Engineering Psychology

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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.

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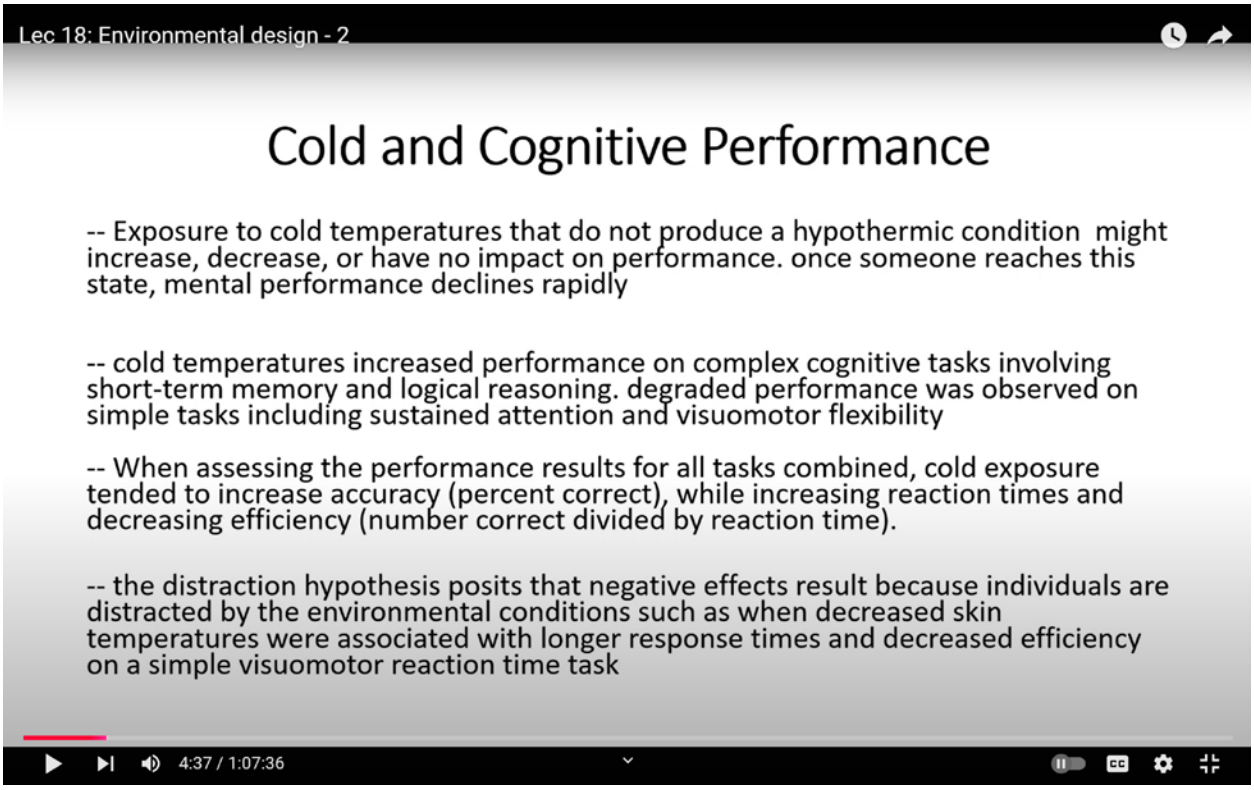

We discussed how temperature, humidity, and air velocity combine to form the heat index and

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.

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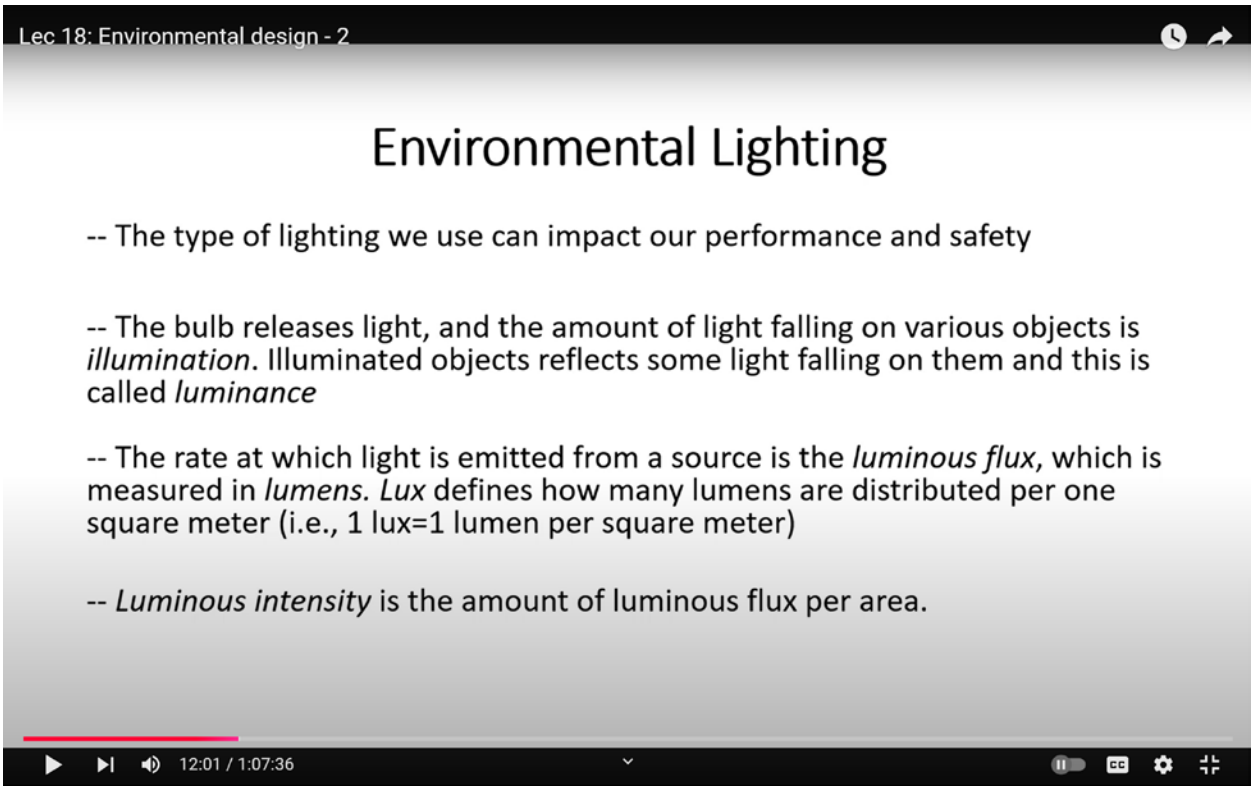

The bulb, a common source of light, emits light, and the amount of light falling on various objects is referred to as illumination. Illumination is defined as the act of light falling on certain objects.

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.

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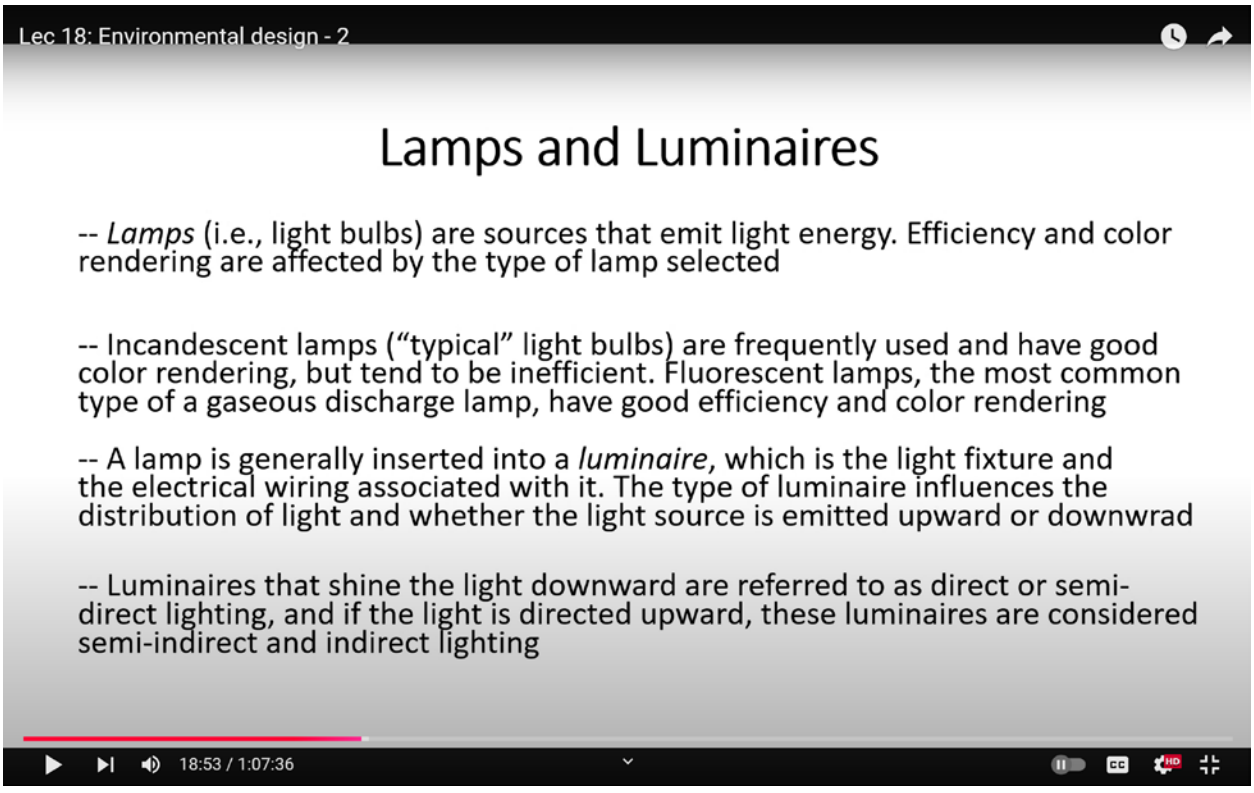

Two key aspects should be considered when selecting a light source: efficiency and color rendering. When choosing a bulb or light source, individuals should consider how efficient the bulb is, specifically, how much light it produces relative to its energy consumption. For example, compact fluorescent 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.

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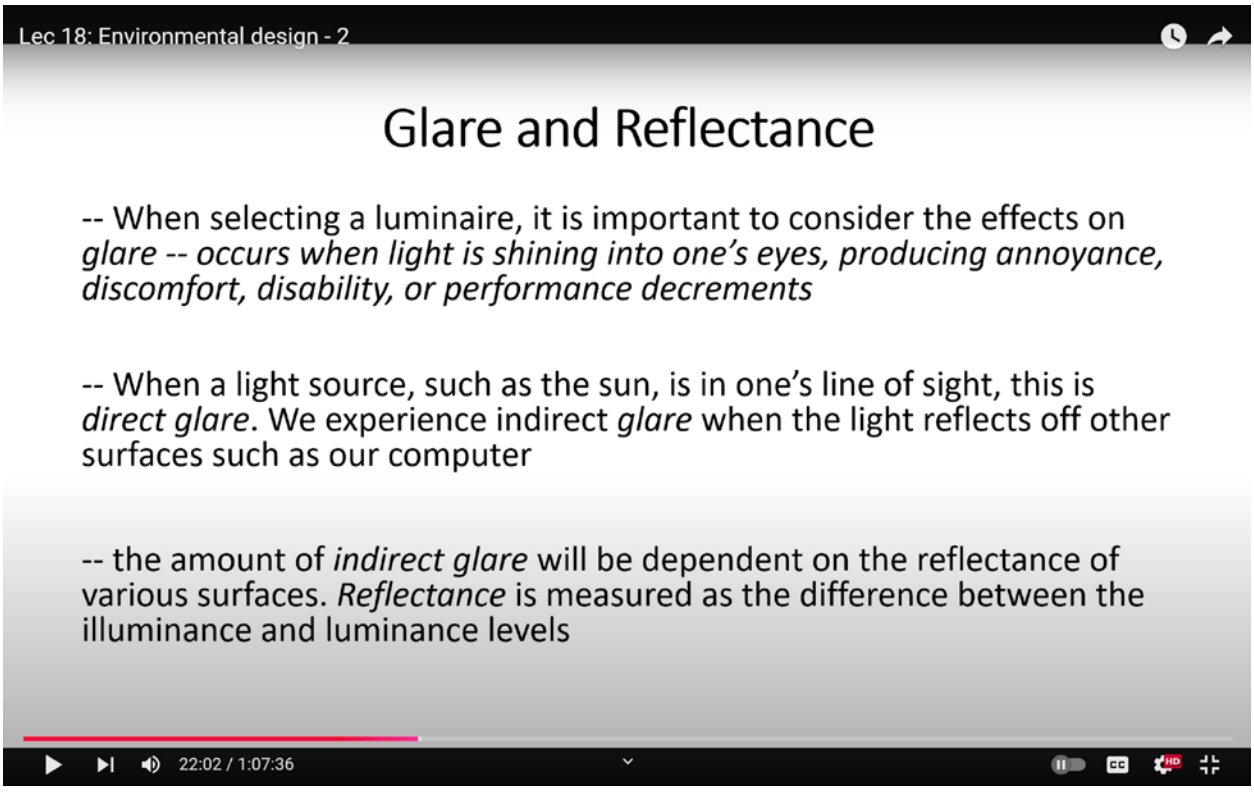

What is glare? Glare occurs when a light source directly illuminates someone's eyes, leading to temporary visual impairment and difficulty focusing on objects. This phenomenon can result in annoyance, discomfort, disability, or a decrease in performance. Therefore, glare is something individuals typically 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.

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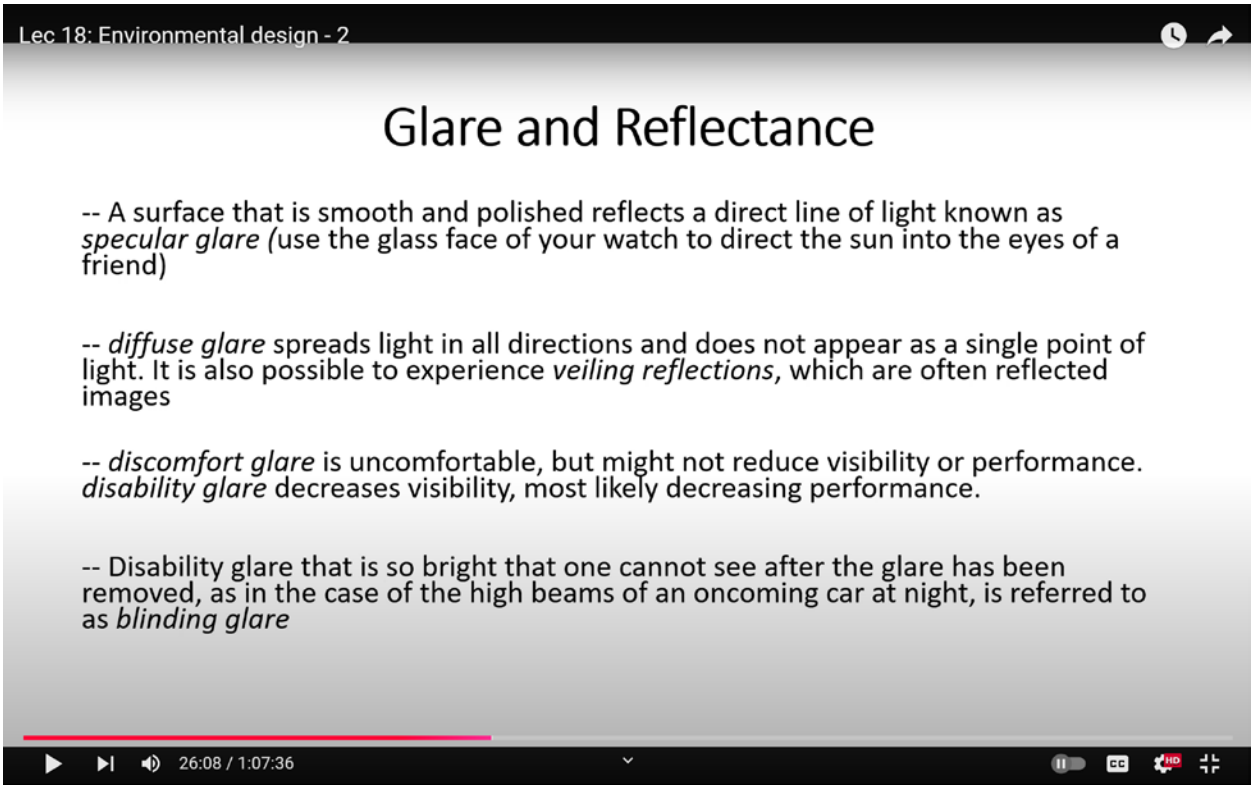

Reflectance is measured by the difference between luminescence and luminance levels. A smooth and polished surface that reflects light in a direct line creates a specular glare. For example, using a watch to focus sunlight into someone's eyes results in specular glare. In contrast, diffuse glare

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.

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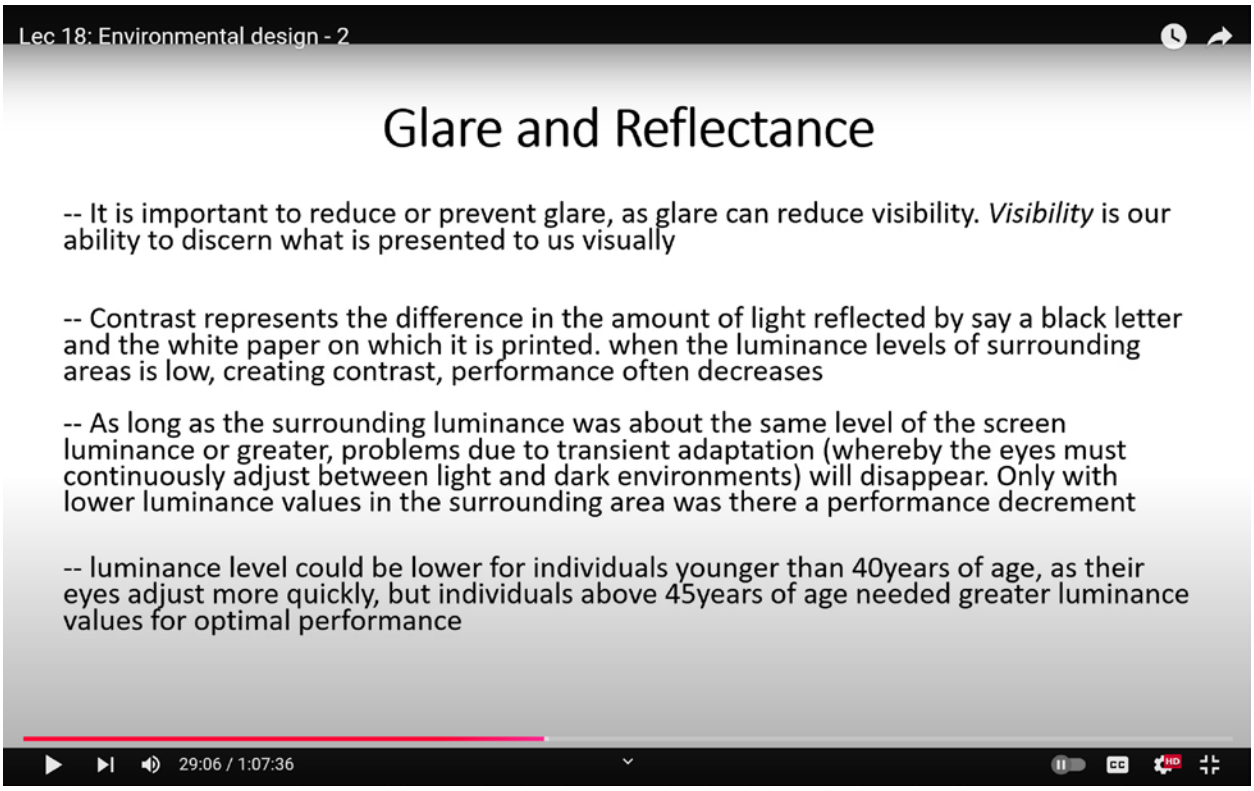

A common example is the glare from oncoming car headlights at night, which is referred to as blinding glare. This phenomenon is often observed when driving, particularly on Indian roads,

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.

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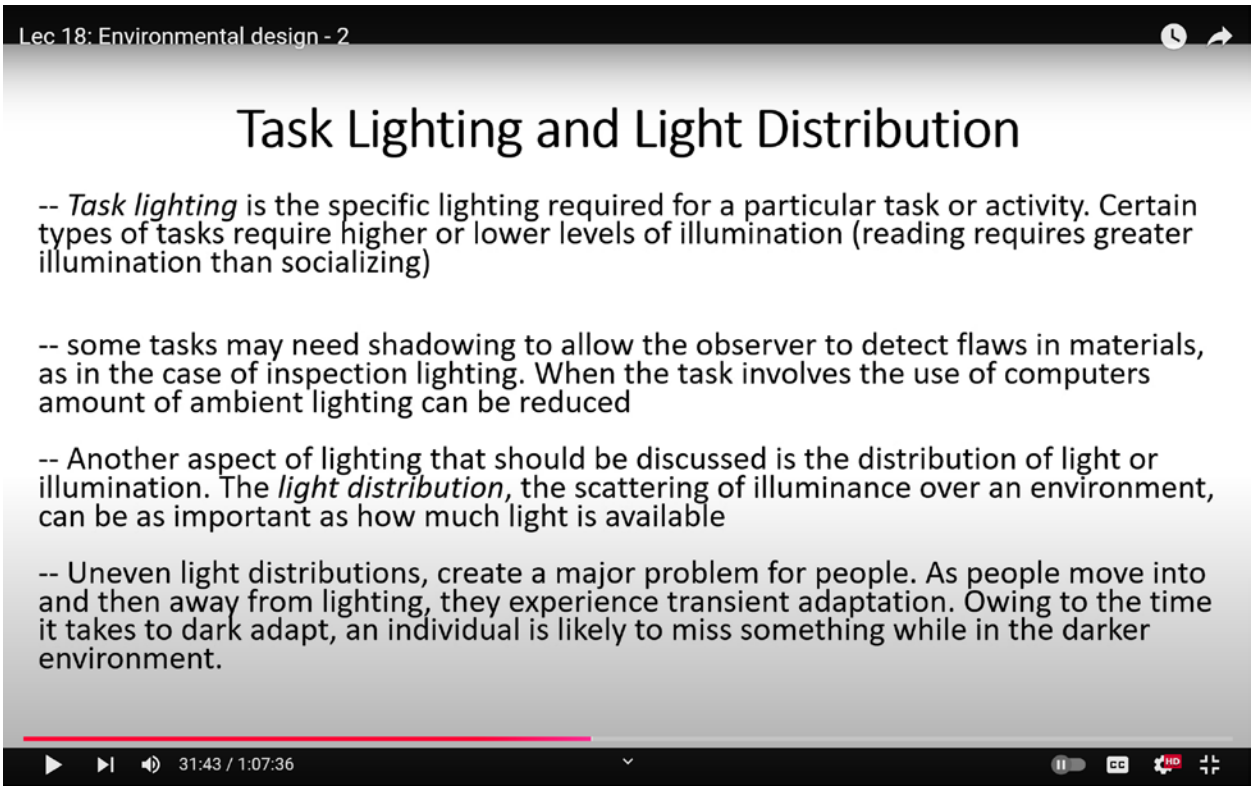

Performance decrement is primarily observed when the surrounding area has lower luminance values. It is important to note that individuals under the age of 40 may experience lower performance decrements in dim environments, as their eyes adjust more quickly. Young people below 40 years of age generally 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.

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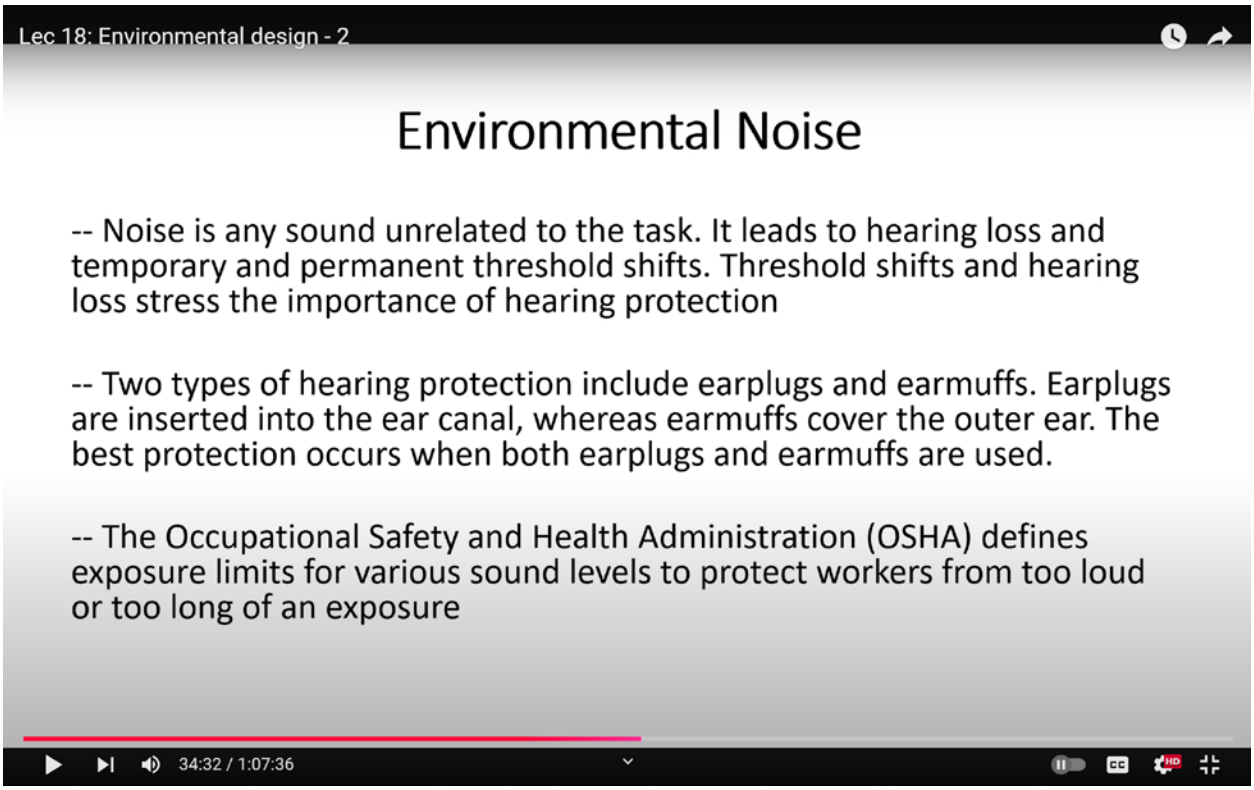

There are two primary types of hearing protection: earplugs and earmuffs. Earplugs are inserted into the ear canal to block or reduce ambient noise, while earmuffs cover the outer ear. For optimal protection, it is common for ground staff at airports to utilize both earplugs and earmuffs simultaneously. 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.

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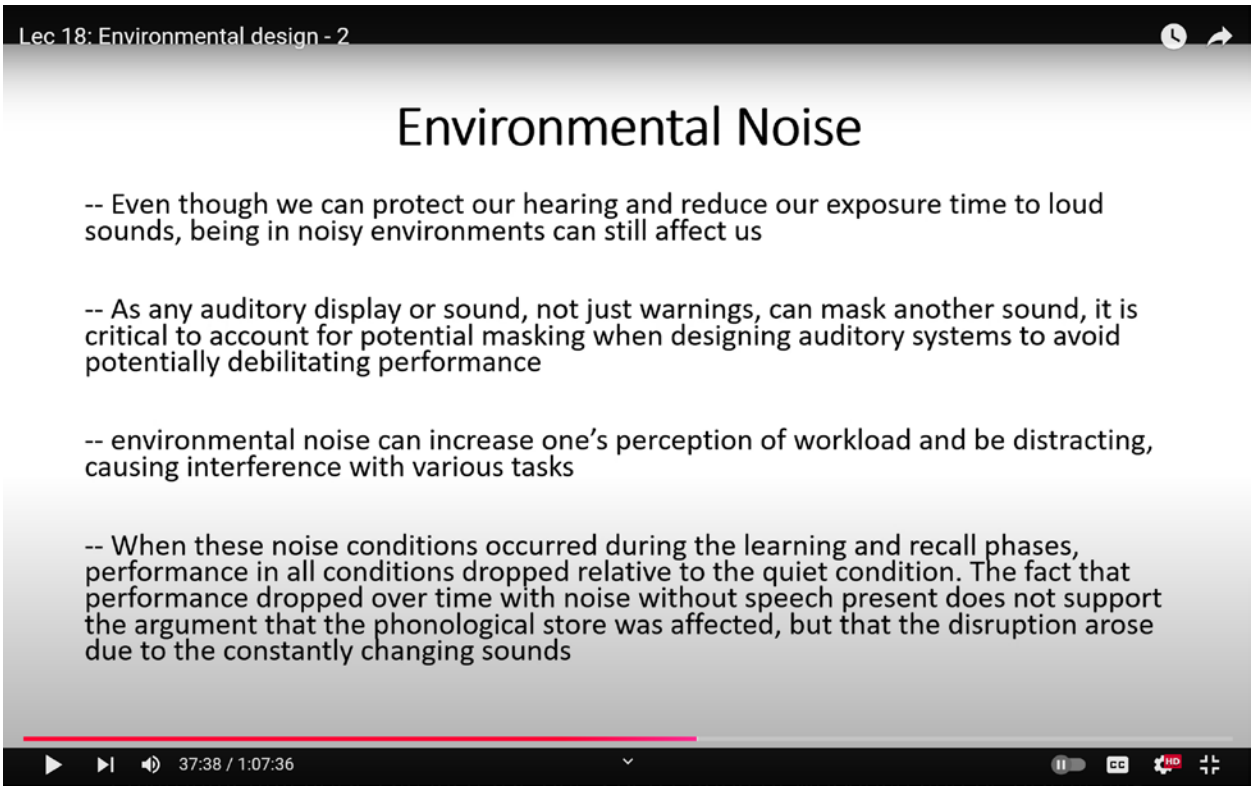

When designing auditory alarms, it is important to ensure that they do not interfere with the signals being monitored. Monitoring alarms should effectively alert users without causing additional issues. If an alarm is excessively loud, it may contribute to masking effects, further complicating the situation. 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.

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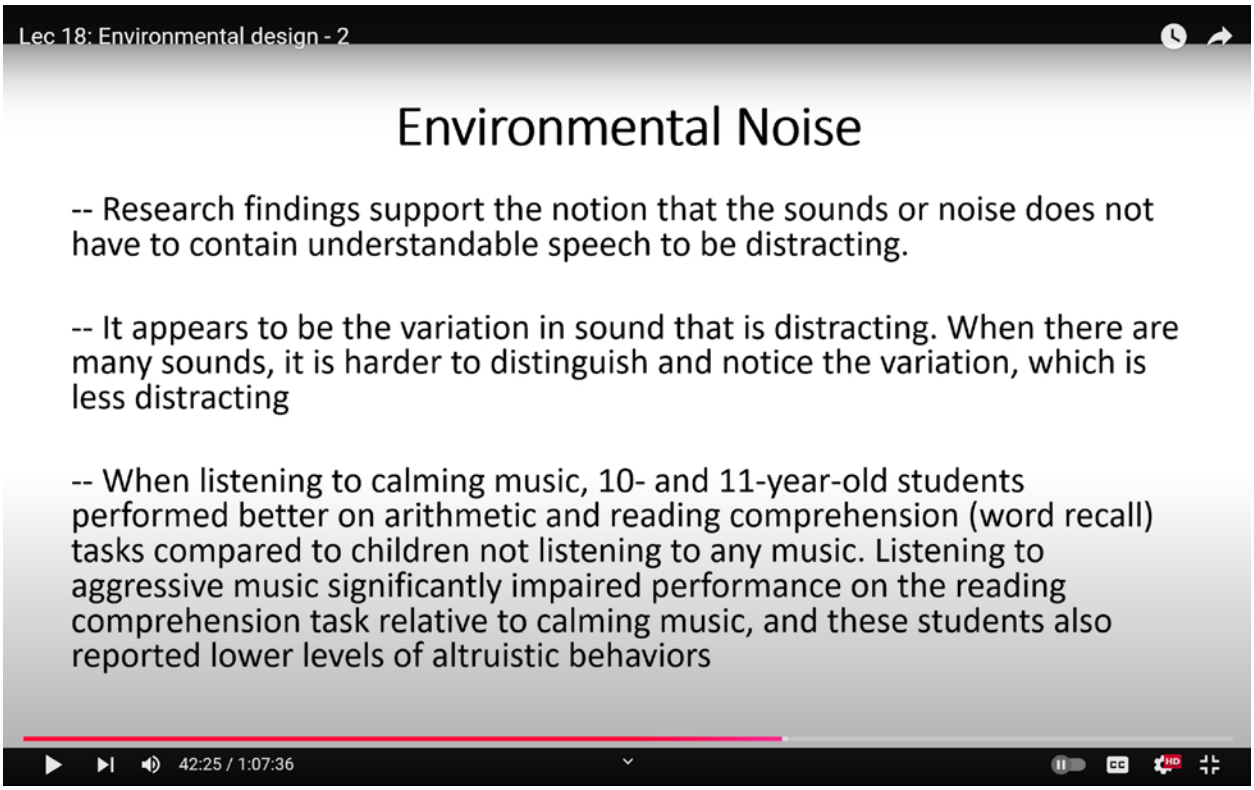

The increased arousal and distraction associated with aggressive music lead to hyperactivity among students, resulting in further impairment of cognitive task performance. Additionally, they exhibited less altruistic behavior compared to peers who listened to calming music. People often advocate for 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.

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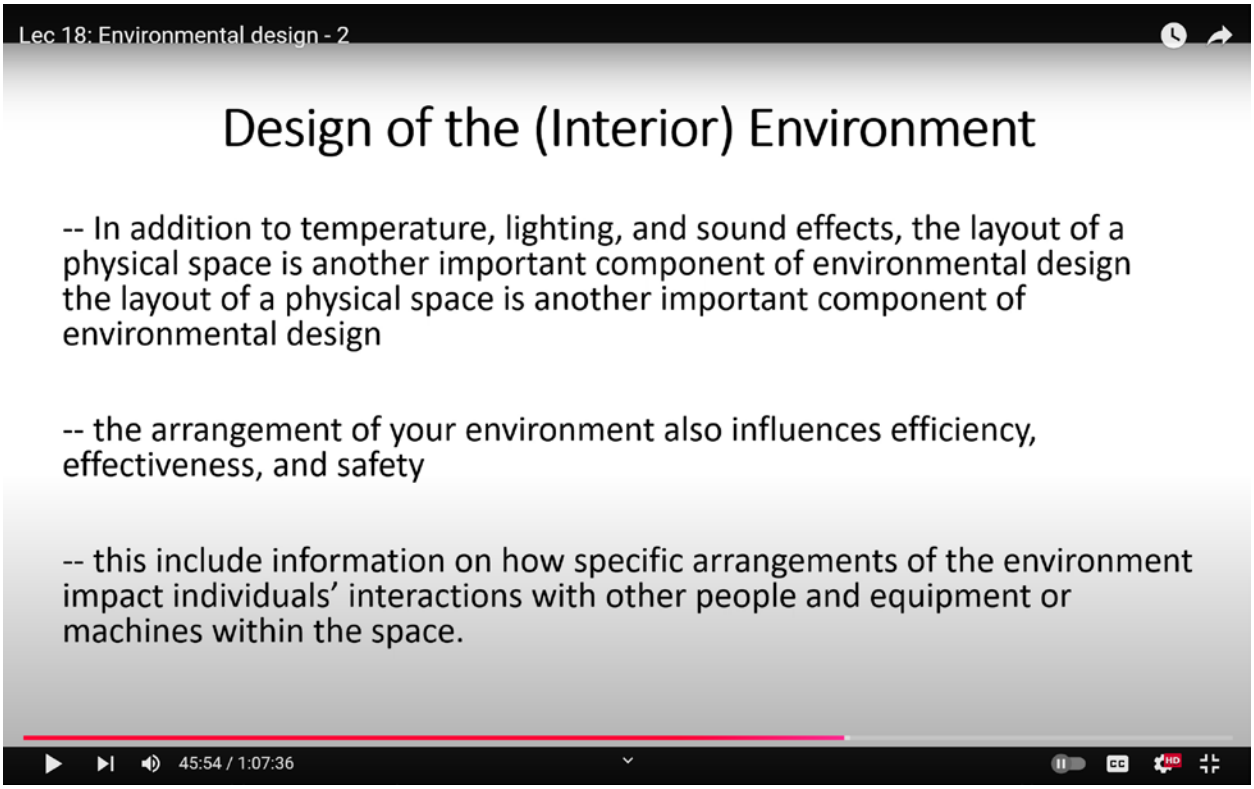

The design of the environment encompasses how specific arrangements affect an individual's interaction with others, as well as with equipment or machinery within the space. Consequently, environmental design will consider both the arrangement of the environment and the interactions between people and 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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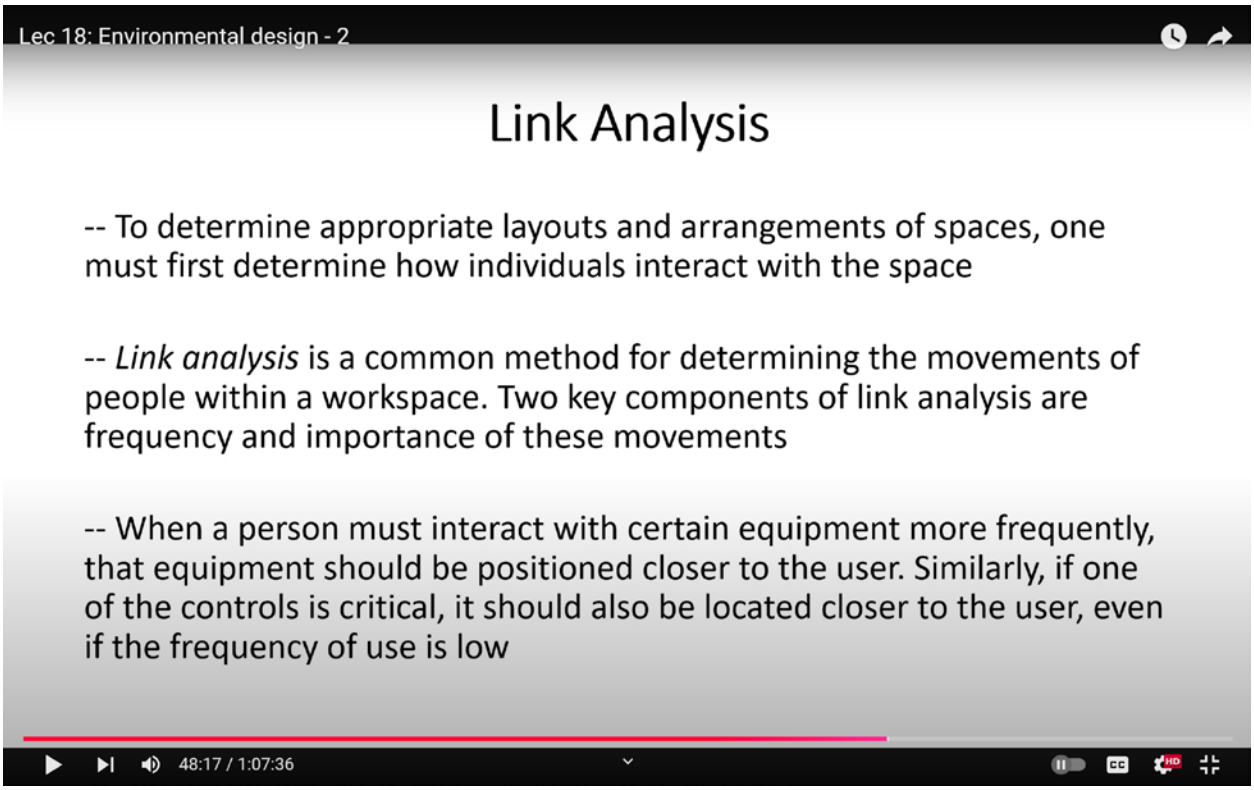

analyze these interactions, a technique called link analysis is employed. In link analysis, all possible interactions a person has with the surrounding objects are examined. By studying these interactions, a flow diagram is created, and certain ergonomic principles are applied to redesign the way people 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.

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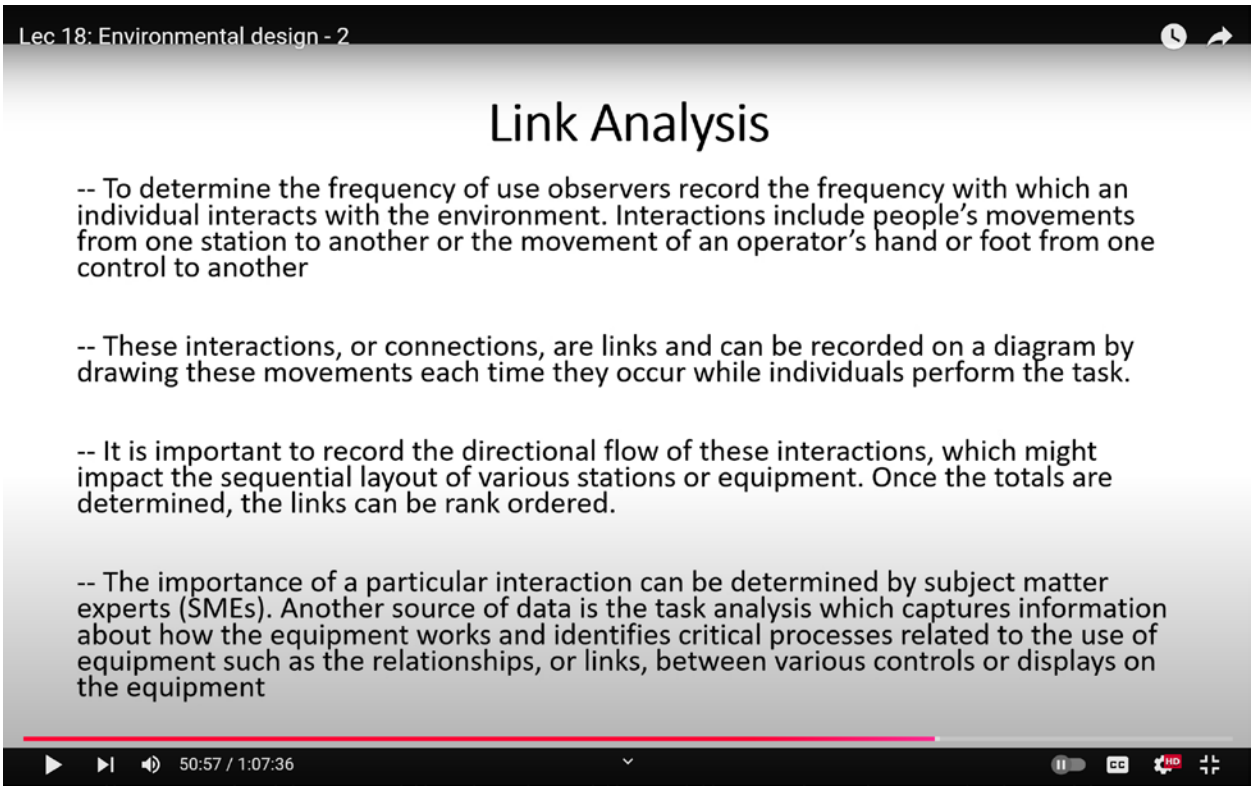

This can be achieved through a diagram that visually represents the rank order of necessary actions versus those deemed less critical. Link analysis thus makes it straightforward to discern which actions are essential for task completion. Subject matter experts can further evaluate the significance of 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.

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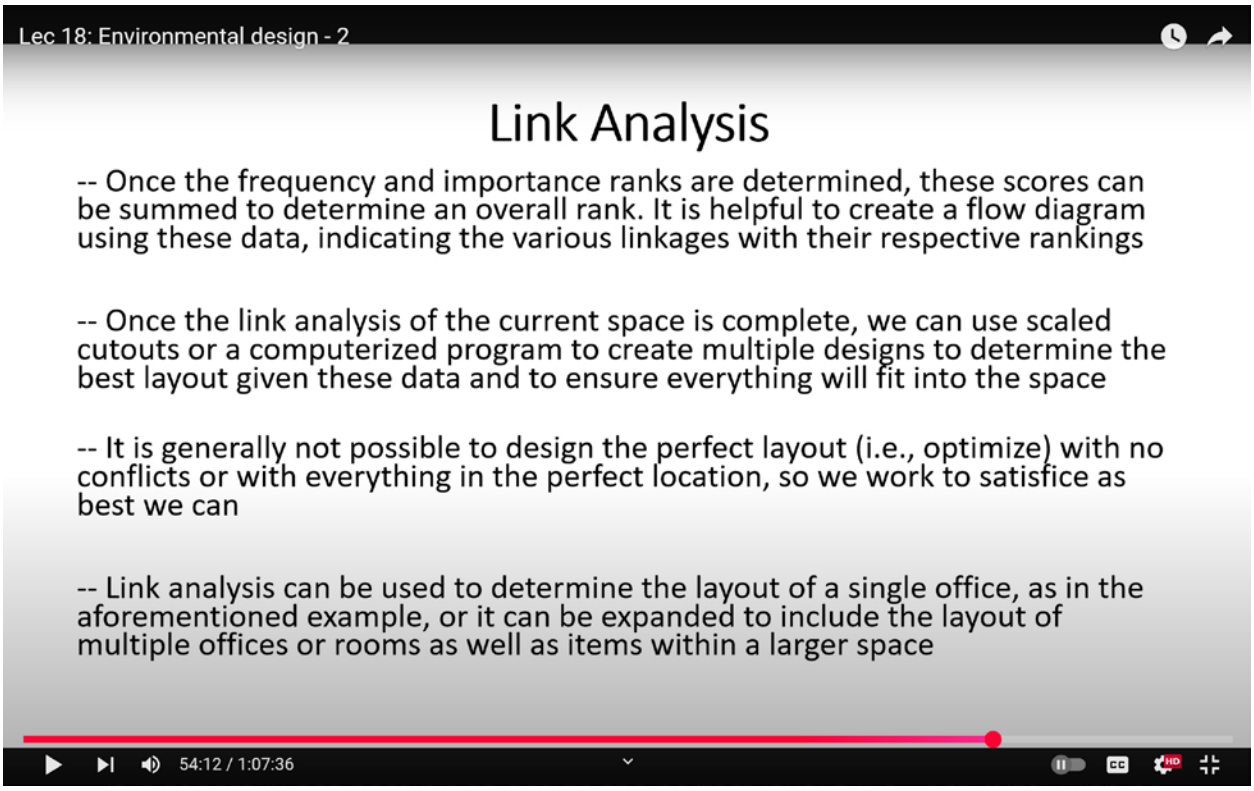

After completing the link analysis for the current space, the findings can be scaled into a cutout or incorporated into a computer program to generate multiple design layouts. This process aims to determine the optimal configuration that accommodates all necessary components within the available space. 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.

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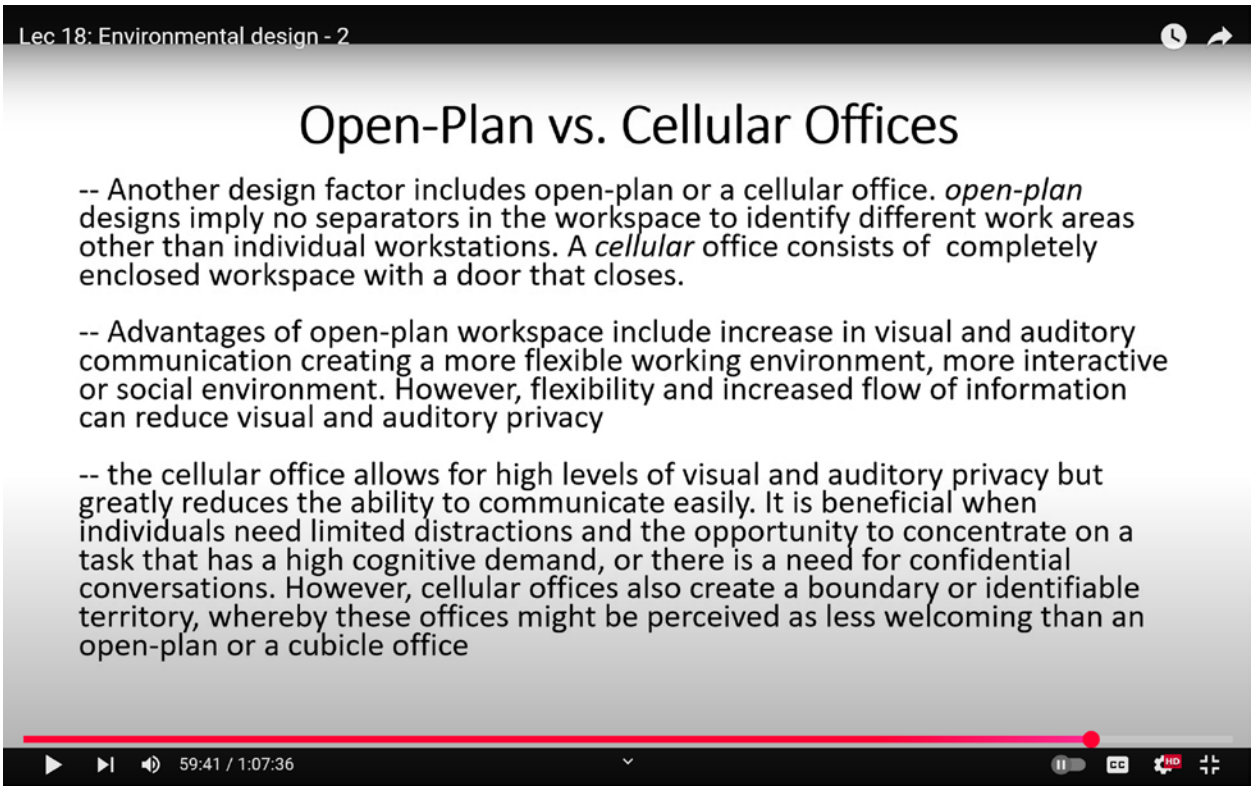

Cellular offices create identifiable boundaries, which may make them seem less welcoming than open plan or cubicle offices. An open office layout enhances communication but can be distracting during confidential or cognitively demanding tasks. The presence of windows also influences performance preferences. 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.

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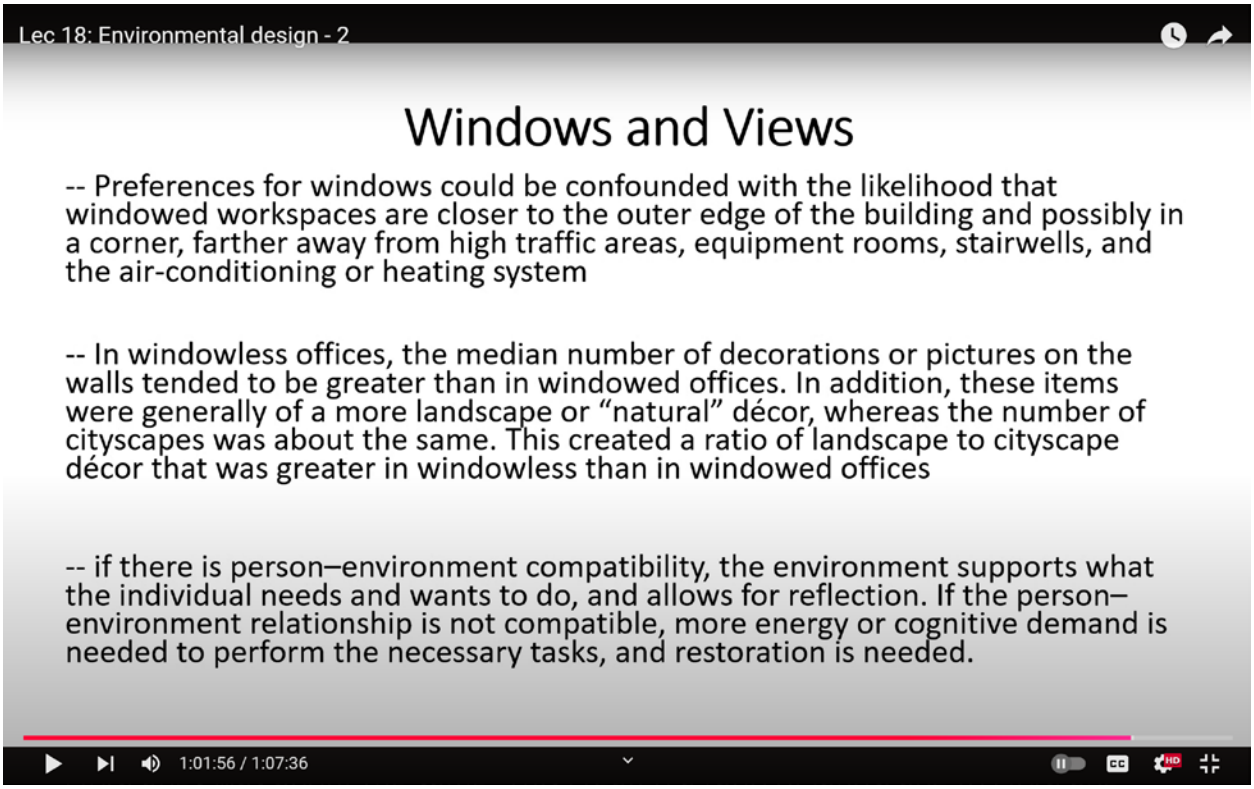

If a person's environment is compatible with their needs and desires, it supports their activities and allows for reflection. Conversely, if there is an incompatibility between the individual and their environment, greater energy or cognitive demand is required to accomplish necessary tasks, such as 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.

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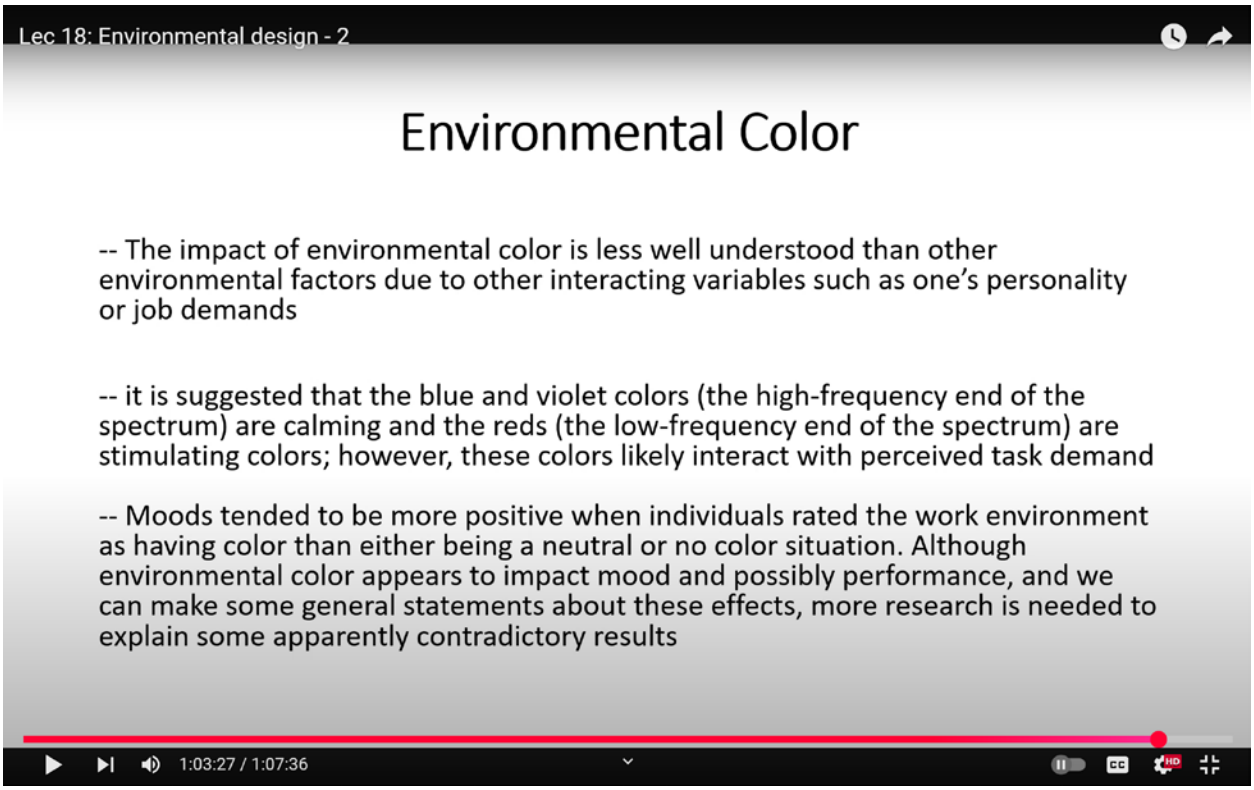

Research suggests that blue and violet colors, which lie at the high-frequency end of the spectrum, are more calming than red, which is at the low-frequency end and is considered a stimulating color. Nevertheless, the effects of these colors likely interact with perceived task demands. We previously 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.

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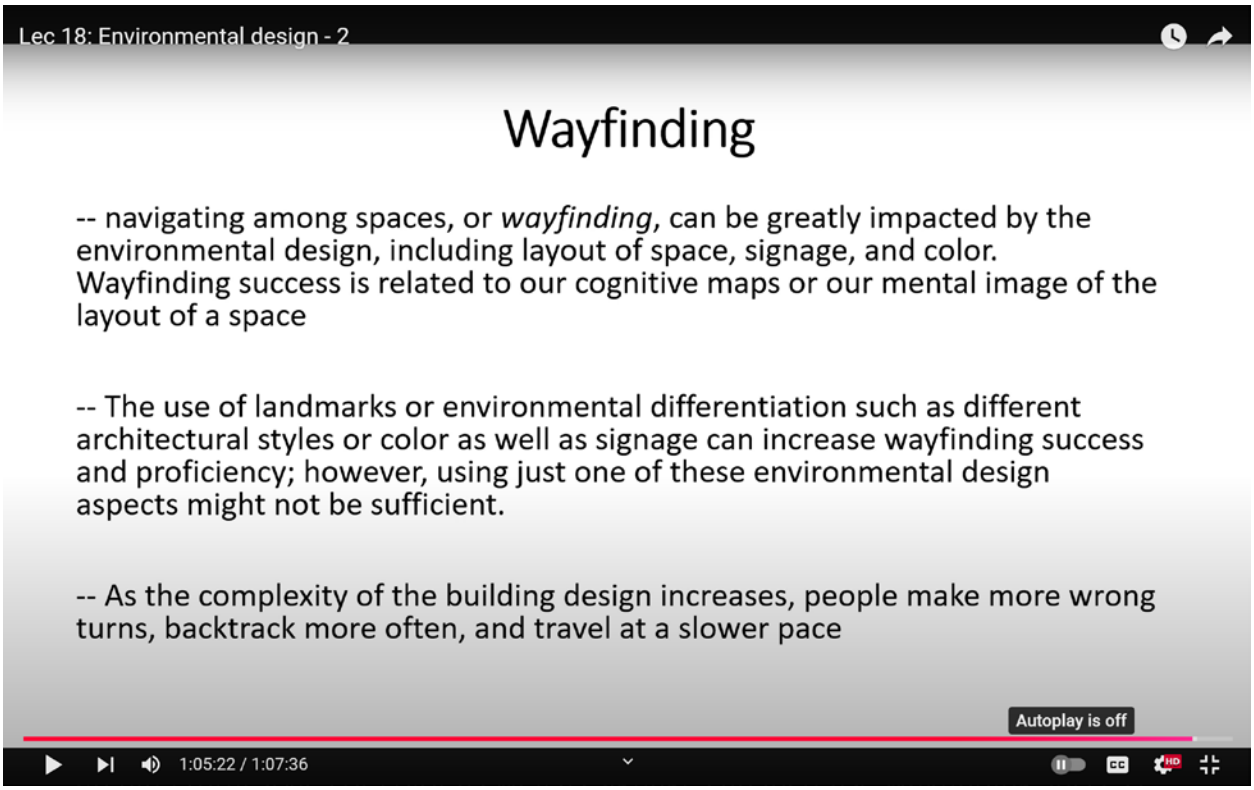

The final topic we will discuss today is wayfinding. While we have focused on a single office, there are circumstances in which individuals must navigate from one office to another, and this movement is referred to as wayfinding. The manner in which wayfinding is structured, including the instructions 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.