second discusses contrast and its effect on performance. The third discusses transient adaptation and the need for continuous adjustment between light and dark environments. The fourth discusses luminance levels for different age groups. At the bottom, a black bar contains a red progress bar, a play button, a volume icon, the time '29:06 / 1:07:36', a dropdown arrow, a full screen icon, and a share icon.

Lec 18: Environmental design - 2

Glare and Reflectance

- It is important to reduce or prevent glare, as glare can reduce visibility. *Visibility* is our ability to discern what is presented to us visually
- Contrast represents the difference in the amount of light reflected by say a black letter and the white paper on which it is printed. when the luminance levels of surrounding areas is low, creating contrast, performance often decreases
- As long as the surrounding luminance was about the same level of the screen luminance or greater, problems due to transient adaptation (whereby the eyes must continuously adjust between light and dark environments) will disappear. Only with lower luminance values in the surrounding area was there a performance decrement
- luminance level could be lower for individuals younger than 40years of age, as their eyes adjust more quickly, but individuals above 45years of age needed greater luminance values for optimal performance

29:06 / 1:07:36

A common example is the glare from oncoming car headlights at night, which is referred to as blinding glare. This phenomenon is often observed when driving, particularly on Indian roads,

where drivers may use high beams. When the bright headlights of an approaching car shine directly into the driver's eyes, the discomfort caused can result in temporary blindness for several seconds.

It is advisable for drivers to avoid using high beams when other vehicles are nearby, as high beams should only be utilized on dark highways where there are no other light sources and when visibility of distant cars is required. In urban traffic conditions or at closer distances, high beams should be avoided to prevent blinding glare. Reducing or preventing glare is essential, as it can significantly impair visibility.

Visibility refers to our ability to discern visual information presented to us. Glass, for instance, can temporarily block visibility, impacting our capacity to identify objects. Another significant factor that affects visibility is contrast, which represents the difference in the amount of light reflected by black letters on white paper, for example. When the luminance levels of the surrounding area are low, creating contrast, performance often decreases.

In an environment with low luminescence, which is the area of interest, a significant contrast can lead to a decline in performance because the eyes must work harder to make adjustments. When the difference between two luminescent areas is substantial, the eyes are compelled to shift focus between regions of low and high luminance, resulting in discomfort and ultimately leading to decreased performance. However, when the surrounding luminance is approximately equal to or greater than the luminance of the screen, problems associated with transient adaptation, where the eyes continuously adjust between light and dark environments, are mitigated.

When using a computer or monitor, if the luminance levels in the surrounding area are similar to that of the monitor, users typically do not experience discomfort. Conversely, imagine typing or working on a computer in a dark room; in this scenario, the eyes must quickly move between the keyboard and the monitor, adjusting between dark and light areas. This adjustment between dark and light regions is known as transient adaptation, which can lead to discomfort. Therefore, it is advisable to read or work in well-lit environments, minimizing the need for the eyes to constantly shift between different luminance levels.

(Refer Slide Time: 31:43)

Lec 18: Environmental design - 2

Task Lighting and Light Distribution

- *Task lighting* is the specific lighting required for a particular task or activity. Certain types of tasks require higher or lower levels of illumination (reading requires greater illumination than socializing)
- some tasks may need shadowing to allow the observer to detect flaws in materials, as in the case of inspection lighting. When the task involves the use of computers amount of ambient lighting can be reduced
- Another aspect of lighting that should be discussed is the distribution of light or illumination. The *light distribution*, the scattering of illuminance over an environment, can be as important as how much light is available
- Uneven light distributions, create a major problem for people. As people move into and then away from lighting, they experience transient adaptation. Owing to the time it takes to dark adapt, an individual is likely to miss something while in the darker environment.

31:43 / 1:07:36

Performance decrement is primarily observed when the surrounding area has lower luminance values. It is important to note that individuals under the age of 40 may experience lower performance decrements in dim environments, as their eyes adjust more quickly. Young people below 40 years of age generally possess good visual acuity, making it easier for them to adapt to varying luminance levels. However, as individuals age beyond 40, they typically require higher luminance levels for optimal performance. Consequently, older adults are encouraged to work in better-lit environments to enhance their performance.

The type of task and the distribution of light also significantly impact performance. Task lighting refers to the specific illumination required for particular activities. Certain tasks necessitate higher or lower levels of illumination; for example, reading requires greater illumination than socializing. When socializing with friends, less light is necessary, whereas reading demands a well-lit area to ensure clarity.

In some cases, tasks may require shadowing to help observers detect flaws in materials, as seen in

inspection lighting. While working with computers, the amount of ambient lighting can often be reduced. Shadowing is particularly important when trying to locate small objects on the floor. For instance, if a needle is dropped, viewing it from a standing position may hinder visibility. To find the needle, one must bend down and position oneself parallel to the floor, allowing for the observation of the needle's shadow cast by the light source. The shadow of the needle will differ from other shadows on the floor, making it easier to locate.

Another critical aspect of lighting to consider is the distribution of light or illumination. The scattering of illumination across an environment is crucial for determining how much light is available. Uneven light distributions can pose significant challenges. As individuals move through areas with varying light levels, they experience transient adaptation, which can lead to missed visual cues in darker environments.

For example, city lighting often features various light posts. When one is near a light post, visibility improves; however, the areas between the posts tend to be darker, resulting in minimal overlap of illumination. The greater the distance between two light posts, the more work the eyes must do to adjust from well-lit areas to darker ones. Therefore, the arrangement of light posts should ensure adequate illumination between them; otherwise, individuals may struggle with transient adaptation, adjusting between brightly lit and dark environments.

Another environmental factor that can impact performance is environmental noise. Noise is defined as any sound unrelated to the task at hand. Any auditory distraction can lead to hearing losses and temporary or permanent threshold shifts. Prolonged exposure to high-frequency noise can adapt the hearing system, resulting in an increased threshold for sound perception.

Hearing protection becomes crucial in environments with significant noise exposure. Various fields can be affected by this issue; for example, workers on a factory floor may experience diminished performance due to noise, as can individuals working in airports.

Individuals working in close proximity to jet engines are frequently exposed to high levels of noise. Therefore, it is essential for them to wear protective equipment that shields them from this loud sound. Humans are vital for the proper functioning of airports and areas where jet engines operate, making it crucial to provide adequate protection against environmental noise.

(Refer Slide Time: 34:32)

Lec 18: Environmental design - 2

Environmental Noise

- Noise is any sound unrelated to the task. It leads to hearing loss and temporary and permanent threshold shifts. Threshold shifts and hearing loss stress the importance of hearing protection
- Two types of hearing protection include earplugs and earmuffs. Earplugs are inserted into the ear canal, whereas earmuffs cover the outer ear. The best protection occurs when both earplugs and earmuffs are used.
- The Occupational Safety and Health Administration (OSHA) defines exposure limits for various sound levels to protect workers from too loud or too long of an exposure

34:32 / 1:07:36

There are two primary types of hearing protection: earplugs and earmuffs. Earplugs are inserted into the ear canal to block or reduce ambient noise, while earmuffs cover the outer ear. For optimal protection, it is common for ground staff at airports to utilize both earplugs and earmuffs simultaneously. The Occupational Safety and Health Administration (OSHA) has established exposure limits to various sound levels to safeguard workers from excessive noise exposure, whether it is too loud or sustained for extended periods.

Even with protective measures like earplugs and earmuffs and by avoiding excessively loud environments, being in noisy settings can still adversely affect individuals. For instance, working in a bar or a railway station, where noise levels are notably high, can impact performance. Auditory displays or sounds that are not task-related, beyond mere warnings, can mask critical auditory signals. Thus, it is vital to consider potential masking effects when designing auditory systems to prevent detrimental performance outcomes.

(Refer Slide Time: 37:38)

Lec 18: Environmental design - 2

Environmental Noise

- Even though we can protect our hearing and reduce our exposure time to loud sounds, being in noisy environments can still affect us
- As any auditory display or sound, not just warnings, can mask another sound, it is critical to account for potential masking when designing auditory systems to avoid potentially debilitating performance
- environmental noise can increase one's perception of workload and be distracting, causing interference with various tasks
- When these noise conditions occurred during the learning and recall phases, performance in all conditions dropped relative to the quiet condition. The fact that performance dropped over time with noise without speech present does not support the argument that the phonological store was affected, but that the disruption arose due to the constantly changing sounds

37:38 / 1:07:36

When designing auditory alarms, it is important to ensure that they do not interfere with the signals being monitored. Monitoring alarms should effectively alert users without causing additional issues. If an alarm is excessively loud, it may contribute to masking effects, further complicating the situation. Environmental noise can heighten an individual's perception of workload, leading to distractions that interfere with various tasks. In environments characterized by significant noise, such as a railway station, a stock market, or a bar, workers often report an inflated sense of their workload. This tendency to overestimate workload is largely due to the distractions and cognitive fatigue induced by excessive noise, compelling individuals to concentrate more on their tasks and utilize greater cognitive resources.

This increased demand for cognitive effort results in a perceived higher workload or stress. Notably, when these noisy conditions are present during learning and recall phases, performance in all scenarios declines in comparison to quiet conditions. In one study, participants were provided with learning materials and later asked to recall them while exposed to varying levels of noise. The findings indicated that performance deteriorated in all noisy conditions relative to quieter

environments.

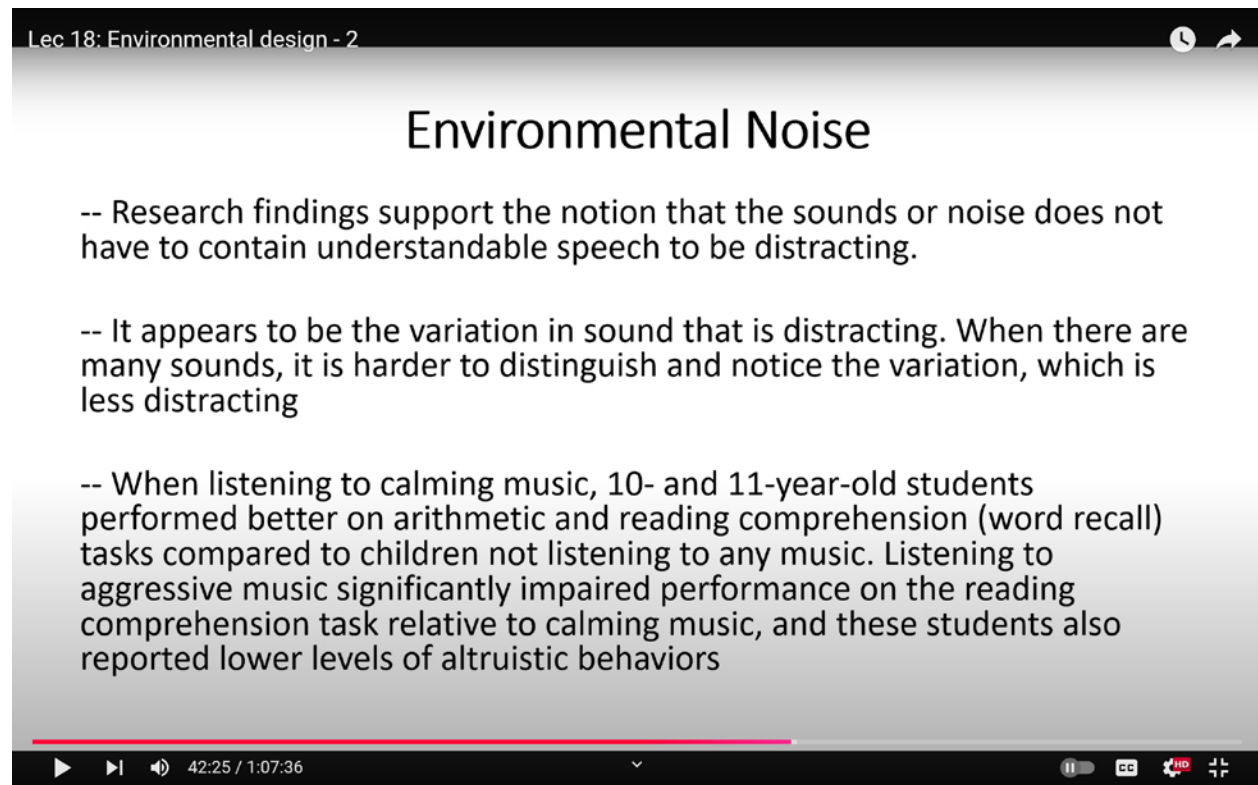
The observation that performance declined over time in the absence of speech, with only environmental noise present, does not support the argument that the phonological store was impacted. Instead, the disruption appears to stem from the ever-changing sounds in the environment. Given that no speech was involved, it can be inferred that executive function or working memory was not overloaded, and the phonological store was not excessively engaged. The decline in performance occurred because the participants faced constant variations in environmental noise, which created discomfort and necessitated additional cognitive effort to focus on the task of recalling information.

Research supports the idea that sounds or noise do not need to contain intelligible speech to be distracting. This is a critical insight, as it is often assumed that conversations lead to environmental noise and subsequent performance decrements. Studies suggest that white noise or sounds devoid of speech can also be distracting and lead to impaired performance. Constant humming or fluctuating sounds, even without discernible speech, can diminish performance levels.

It seems that the variation in sound, specifically, how it is produced and the modulation of sound waves, contributes to distraction and performance decrements. When multiple sounds occur simultaneously, it becomes increasingly challenging to identify less distracting variations. However, an overwhelming number of sounds may become less distracting overall, as it becomes difficult to pay attention to all of them, resulting in lower mental load.

Research has shown that when 10- and 11-year-old students listen to calming music, their performance improves on arithmetic and reading comprehension tasks compared to children who do not listen to music. Experiments indicate that music can enhance arithmetic and reading comprehension. Conversely, exposure to aggressive music significantly impairs performance on reading comprehension tasks compared to calming music. Students exposed to aggressive music also reported lower levels of altruistic behavior.

(Refer Slide Time: 42:25)



The screenshot shows a video player interface. At the top, a black bar contains the text 'Lec 18: Environmental design - 2' on the left and a clock icon on the right. Below this is a large white box with the title 'Environmental Noise' in a bold, black, sans-serif font. Under the title, there are three bullet points, each preceded by '--'. The first bullet point states that research findings support the notion that sounds or noise do not have to contain understandable speech to be distracting. The second bullet point states that it appears to be the variation in sound that is distracting, and that when there are many sounds, it is harder to distinguish and notice the variation, which is less distracting. The third bullet point states that when listening to calming music, 10- and 11-year-old students performed better on arithmetic and reading comprehension (word recall) tasks compared to children not listening to any music. Listening to aggressive music significantly impaired performance on the reading comprehension task relative to calming music, and these students also reported lower levels of altruistic behaviors. At the bottom of the slide, there is a red progress bar. Below the progress bar is a black bar containing a play button, a volume icon, the text '42:25 / 1:07:36', a dropdown arrow, a full screen icon, a CC icon, a red 'HD' icon, and a settings icon.

Lec 18: Environmental design - 2

Environmental Noise

- Research findings support the notion that the sounds or noise does not have to contain understandable speech to be distracting.
- It appears to be the variation in sound that is distracting. When there are many sounds, it is harder to distinguish and notice the variation, which is less distracting
- When listening to calming music, 10- and 11-year-old students performed better on arithmetic and reading comprehension (word recall) tasks compared to children not listening to any music. Listening to aggressive music significantly impaired performance on the reading comprehension task relative to calming music, and these students also reported lower levels of altruistic behaviors

42:25 / 1:07:36

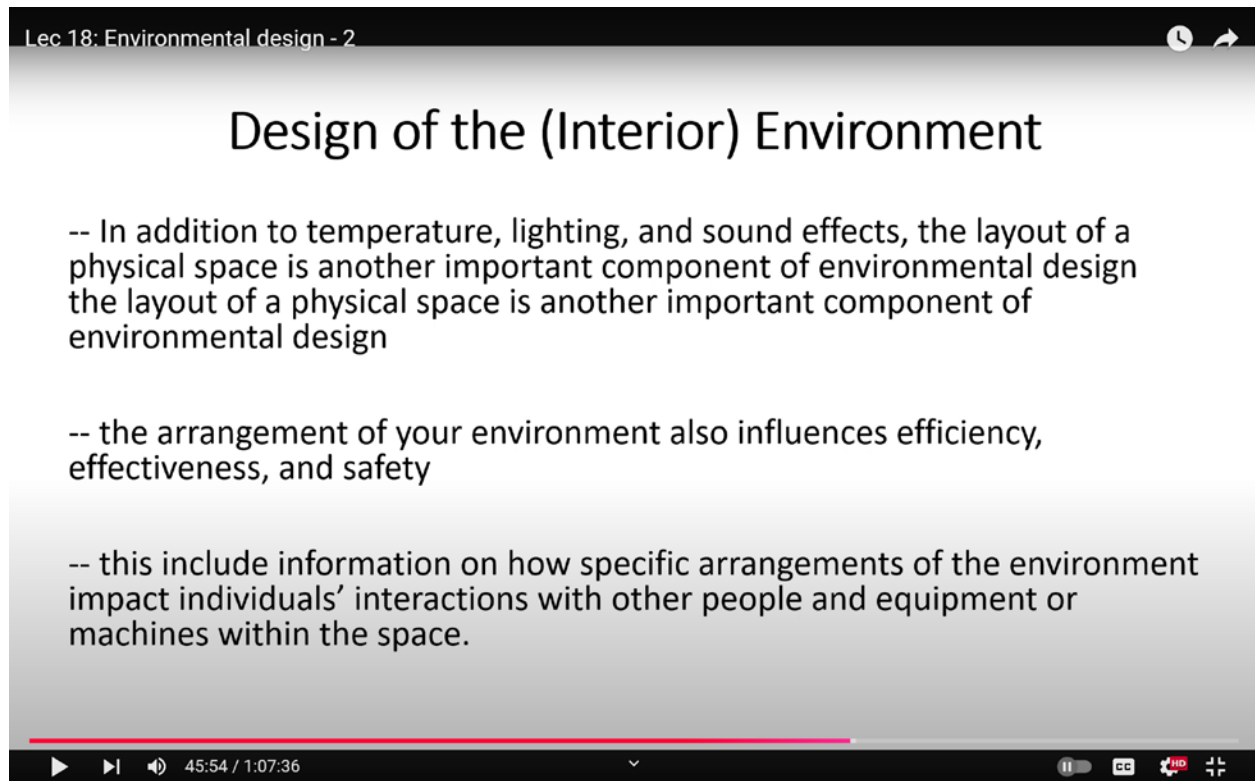
The increased arousal and distraction associated with aggressive music lead to hyperactivity among students, resulting in further impairment of cognitive task performance. Additionally, they exhibited less altruistic behavior compared to peers who listened to calming music. People often advocate for meditation as a method to lower arousal levels and brain activity. By reducing brain activity, meditation can enhance concentration and, consequently, improve performance.

Conversely, when individuals are exposed to more distracting sounds that increase brain activity, their workload will rise, and this can also impact their social behavior. Additionally, the design of the interior environment plays a significant role in performance. Beyond temperature, lighting, and sound effects, the layout of a physical space is another crucial element of environmental design. The arrangement of physical space has significant implications for performance and is an essential aspect of environmental design. Thus, the way one works is influenced by the environment in which they operate.

The nature of the environment in which one sits and works greatly affects performance. The

arrangement of the workspace also impacts efficiency, effectiveness, and safety. Consider the design of your environment: What objects are on your desk? Who are your colleagues? What level of privacy do you have in your office? What environmental stimuli do you observe while working? All these factors will influence your work performance.

(Refer Slide Time: 45:54)



The screenshot shows a video player interface. At the top, a black bar contains the text 'Lec 18: Environmental design - 2' on the left and a circular icon with a right-pointing arrow on the right. Below this is a light gray header area with the title 'Design of the (Interior) Environment' in a large, bold, black font. The main content area is white and contains three bullet points, each preceded by two dashes '--'. The first bullet point reads: '-- In addition to temperature, lighting, and sound effects, the layout of a physical space is another important component of environmental design'. The second bullet point reads: '-- the arrangement of your environment also influences efficiency, effectiveness, and safety'. The third bullet point reads: '-- this include information on how specific arrangements of the environment impact individuals' interactions with other people and equipment or machines within the space.' At the bottom of the slide is a red horizontal line. Below the slide is a black video player control bar. It includes a play button, a next button, a volume icon, a progress bar showing '45:54 / 1:07:36', a dropdown arrow, a full screen button, a settings gear icon, and a red 'HD' logo.

Lec 18: Environmental design - 2

Design of the (Interior) Environment

- In addition to temperature, lighting, and sound effects, the layout of a physical space is another important component of environmental design
- the arrangement of your environment also influences efficiency, effectiveness, and safety
- this include information on how specific arrangements of the environment impact individuals' interactions with other people and equipment or machines within the space.

The design of the environment encompasses how specific arrangements affect an individual's interaction with others, as well as with equipment or machinery within the space. Consequently, environmental design will consider both the arrangement of the environment and the interactions between people and machines. To determine the optimal layout and arrangement of spaces, it is essential to first assess how individuals interact with that space. Understanding how environments affect performance requires knowledge of the types of interactions people have with their surroundings.

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Lec 18: Environmental design - 2

Link Analysis

- To determine appropriate layouts and arrangements of spaces, one must first determine how individuals interact with the space
- *Link analysis* is a common method for determining the movements of people within a workspace. Two key components of link analysis are frequency and importance of these movements
- When a person must interact with certain equipment more frequently, that equipment should be positioned closer to the user. Similarly, if one of the controls is critical, it should also be located closer to the user, even if the frequency of use is low

48:17 / 1:07:36

analyze these interactions, a technique called link analysis is employed. In link analysis, all possible interactions a person has with the surrounding objects are examined. By studying these interactions, a flow diagram is created, and certain ergonomic principles are applied to redesign the way people interact with each other and with equipment. This approach aims to ensure that individuals can effectively perform their tasks without distractions.

Link analysis serves as a common method for assessing individuals' movements within a workspace. It evaluates how people navigate their environment, whom they engage with, and the nature of those interactions. All relevant factors are taken into account, including which equipment is used frequently and which is used less often, as well as the positioning of both individuals and equipment. Two key components of link analysis are the frequency and importance of movements within the work environment.

When a person must frequently interact with specific equipment, that equipment should be positioned closer to the user. Similarly, if a control is deemed critical, it should be easily accessible,

even if it is not used often. Consider a typical office worker who interacts with a computer, keyboard, mouse, and various other items on their desk. Additionally, this person may need to visit a file cabinet for documents or the water cooler for hydration. They will also need to move around to consult colleagues and seek information or assistance.

To enhance performance, frequently used items should be placed within easy reach to minimize unnecessary movements. The placement of emergency buttons or critical controls also raises important considerations. Although critical controls should be readily accessible, they must be designed to prevent accidental activation. Therefore, some form of resistance should be incorporated.

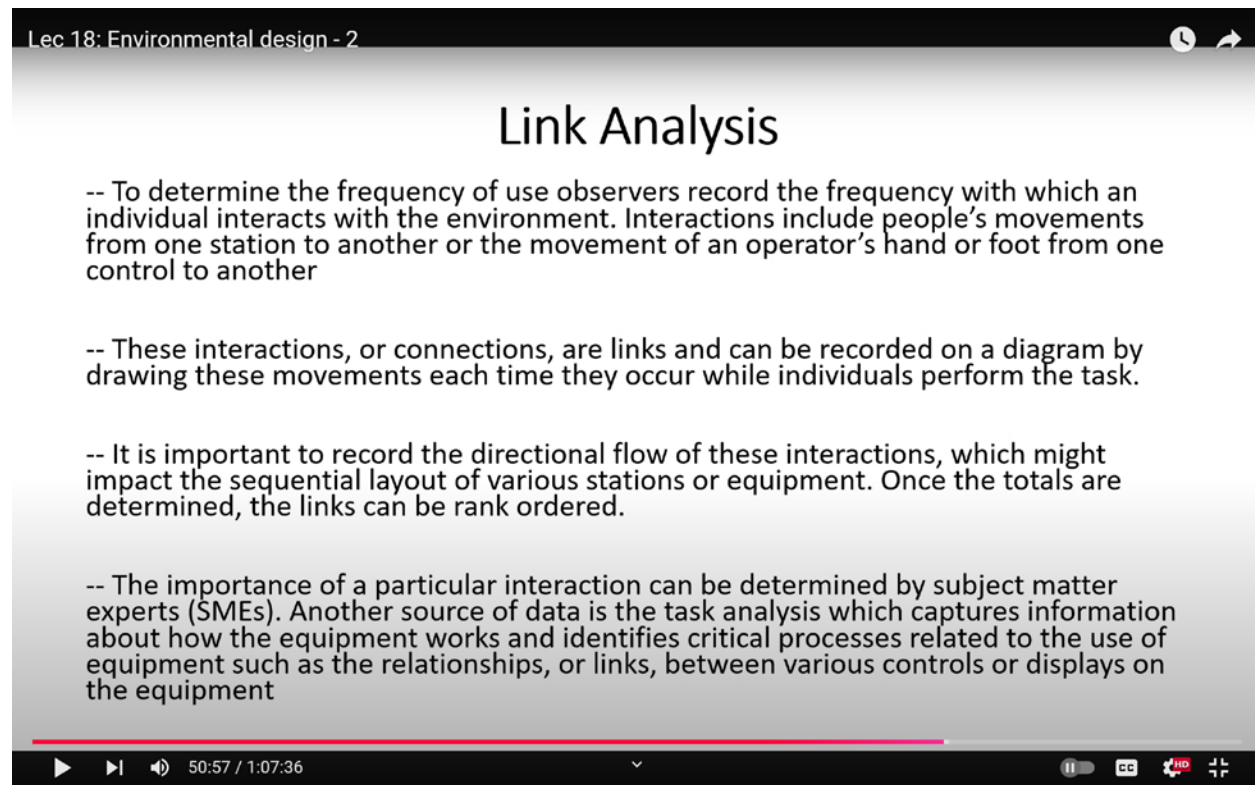
To assess usage frequency, observers record how often an individual interacts with their environment. This interaction includes movements from one station to another and the operation of controls by hand and foot. In conducting link analysis, the frequency of interactions with other individuals, objects, or controls is documented. All movements required to perform tasks are recorded, along with the manner in which these movements occur.

These interactions, or connections, are represented as links in a diagram that illustrates the movements occurring during task performance. The diagram outlines the tasks assigned to the individual and quantifies the number of movements as links. The frequency of each movement is given weight, with thicker lines indicating more frequent use compared to thinner lines.

It is also important to document the directional flow of these interactions, including how actions are performed. For example, is the individual typing from a limb to the computer, or are they reading from the computer to comprehend information? This exchange of information, or flow, should be meticulously recorded in link analysis.

Reporting on the directional flow of interactions may influence the sequential layout of various stations and equipment. The data gathered will indicate where different stations and equipment should be positioned. Once the totals are determined, links can be rank-ordered. By identifying the most frequently occurring interactions, a weight is assigned to each link, allowing for a ranking of their importance.

(Refer Slide Time: 50:57)



The screenshot shows a video player interface. At the top, a black bar contains the text 'Lec 18: Environmental design - 2' on the left and a clock icon on the right. Below this, the slide title 'Link Analysis' is centered in a large, bold, black font. The slide content consists of four bullet points, each preceded by '--'. The first bullet point discusses recording the frequency of interactions. The second discusses recording these interactions as links on a diagram. The third discusses the importance of recording the directional flow of these interactions. The fourth discusses determining the importance of a particular interaction using subject matter experts (SMEs) and task analysis. At the bottom of the slide, a red progress bar is visible. Below the progress bar, a black bar contains a play button, a volume icon, the text '50:57 / 1:07:36', a dropdown arrow, a full screen icon, a CC icon, a red 'HD' icon, and a settings icon.

Lec 18: Environmental design - 2

Link Analysis

- To determine the frequency of use observers record the frequency with which an individual interacts with the environment. Interactions include people's movements from one station to another or the movement of an operator's hand or foot from one control to another
- These interactions, or connections, are links and can be recorded on a diagram by drawing these movements each time they occur while individuals perform the task.
- It is important to record the directional flow of these interactions, which might impact the sequential layout of various stations or equipment. Once the totals are determined, the links can be rank ordered.
- The importance of a particular interaction can be determined by subject matter experts (SMEs). Another source of data is the task analysis which captures information about how the equipment works and identifies critical processes related to the use of equipment such as the relationships, or links, between various controls or displays on the equipment

50:57 / 1:07:36

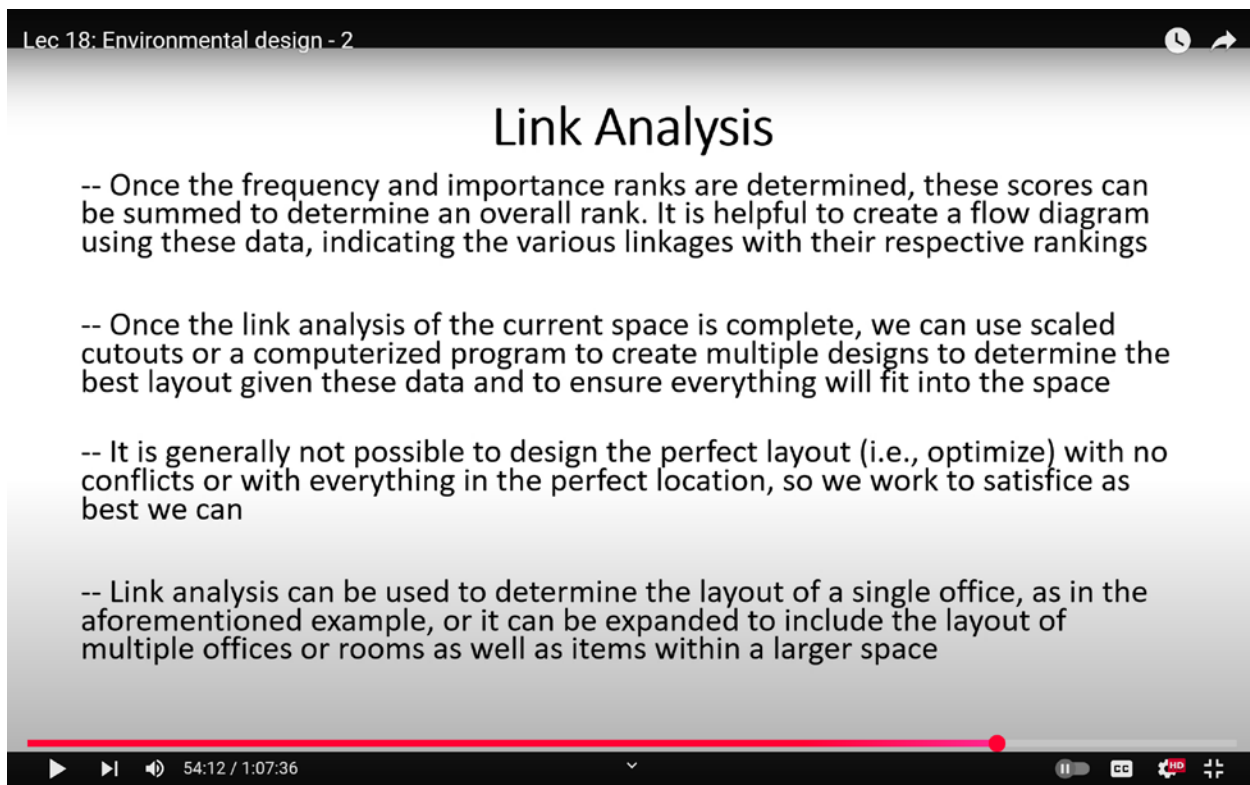
This can be achieved through a diagram that visually represents the rank order of necessary actions versus those deemed less critical. Link analysis thus makes it straightforward to discern which actions are essential for task completion. Subject matter experts can further evaluate the significance of particular interactions. Additionally, task analysis serves as another source of data, capturing how equipment functions and identifying critical processes related to its use, including the relationships or links between various controls or displays on the equipment.

A task analysis can be conducted to identify the actions that a user must perform to complete a given task. However, there are instances when task analysis may not be particularly effective. In such cases, subject matter experts can be consulted to highlight and select the essential actions necessary for task completion. These critical actions can be evaluated using either task analysis or insights from subject matter experts. Actions that are deemed critical can be represented through links, and relationships among these links can be established along with associated weights.

Once the frequency and importance rankings are determined, these scores can be aggregated to

establish an overall rank. Creating a flow diagram with this data will illustrate the various linkages alongside their respective rankings, thus providing a clearer understanding of the frequency of use for specific controls and actions. By summing these scores, we can ascertain which controls are important, which are critical, and which are not. This ranking can assist in developing a flow diagram that illustrates how a task is performed, highlighting the various connections with their rankings.

(Refer Slide Time: 54:12)



The screenshot shows a video player interface. At the top, a black bar contains the text 'Lec 18: Environmental design - 2' on the left and a clock icon on the right. Below this is a light gray slide with the title 'Link Analysis' in a large, bold, black font. The slide contains four bullet points, each preceded by a double dash '--'. The first bullet point discusses summing frequency and importance ranks to determine an overall rank and creating a flow diagram. The second bullet point discusses using scaled cutouts or a computerized program to create multiple designs for the best layout. The third bullet point states that it is generally not possible to design the perfect layout without conflicts, so the goal is to satisfy as best as possible. The fourth bullet point mentions that link analysis can be used for a single office or expanded to multiple offices and rooms. At the bottom of the slide is a red progress bar. Below the slide is a black video player control bar with a play button, a volume icon, the text '54:12 / 1:07:36', a dropdown arrow, a pause button, a closed captions icon, a red 'HD' logo, and a full screen icon.

Lec 18: Environmental design - 2

Link Analysis

- Once the frequency and importance ranks are determined, these scores can be summed to determine an overall rank. It is helpful to create a flow diagram using these data, indicating the various linkages with their respective rankings
- Once the link analysis of the current space is complete, we can use scaled cutouts or a computerized program to create multiple designs to determine the best layout given these data and to ensure everything will fit into the space
- It is generally not possible to design the perfect layout (i.e., optimize) with no conflicts or with everything in the perfect location, so we work to satisfy as best we can
- Link analysis can be used to determine the layout of a single office, as in the aforementioned example, or it can be expanded to include the layout of multiple offices or rooms as well as items within a larger space

54:12 / 1:07:36

After completing the link analysis for the current space, the findings can be scaled into a cutout or incorporated into a computer program to generate multiple design layouts. This process aims to determine the optimal configuration that accommodates all necessary components within the available space. It is generally acknowledged that designing the perfect layout without conflicts is challenging. Consequently, individuals strive to identify the best possible solution given the circumstances.

Link analysis can be applied to design the layout of a single office, as previously mentioned, or it

can be extended to encompass the layout of multiple offices or rooms within a larger area. Therefore, link analysis can be utilized for both smaller and larger offices. While the layout may not be perfect, it can effectively identify the most efficient means of performing a task or the best solution for job execution. To illustrate this concept, consider the following example:

Suppose I am a data entry operator responsible for inputting data. From the moment I sit in my chair until I leave my desk for another task, the sequence of actions I perform can be documented through link analysis. An observer would first note my initial actions upon sitting down. Do I log into a computer? If so, what software do I access? For instance, if I open an Excel spreadsheet, how do I input the data? Do I copy it from one file to another using a mouse, or do I get up from my chair, retrieve a file from a cabinet, and return to my desk?

The significance of retrieving the file and entering numbers must also be considered. How often do I engage in other actions, such as consulting a colleague for data clarification? What is the frequency of these interactions? How many breaks do I take? What motions do I employ while performing my data entry tasks? Is data entry merely entering a number once, or does it involve re-verifying the information?

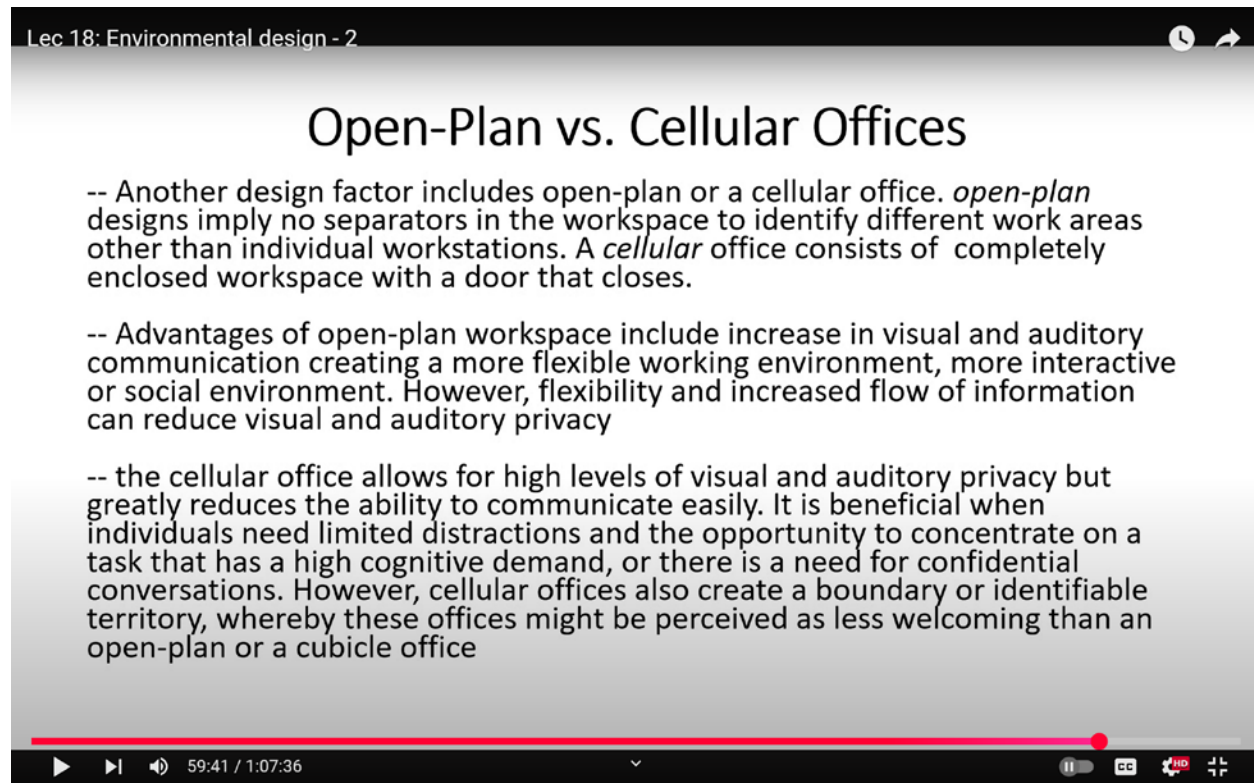
All these tasks, from moving between my chair and the computer to consulting colleagues and retrieving files, can be evaluated and linked. Each action I undertake will be assigned a specific weight. A subject matter expert or task analyst can utilize task analysis to determine which of these actions are essential, leading to the creation of a flow diagram that illustrates these actions. For example, if I need to call someone to obtain specific data, this action can be streamlined by establishing a chat system. While inputting data, I could send a request via chat, allowing the other person to respond directly from their terminal. This approach would eliminate unnecessary actions, such as making phone calls.

Link analysis can generate such solutions. Different types of office layouts also produce distinct performance effects. Another design consideration is whether to utilize an open plan or cellular office configuration. Open plan offices feature cubicles and lack separators between work areas, while cellular offices consist of fully enclosed spaces with doors.

Open plan designs promote visual and auditory communication, creating a more flexible and

interactive work environment. However, this flexibility may come at the cost of reduced visual and auditory privacy. Conversely, cellular offices provide greater auditory privacy but hinder easy communication. While they offer the advantage of reduced distractions, cellular offices are ideal for tasks requiring high levels of concentration, particularly those with significant cognitive demands. Such tasks are better suited for closed or cellular offices, where confidentiality can also be maintained.

(Refer Slide Time: 59:41)



The screenshot shows a video player interface. At the top, a black bar contains the text 'Lec 18: Environmental design - 2' on the left and a circular icon with a right-pointing arrow on the right. Below this is a light gray slide with the title 'Open-Plan vs. Cellular Offices' in a large, bold, black font. The slide contains three bullet points, each preceded by two dashes. The first bullet point discusses design factors for open-plan and cellular offices. The second bullet point lists advantages of open-plan workspace. The third bullet point discusses the benefits and drawbacks of cellular offices. At the bottom of the slide is a red progress bar. Below the progress bar is a black control bar with a play button, a next button, a volume icon, the text '59:41 / 1:07:36', a dropdown arrow, a pause button, a closed captions icon, a red 'HD' icon, and a full-screen icon.

Lec 18: Environmental design - 2

Open-Plan vs. Cellular Offices

- Another design factor includes open-plan or a cellular office. *open-plan* designs imply no separators in the workspace to identify different work areas other than individual workstations. A *cellular* office consists of completely enclosed workspace with a door that closes.
- Advantages of open-plan workspace include increase in visual and auditory communication creating a more flexible working environment, more interactive or social environment. However, flexibility and increased flow of information can reduce visual and auditory privacy
- the cellular office allows for high levels of visual and auditory privacy but greatly reduces the ability to communicate easily. It is beneficial when individuals need limited distractions and the opportunity to concentrate on a task that has a high cognitive demand, or there is a need for confidential conversations. However, cellular offices also create a boundary or identifiable territory, whereby these offices might be perceived as less welcoming than an open-plan or a cubicle office

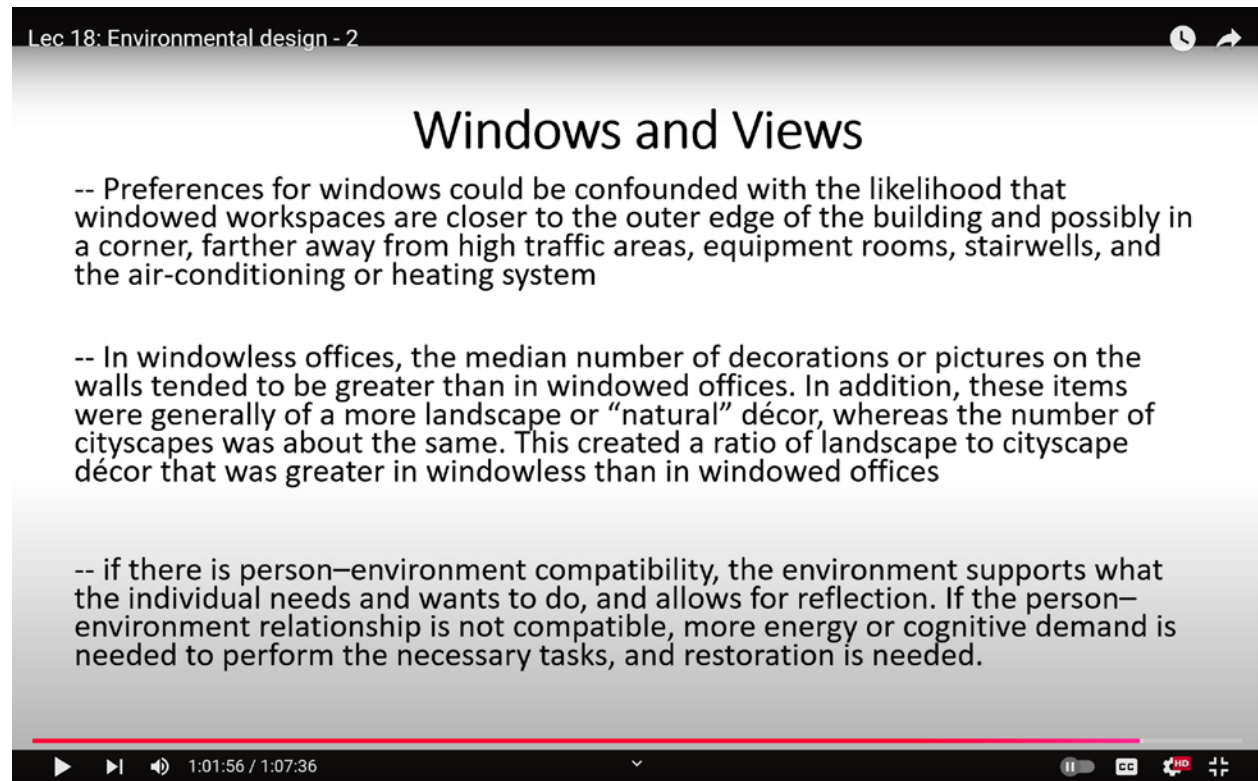
59:41 / 1:07:36

Cellular offices create identifiable boundaries, which may make them seem less welcoming than open plan or cubicle offices. An open office layout enhances communication but can be distracting during confidential or cognitively demanding tasks. The presence of windows also influences performance preferences. It is possible that windowed workspaces are located near the outer edges of a building, away from high-traffic areas, equipment rooms, stairwells, and HVAC systems.

In windowless offices, there tends to be a greater number of decorative items on the walls compared to windowed offices. Additionally, the decorations in windowless offices often feature

more landscape or natural imagery, whereas cityscape decorations are less prevalent. This creates a higher ratio of landscape to cityscape decor in windowless offices than in those with windows, suggesting that individuals in windowless offices tend to favor images of nature over urban landscapes.

(Refer Slide Time: 1:01:56)



The screenshot shows a video player interface. At the top, a black bar contains the text 'Lec 18: Environmental design - 2' on the left and a clock icon on the right. Below this is a light gray header with the title 'Windows and Views' in a large, bold, black font. The main content area has a light gray background and contains three bullet points, each preceded by '--'. The first bullet point discusses how preferences for windows might be confounded by their location in a building. The second bullet point compares the number and type of decorations in windowless versus windowed offices. The third bullet point discusses person-environment compatibility and its impact on cognitive demand. At the bottom of the slide is a black video player control bar with a red progress line, play/pause, volume, and time (1:01:56 / 1:07:36) controls.

Lec 18: Environmental design - 2

Windows and Views

- Preferences for windows could be confounded with the likelihood that windowed workspaces are closer to the outer edge of the building and possibly in a corner, farther away from high traffic areas, equipment rooms, stairwells, and the air-conditioning or heating system
- In windowless offices, the median number of decorations or pictures on the walls tended to be greater than in windowed offices. In addition, these items were generally of a more landscape or “natural” décor, whereas the number of cityscapes was about the same. This created a ratio of landscape to cityscape décor that was greater in windowless than in windowed offices
- if there is person–environment compatibility, the environment supports what the individual needs and wants to do, and allows for reflection. If the person–environment relationship is not compatible, more energy or cognitive demand is needed to perform the necessary tasks, and restoration is needed.

If a person's environment is compatible with their needs and desires, it supports their activities and allows for reflection. Conversely, if there is an incompatibility between the individual and their environment, greater energy or cognitive demand is required to accomplish necessary tasks, such as restoration. Offices that feature windows and incorporate nature-related imagery tend to exhibit better performance outcomes. Additionally, color plays a significant role in shaping the environment. However, the impact of environmental color is not as well understood as other environmental factors, largely due to interacting variables such as personality and job demands.

(Refer Slide Time: 1:03:27)

Lec 18: Environmental design - 2

Environmental Color

- The impact of environmental color is less well understood than other environmental factors due to other interacting variables such as one's personality or job demands
- it is suggested that the blue and violet colors (the high-frequency end of the spectrum) are calming and the reds (the low-frequency end of the spectrum) are stimulating colors; however, these colors likely interact with perceived task demand
- Moods tended to be more positive when individuals rated the work environment as having color than either being a neutral or no color situation. Although environmental color appears to impact mood and possibly performance, and we can make some general statements about these effects, more research is needed to explain some apparently contradictory results

1:03:27 / 1:07:36

Research suggests that blue and violet colors, which lie at the high-frequency end of the spectrum, are more calming than red, which is at the low-frequency end and is considered a stimulating color. Nevertheless, the effects of these colors likely interact with perceived task demands. We previously examined color in the third section concerning the design of visual signage and the aspects of visual adaptation, so I will limit the discussion of colors here. Nonetheless, the perception of color significantly influences our performance. One notable effect of color is its impact on mood.

Individuals generally report more positive moods in work environments that feature color compared to those that are neutral or devoid of color. While environmental color appears to influence mood and potential performance, and we can make some general observations about these effects, further research is needed to clarify and address contradictory findings. Thus, color plays an essential role in performance, directly linked to mood.

(Refer Slide Time: 1:05:22)

Lec 18: Environmental design - 2

Wayfinding

- navigating among spaces, or *wayfinding*, can be greatly impacted by the environmental design, including layout of space, signage, and color. Wayfinding success is related to our cognitive maps or our mental image of the layout of a space
- The use of landmarks or environmental differentiation such as different architectural styles or color as well as signage can increase wayfinding success and proficiency; however, using just one of these environmental design aspects might not be sufficient.
- As the complexity of the building design increases, people make more wrong turns, backtrack more often, and travel at a slower pace

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1:05:22 / 1:07:36

The final topic we will discuss today is wayfinding. While we have focused on a single office, there are circumstances in which individuals must navigate from one office to another, and this movement is referred to as wayfinding. The manner in which wayfinding is structured, including the instructions provided and the signage available, significantly impacts performance. Effectively navigating spaces or wayfinding can greatly influence environmental design, including layout, space utilization, signage, and color. Success in wayfinding is closely related to our cognitive maps, which reflect our ability to visualize the layout of a space.

To clarify, a cognitive map is a mental representation of a physical environment. For example, if you close your eyes and picture your house or room, you have created a cognitive map of that space. This cognitive map plays a crucial role in navigation and wayfinding, and its accuracy can lead to varying levels of performance based on how well it is encoded. Utilizing landmarks or differentiating environmental features, such as distinct architectural styles or colors, along with effective signage can enhance wayfinding success and proficiency. However, relying on just one of these design aspects may not suffice.

The way signage is designed, the architecture of buildings, and the type of instructions provided for navigation all impact job performance. As the complexity of a building's design increases, individuals are more likely to make wrong turns, backtrack frequently, and move at a slower pace. Confusing signage can exacerbate these issues, leading to backtracking and incorrect turns that hinder performance. To improve wayfinding success in complex environments, effective signage is critical, and employing multiple cues is the most beneficial approach.

While textual signage can be somewhat distracting, it tends to be more helpful in simpler environments than graphical signs. Conversely, in more complex designs, graphical signs are generally more effective than simple signs. Therefore, the choice between simple and complex signage should be tailored to the specific task and the environmental complexity.

Environmental designs can be implemented across multiple settings to facilitate or influence movement. Specifically, such designs can create spaces that are easy to defend, enhance surveillance capabilities, detect criminal activity through obstacles, and foster a sense of ownership by enhancing territoriality. By designing environments that promote safety and surveillance, it is possible to reduce criminal activity while increasing positive feelings among employees. This can lead to enhanced feelings of ownership, resulting in improved moods and overall job performance.

This concludes my presentation for today. Thank you, and goodbye. Namaskar. Amen.