Acoustics, Work and the Physical Environment
The open-plan office has long been seen as the solution to bringing people together to boost collaboration, build relationships and spark new ideas. However, while communication speeds up and transparency spurs trust, out in the open people are desperately seeking ways to control their privacy. And the number one distraction in the workplace is no longer visual — it’s noise.
Why Acoustics Matter

Modern workplaces offer great aesthetics, but little acoustic comfort, causing people to be distracted by sound time and again. Steelcase has been studying the issue of privacy at work for decades and in the early ‘90s synthesized a solid understanding of the four types of privacy that need to be addressed in the physical setting to help people avoid distractions: acoustical, visual, territorial and informational.

Steelcase research reveals distraction is an issue worldwide. A study conducted by the University of California, Irvine and Humboldt University in Berlin, Germany echoes these findings — on average, employees who do the majority of their work on computers are distracted once every 11 minutes. What’s worse, once distracted, it takes an average of 23 minutes and 15 seconds to get back on track.

Although many people believe they are capable of multitasking, the facts disagree. As the study describes, “People compensate for interruptions by working faster, but this comes at a price: experiencing more stress, higher frustration, time pressure and effort... businesses also feel the consequences since even the briefest interruptions can double a worker’s error rate.”

Research reported by Dr. Glen Wilson from Kings College in London adds to these findings, proving multitasking is wishful thinking. According to the study, while multitasking, women’s cognitive capability is decreased by the equivalent of five IQ points while men lose 15.

So why are people so easily distracted? Our brains are programmed to do so. According to David Rock, author of “Your Brain at Work,” “Social interactions are a delicious thing to the brain... Your brain loves interaction with people; it’s a very important part of keeping ourselves alive.”

“In the open plan, people are asked to collaborate and concentrate in the same space, leaving them exposed to an elevated level of stimuli, which includes everything from a co-worker’s conversation to the neighborhood espresso machine. Overwhelmed and left without any way to control the sound they experience, people are becoming more and more distracted and stressed, and this is having a significant impact on their engagement and wellbeing.

So how can organizations provide high-performing work environments that leverage the real benefits of the open plan while simultaneously addressing the drawbacks that come with it? Addressing acoustical comfort in the office is key.

“Social interactions are a delicious thing to the brain... Your brain loves interaction with people; it’s a very important part of keeping ourselves alive.”

David Rock, Author
“Your Brain at Work”
“Cognitively, there is plenty of research now that shows that in loud offices in particular the most destructive sound of all is other people’s conversations.”

Julian Treasure, The Sound Agency

Distraction is costly
Countless articles describe the woes of visual distraction in the open office. While true, ears are even more vulnerable. They can’t be shut. Studies show that noise is one of the most prevalent sources of annoyance in offices, and can lead to increased stress and dissatisfaction with the work environment and job itself.⁵

Half of the global workforce agrees. Professors at the University of Sydney surveyed over 300 office buildings in the United States, Finland, Australia and Canada and found that nearly 50 percent of people with a completely open-office floor plan, and nearly 60 percent of people in cubicles with low walls, are dissatisfied with their sound privacy. Steelcase surveyed 20 countries in their report, “Engagement and the Global Workplace,” and it found people are very unsatisfied with ambient noise levels in the workplace. The study also found a correlation between employee engagement and how people feel about their workplace. People who are highly dissatisfied with their work environment are also highly disengaged at work. The survey concluded only 13 percent of workers are highly engaged and highly satisfied.

Cost of Disengagement
Up to 60 percent of workers are dissatisfied with their sound privacy at work. Gallup’s State of the Global Workplace reported the cost of disengagement for countries worldwide, and the numbers are sobering.

USA
$450 — 550B

Germany
€112 — 138B

Australia
$54.8B

United Kingdom
£52 — 70B
The creative shift in work, residential design trends in the workplace, short-term leases and the need for more flexible spaces is causing an assault on the senses.

Disengagement drains productivity. Psychological researchers at University College of London revealed the true impact of noise on productivity after conducting a meta-analysis of over 75 studies. They found that after sound was reduced, the average increase in productivity was 27.8 percent. The researchers then weighted these results against other factors like the office environment, and the type of work participants did. They concluded that unwanted noise decreases productivity by 1.7 percent. This may sound small, but the British Council for Offices suggests that “a one percent improvement in productivity swamps utility costs,” and it is estimated that a change in productivity of just five percent may cover annual property costs.

Why Now?

The need to control stimuli in the office has never been greater. The creative shift in work from process-driven individual tasks to highly collaborative, generative work has drawn workers out of private offices and into the open plan. In the age of industry disruptors, rapidly changing business models and a diverse global workforce, employers increasingly see the many benefits of collaboration, impromptu meetings and the peer-to-peer learning that happens in an office without walls.

And while walls were coming down, ceilings were going up. Recent design trends favor industrial spaces with high ceilings, large windows, no carpet and open, airy atmospheres. Offices these days blur the line between home and work more than ever. People don’t want to work in “stuffy” offices; they want access to informal lounge and café spaces where they can connect with their peers, high-end aesthetics and places that make them feel they can be themselves at work.

Companies are also leasing office space for shorter periods, enjoying the freedom that comes with saving money and the flexibility to grow and move as their circumstances change. Most acoustic elements, such as ceiling insulation, wall thickness and window size, are added during the construction of a brand new building. When an organization leases space, they lose the ability to control these critical elements, which places more importance on the acoustic elements of the furniture. But the emphasis on fast-paced agility in temporary environments has resulted in less fixed furniture and soundproof elements, meaning sound waves are free to travel the office unimpeded and create an atmosphere with lower acoustic comfort.

Add together all these drivers — the creative shift in work, residential design trends, short-term leases and the desire and need for more flexible spaces — and the result is an assault on the senses.
Four Non-Physical Factors In How We Perceive Noise

Many people assume that sound and noise are the same thing, but they aren’t. Sound is a form of energy made up of pressure variations, or waves. If the frequency of a wave is between 20 – 20,000 hertz (Hz) the human ear can detect it.

Noise is unwanted sound, and it’s the noise at work that bothers people. Research shows sound level only accounts for 25 percent of the variance in annoyance, which is why individual emotions, preferences and the amount of choice and control workers have over the sounds they hear in their environment is crucial.
The perception of noise level and the impact it has varies from person to person based on the following four non-physical factors.

What are they working on?
The type of task people are doing impacts how they perceive sound. If someone is concentrating, a co-worker’s conversation will likely be more distracting than if they are collaborating with someone else.

How do they feel about it?
Similar to the whisper and ambulance example, the attitude workers attach to the sound will influence if it becomes noise or not. If an esteemed colleague is talking, the conversation may not bother someone as much as a discussion taking place between colleagues they don’t care for.

Can they predict or control it?
Consistent sounds are easier to block out; it’s variety and suddenness that distracts us. As one study states, “The hum of a fan doesn’t interrupt thinking, a burst of laughter does.” The same study shows work performance improves if people have perceived control of surrounding sound, even if they don’t use it.

What’s their personality and mood?
Several studies indicate that extroverts perform better than introverts under noisy conditions. They tend to handle stimuli differently, so environments with a lot of sound don’t necessarily feel noisy. Stress and anxiety also influence how people react to sounds. The more stressed someone is, the more likely they are to be distracted.
Acoustic Dictionary

1. Sound Level
The combination of all sounds present in a space, with 60 dB being the average sound intensity of a normal conversation in an enclosed room.

2. Absorption
When a material, structure or object takes in sound energy when sound waves reach it.

3. Reflection
When sound waves bounce back after encountering a surface.

4. Transmission
The process of sound energy traveling through a medium.

5. Frequency
The amount of sound waves over a period of time, which are counted in wavelengths, the distance from the crest of one wave to the crest of another.

6. Reverberation
The prolongation of sound in a space due to a multitude of reflections.

7. Sound Propagation
The traveling of pressure waves through a medium.

8. Speech Clarity
The ease at which a listener can understand speech within a space.
Acoustics, Work and the Physical Environment

No Acoustic Protection
In spaces with no acoustic protection, sound waves are often reflected off surfaces before they are heard. When multiple sound waves are reflected, sound reverberation takes place. This effect decreases speech clarity — making you expend more mental and physical energy to hear or be heard.

Acoustically Sound
Spaces with acoustic-enhancing features, such as sound absorbing walls or ceiling tiles, decrease sound reverberation. With less reverberation, focusing is often easier and speech clarity increases.

What Does Acoustics Mean?
Most people realize acoustics are an issue at work, but many don’t really understand what people mean when they say acoustics. Here are common definitions to help break it down.

Sound can be measured.
Sound is typically measured in decibels (dB). A decibel is a unit to express magnitudes of difference. The decibel scale accurately represents the large and dynamic range at which humans hear — from a rustle of a leaf at 10 dB to the roar of a jet engine at 120 dB.

Low and high sound waves move differently.
High pitched sounds produce shorter sound waves compared to low pitched sounds. Lower sounds (longer waves) are likely to pass through thin materials, curve around barriers and bend through gaps and apertures. High sounds (short waves) are more directional, making them likely to bend less around barriers.

Sound propagation at work.
Sound propagation is related to spatial decay. The farther away one is from the source of the sound, the more the sound level decreases. This is a challenge in open-plan offices where workers are expected to communicate and concentrate in the same space and contributes to two of the main noise complaints: distraction by speech and lack of speech privacy.
Designing For Acoustical Comfort

So, how can employers mitigate distraction to help their people think better, stay engaged and improve their wellbeing?

A first step is to nurture a culture that lets people know when and where they can make noise. Consider introducing office etiquette such as do not disturb signals and placing visual cues around the office that indicate how people should behave in a space. If noise is planned, explain the reasons for this effect. If direct sounds and reflected sounds are heard less than 50–80 milliseconds apart from each other, they are typically perceived as a single sound.

If sound waves arrive at the ear after 80 milliseconds, they can be perceived as a new sound—an echo. Environments that are full of reflective materials like windows, concrete, brick—materials often seen in modern offices—reflect more sound, as less of it tends to be absorbed. If there is too much reverberation, speech clarity decreases, making you expend more mental energy to listen or physical energy to raise your voice to be heard.

Reverberated sound waves impact speech clarity.

When a sound wave reflects off a surface, it bounces back. A combination of reflections inside an enclosed space creates reverberation. Naturally, direct sound waves, which go directly from the source to what receives the sound, and reflected sound waves, which hit at least one surface while traveling, do not arrive at the ear at the same time. Humans are great at filtering for this effect. If direct sounds and reflected sounds are heard less than 50–80 milliseconds apart from each other, they are typically perceived as a single sound.

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Address Architecture

Building construction has the most significant influence on the acoustics in a space, so it is critical to address the holistic room architecture—from the ceiling to the floor.

- Build interior walls up to the ceiling deck rather than the ceiling for acoustical privacy.
- Ensure that all gaps and holes in the space are filled so sound doesn’t leak out and destroy the sound isolation of a room.
- Ceiling treatments are great acoustic solutions and can vary from acoustical grid ceilings to hanging sound absorbers. Consider the various options that will work for both the aesthetics and acoustics of the space.

Placement is Key

When integrating acoustic features into the design of a space, strategic placement of the features is key to creating acoustic comfort.

- Place sound absorbers near the workstation and in noisier areas where there is equipment such as coffee machines, printers or heating, ventilation and air conditioning systems.
- In high-traffic areas, hanging acoustic absorbers from the ceiling can help prevent sound propagation.
- Whiteboards are great for collaboration, but also reflective. Optimizing the whiteboard space for what a user can conveniently reach improves the sound reflections.
- If the critical zone from sitting to standing height (915mm – 2135mm) on a wall is treated with sound absorbers, it may not be necessary to treat the entire wall. At a minimum, wall absorbers should cover 25 percent of a wall.

Materials Matter

The large range of materials seen in offices today provides a variety of options to create inspiring spaces. While it’s wonderful to have choices, the materials in a space can have a large impact on how acoustically comfortable the environment is so it’s important to choose wisely.

- Flooring material has an impact: certain types of carpeting absorb sound waves, thus improving overall acoustics. Options like carpets, cork flooring, linoleum, soundproof subfloors and underlayment can improve the acoustics of a space, especially in corridors and walkways.
- Reflective surfaces can be avoided by adding furniture with acoustical properties such as cabinets, lockers, desk screens and freestanding screens.
To help control distractions caused by noise, design space by creating zones of high, medium and low sound activities. Allow as much distance as possible between quiet and noisy areas. Never place a quiet area adjacent to a noisy area.

Design an Ecosystem of Spaces
Context is a key consideration when evaluating the acoustics of a space; the same type of setting can provide very different experiences depending on its adjacency, location and level of exposure to surrounding sound. An ecosystem of spaces with varying levels of acoustic absorption support workers, no matter the task at hand.

- Make sure that rooms are truly sealed and don’t only provide psychological acoustic privacy. Doors should have quality seals with a sound transmission class of at least 45.

- Consider creating zones of high, medium and low sound activities. Start by learning the needs and nature of work performed by individual teams and then plan accordingly.

- Create as much distance as possible between noisy and quiet areas. To do this, follow the inverse square law: every time distance is doubled between the source and the receiver, the sound is half as loud.

- Offer highly-differentiated settings to ensure that users can choose their best place based on task, mood and personality, providing workers with choice and control over their individual experience.

- Understand that every office is different, and each user interprets noise from sound sources differently.

Acoustic Design Thought Starters
Informed by insights from our research on privacy, attention at work, engagement and creativity, we’ve developed some settings that can be a catalyst for intentionally designing work environments that support acoustic comfort and help enhance people’s wellbeing and performance.
During a meeting, it’s important that each person can hear and be heard clearly. Direct sound and early reflections are critical to speech clarity. To enhance the acoustic comfort of a conference room, aim to keep the sound level between 30 dB – 35 dB by strategically utilizing sound absorbers to prevent sound reverberation and choosing less reflective materials like carpet when designing the space.

1. **Avoid Sound Reflective Corners**
   Two reflective walls should not face each other. With a highly-reflective front wall, sound absorption on the back wall can be enhanced by adding Truchet Acoustic wall tiles to prevent late reflections.

2. **The Middle Zone**
   Place sound absorbers where people gather. By placing Truchet Acoustic ceiling tiles in the middle of the ceiling, sound from participants meeting around the table is absorbed.

3. **Sound Absorbing Storage**
   Acoustic tambour fronts in Share It storage help reduce the level of ambient sound. If possible, the front should cover the storage to the floor.
Speech intelligibility over audio devices in a mixed-presence meeting is a crucial acoustic experience. A speaker needs to be understood by those in the room, on the phone and participants calling in through the telepresence unit. Confidential conversations also need to remain private. Ensure there are no gaps in the space that could destroy sound isolation.

**Before**

**Mixed-Presence Collaboration Studio**

**After**

1. **Parallel Reflective Surfaces**
   To optimize the sound for audio or video calls, it’s important to eliminate parallel reflective surfaces. Limit reflections from the whiteboards by adding Truchet Acoustic wall tiles to the parallel back wall.

2. **Optimize Whiteboard Space**
   Whiteboards are key to sharing ideas when collaborating on creative projects, but they are also highly reflective. Optimize the whiteboard space by only placing it where a user can reach to improve sound reflection.

3. **Carpet Preferred Over Hard Flooring**
   Choose carpeting that absorbs medium or high frequency sound waves to improve room acoustics.
Before

Focus Pod

Providing areas where people can focus or have a quick call near workstations or collaborative areas is key to minimizing distractions. Add acoustic elements to keep the sound level as close to the human speaking range as possible — ideally 100 Hz–3,000 Hz — by preventing sound from escaping the pod and outside sound from flowing in.

After

1. Officebricks Acoustic Pod
   A modular, plug-and-play system, Officebricks Acoustic Pods provide an ideal two-way sound insulation of 34 dB.

2. A Comfortable Atmosphere
   Adding absorptive elements at the speech-height zone creates a comfortable atmosphere inside the pods.

3. Confidential Conversations
   In an enclosed space, people feel a psychological sense of acoustic privacy, so it’s critical that confidential conversations stay private. The clever brick system of the Officebricks Acoustic Pods provide sealed doors and ceilings ensuring speech isolation.
The open-plan office needs an ecosystem of spaces so people can work in a variety of modes — from collaboration to focus — without being distracted. Design the layout with the largest distance possible between quiet zones and meeting areas and add acoustic enhancing features to prevent sound propagation across the room.

### 1. Ceilings Have Impact
To prevent sound propagation in open, mix-use spaces, locate additional sound absorbers near the acoustic ceiling or hang acoustic tiles from the ceiling in nearby areas where people collaborate.

### 2. At the Workstation
A benefit of team benches or nomadic touchdown areas is the natural collaboration and bonding that takes place. Place Divisio Acoustic floor screens near these workstations to prevent conversations from drifting across the office.

### 3. Freestanding Screens
Freestanding Divisio Acoustic screens provide both acoustic and visual privacy for teams and people working close by. It is recommended to have screens covering the full length of human height and going to the floor as much as possible.

### 4. Sound Absorbing Storage
Storage with acoustically absorbing material in the front and back helps to lower noise levels and provides boundaries between teams.

### 5. Share It Collection
The Share It Hutch offers a place to display content while adding additional sound absorption to collaborative areas.
1. The Critical Zone
It is not always necessary to treat an entire wall if the critical sitting to standing-height zone (915mm–215mm) has sound absorbing acoustic tiles.

2. Increase Privacy
Place ceiling tiles above the user to improve acoustics while the worker is in focus mode.

3. Materiality
When a room has a hard ceiling it is best to choose a carpet to prevent sound reverberation in the room.

A private office adjacent to the open plan can be owned or shared, offering workers a place to focus or meet confidentially one-on-one. Aim for a reverberation time of 0.1–0.4 seconds and a sound transmission class of 45 dB to keep speech clear while meeting over the phone or on a video call.
Before

WorkCafé

Often people choose to work in a café because of the energy and ambiance that a level of ambient sound provides. To keep the sound level from getting too high, it’s important to define zones to separate collaborative areas from quiet areas and to add sound barriers to prevent propagation.

After

1. Treat an Open Ceiling
When designing a space with a non-acoustic or open ceiling, it’s best to place sound absorbing ceiling acoustic tiles closest to the sound source. Hang tiles above areas where people come for social connection and collaboration or in corridors and high traffic areas.

2. Sound Barriers
Add sound barriers or walls to reduce sound from propagating to focus zones.

3. Sound in Social Spaces
Use freestanding Divisio acoustic screens to improve the reverberation time in social spaces.
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