white paper

The Science of Sound

How Innovations in Audio Quality Lead to Better Meetings and Brighter Minds

PGi COLLABORATIVE ADVANTAGE

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Introduction

Sound is both a science and an art. It influences our emotions, drives our creativity and is a crucial source of information in our day-to-day lives. In the corporate workplace, sound plays an integral role in facilitating collaboration with colleagues and acting as a catalyst for growth and learning. The conference call has long been a cornerstone of corporate America and is an area where sound plays a monumental role in enabling us to communicate and collaborate with our peers.

With the technology of the future suddenly within arm's reach, we have had a front row seat from which to witness the evolution of the conference call, an evolution largely predicated upon the development of technology that allows for the transmission of high-quality audio. Conferencing technology has improved at a careful, measured pace, but the complexities of the conference call go far beyond what meets the eye (or ear).

The time for better conference calls and better communication in the workplace is now. The age-old conference call issues we've all experienced — from conference call interruptions to excessive background noise to difficult-to-understand meeting dialogue — are a thing of the past. Everyone deserves high-quality audio; everyone has the right to clear communication and a seamless conferencing experience. Why? Because the effects of subpar audio quality actually have far-reaching implications on our brain and cognition, and can significantly impact our long-term performance in the workplace. High-quality audio is essential to high-quality collaboration, and high-quality collaboration cannot exist when our brains are not functioning at peak capacity. Audio quality that is anything less than stellar does a disservice to our cognitive functioning and, more broadly, to our communication efforts in the workplace.

Let's take a deeper look at how audio quality can affect our ability to think, create and problem-solve as we embrace this new era of conferencing defined by crystal-clear audio quality and online meetings that take collaboration to unprecedented new heights.

The Science of Sound

In order to understand the large-scale impact of audio quality on our psychology, behavior and work performance, it is crucial to first understand, at a very basic level, the science of sound and how our brain is able to transform sound waves into meaningful information.

Good Vibrations: From Sound Wave to Conscious Perception

To process how sound works — and how we perceive and interpret sound — we must first understand sound waves. Sound waves exist as variations of pressure which are conducted through a medium such as air. Sound waves are created by the vibration of an object which, in turn, causes the air surrounding the object[1] to vibrate. The vibrating air, or sound waves, enter our ear and are funneled through our ear drum, causing a vibration of the ear-drum that stimulates the inner ear. The sound wave is pushed through the cochlea of our ear and then is able to be processed by our brain as sound.

How Our Brain Perceives and Interprets Sound

To transform from vibrations into tangible sound that our brains can identify and recognize, the auditory nerve fibers in our brain have to transmit the signals from the cochlea to the brain.[2] Groups of neurons in our brain receive said signals and decode information about the sound, such as pitch, timbre and duration in order to cause a sensation, or conscious perception, of that sound.

From there, the brain processes the sound on several different levels, one of which is as a reflex. This is what happens when a sudden noise startles you and causes you to jump or turn your head. The sound is also processed in the auditory cortex, the core area of the brain in charge of perceiving sound. And finally, the sound is processed in many other brain areas at once, which allows us to consciously perceive the sound, recognize the sound by comparing it to those we have previously heard and memorized and determine an appropriate voluntary response.[3]

It is also important to note that we hear binaurally, meaning that our brain receives sound from two separate sources, our ears. Our brain synthesizes the information received from both ears to help us localize sound sources and improve our ability to listen in complex auditory environments. Binaural hearing allows us to determine the type and direction of sound. When we communicate, we rely on these capabilities. Binaural hearing allows us to rapidly recognize a speaker and their position in relation to ourselves, in addition to helping us readily distinguish between multiple talkers and isolate speech from other distracting noises.

How Sound Affects Attention, Learning and Perception in the Workplace

With the development of language, hearing became the main sense associated with interpersonal interaction and communication. In a corporate setting, hearing is of paramount importance when it comes to how we learn, create and communicate with our peers. The contemporary office environment is one littered with technology that requires us to engage our hearing to share and receive information. In particular, conference calling is a crucial element of day-to-day life in corporate America.

Recent research into how background noise affects the brain would suggest that common conferencing aggravations are actually preventing your brain from firing on all cylinders in the short term and creating undue stress that can negatively affect your health in the long term.

Improvements in conferencing technology mean improvements in communication — that much is obvious. More significantly, improvements in conferencing technology mean improvements in the brain functioning of conference callers across the globe. Let's take a detailed look at the problems that used to plague conference callers as a result of poor-quality audio and contemplate how innovations in audio technology are actively working to relieve cognitive stress and free up brainpower for learning, complex problem-solving and sophisticated high-level processing for end users.

Background Noise: More than Just a Nuisance

It probably comes as no surprise that background noise is a detriment to focused concentration. But background noise is more than just a nuisance or concentration-killer; background noise can actually have a negative effect on your health. The National Institute for Occupational Safety and Health argues that background noise can increase stress levels and exacerbate stress-related conditions like high blood pressure, migraine headaches and even coronary disease[4]. Furthermore, continued exposure to background and ambient noise when you're trying to focus can actually worsen and compound upon these stressful effects.

When you're trying to focus but your brain is also forced to process the sound of background noise, the sensory overload floods your brain, causing your brain to release cortisol, the stress hormone. Excess cortisol in your body can inhibit the functions of your brain's prefrontal cortex, the hub of emotional learning that enables you to regulate 'executive' functions like planning, reasoning and exhibiting impulse control.

The prefrontal cortex has also been linked to short-term memory storage and inhibition to this area can disrupt an individual's ability to think clearly and retain information. The implications of background noise on your work performance aren't to be ignored. The stress caused by background noise may decrease higher brain function and impair learning and memory.

In fact, the distracting presence of background noise in your office has a drastic and tangible negative impact on your productivity. As Julian Treasures, the chair of Sound Agency[5] noted in a 2009 Ted Talk on the effect of sound, in open plan offices, productivity goes down a whopping 66 percent due to the distracting nature of background noise.[6]

Anyone who has experienced poor audio quality on a conference call has undoubtedly been subject to the clueless remote co-worker who forces his or her colleagues to endure the din of the coffee shop in the background of the call. And we all know how annoying the incessant barking of a dog or the wailing siren of a passing ambulance in the background of your meeting can be. But recent research into how background noise affects the brain would suggest that common conferencing aggravations are actually preventing your brain from firing on all cylinders in the short term and creating undue stress that can negatively affect your health in the long term.

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Incomprehensible Dialogue: The Negative Cognitive Effects of Struggling to Understand Speech

In a 2012 study examining the effects of hearing loss on cognition in the elderly, researchers discovered that when the elderly begin to experience hearing loss, their struggle to understand the speech of others can draw on cognitive resources that might otherwise be available for encoding what has been heard in memory, or for the comprehension of the rapid, informationally-complex speech that is a regular facet of everyday life.[7]

Put more simply, as hearing loss gets worse, it's harder to understand the speech of those around you. And the process of straining and struggling to understand speech — even if the speech is eventually comprehended — requires so much additional work for your brain that areas that would usually be devoted to tasks like forming memories or problem-solving are instead devoted to trying to understand the speech.

This type of listening, in which a concerted effort is made to understand what is being said, can be referred to as 'effortful listening,' and this type of listening is associated with increased stress responses, changes in pupil dilation and degraded memory performance.

Though this study was centered on hearing loss in the elderly, the cognitive implications are profound. It would seem that, even for those of us with adequate hearing, struggling to understand speech has the potential to flood your body with stress and negatively affect your cognitive performance.[8]

Struggling to understand what a co-worker is saying, whether it's due to excessive background noise, a subpar internet connection or garbled, delayed audio, is a common conference call aggravation. Chances are, if you're having trouble comprehending what's being said on a conference call, you're devoting imperative mental faculties to comprehension that, if the speech was easy to understand, would be devoted to crucial cognitive activities like remembering what is being talked about on the conference call.

The Perils of Interruption: How Being Interrupted Affects Your Ability to Focus

There is nothing worse than struggling to voice a thought or opinion because your partner in conversation keeps speaking over you or cutting you off. When you are interrupted, in addition to feeling frustrated, your ability to focus on the task at hand is impaired.

In one study examining the effects of interruption on focus and productivity, researchers discovered that there is a 15-second recovery period after an interruption where your brain struggles to get back on track and remember the information it was focused on before the interruption.[9]

Another study focusing on the employee strain resulting from interruptions in the workplace found that said interruptions were a large contributing factor to emotional exhaustion, physical complaints and increased anxiety in the interrupted employees.[10] In fact, interruptions in the workplace, be they momentary distractions from working on a task or an interpersonal interruption in conversation, have been shown in studies to increase strain and negatively affect job performance by depleting the self-regulatory and cognitive resources in the body.[11]

On a conference call with poor audio quality, it is sometimes difficult to tell who is being addressed by the speaker, which often leads to employees talking over or interrupting one another in response. This tendency, coupled with the interruption that occurs due to delays in audio, creates an environment where interruptions are all too common. Given the detrimental effects of interruption on cognitive function and stress levels, conference callers would benefit greatly from a conference calling system that allows for more seamless communication and collaboration.

The Conference Call: The Cornerstone of Corporate America

Conference calling has long been an integral facet of corporate America, one that has evolved alongside our business practices. Rapidly changing technology is providing us with newer, more efficient ways to collaborate. The conference call continues to be a mainstay, though, with web and audio conferencing expected to reach a combined global market size of $7.5 billion in 2016.[12] The enduring presence of the conference call in the corporate workplace means that technology is constantly being tweaked and improved so that our conferencing needs are never left unmet by conferencing solutions.

A Quest for Better Audio Quality

The technology that powers many non-VoIP conferences calls today utilizes a technology called public switching telephone network (PSTN) with a codec of G.711 to transmit audio signals in a conference call.[13] PSTN was designed so the audio codec would function to compress the raw audio down into a smaller size for transmission, and the compression function was set to crop the bandwidth of its audio from its raw state of 0 to 20kHz to a 300 to 3400Hz range, which provided acceptable audio quality.[14] This codec was used for decades and, because the codec was designed to cap bandwidth at 3400Hz, the audio quality remained at a constant level, even while audio technology in other devices improved alongside it.

After the mobile phone became a permanent fixture in contemporary culture, a newer, more efficient codec was designed so that voice signals could be transmitted in fewer bytes, guaranteeing that the maximum number of possible users would be accommodated into the core infrastructure. Between the radio-borne system used to transmit mobile telephone calls and the compression of voice signals to take up fewer bytes, call quality stayed relatively constant. Though the change in design did not noticeably improve call quality, the convenience of being able to access a conference call from practically anywhere more than made up for that, due to the premium placed on accessibility as a result of the mobile phone boom.

Finally, VoIP (Voice over IP) came into being and began carrying voice calls over IP networks rather than over dedicated telephone networks. At first, VoIP failed to deliver better quality because it was used on networks that were designed to transmit data only, not real-time voice signals. VoIP eventually managed to deliver a much higher quality of audio. While other factors like bandwidth and WiFi access can impact a VoIP experience, the constricting voice codecs have been removed and now we have the option to implement a number of 'wideband' or 'HD voice' codecs that can be used on phone or conferencing systems and even alongside video.[15] Increasingly, more solutions have the ability to deliver this high-quality audio across a wide range of usage environments, giving end users the opportunity to experience clear, well-defined sound in their meetings.

The Case for Better Audio

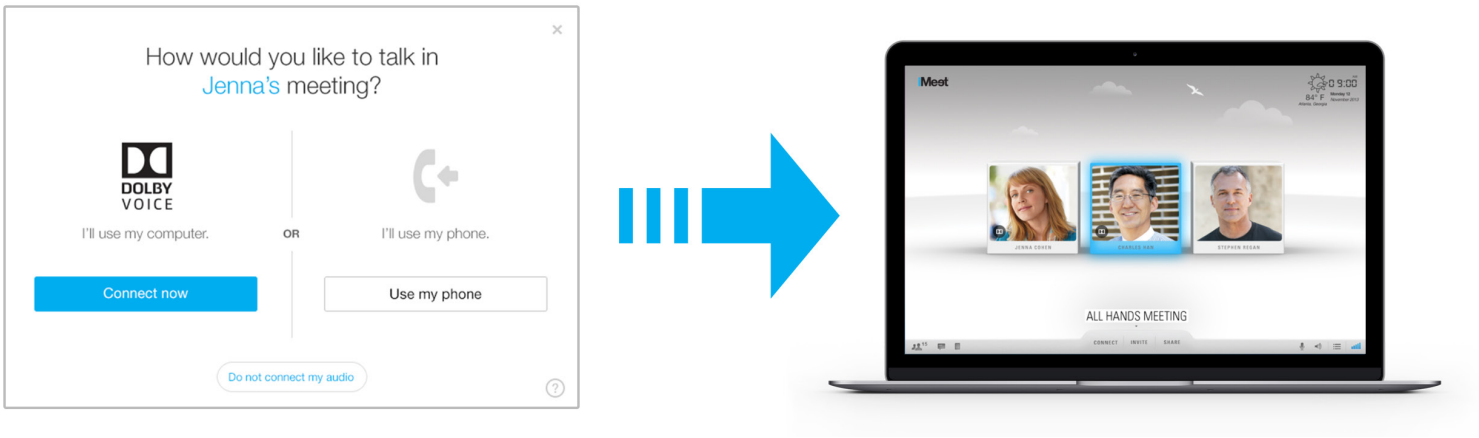
Audio quality on conference calls has drastically improved, and the benefits of said improvements are tangible in the realm of workplace communication. As evidenced by the studies above, poor audio quality invites significant cognitive impairments and hinders our ability to effectively communicate, as poor audio forces participants to struggle and strain to understand the speech of their co-workers, deal with distracting background noises and even put up with constant interruptions thanks to delays in the arrival of sound and difficulty determining who is speaking.

Poor audio quality has a drastic effect on our brains because low-quality audio technology works against how our brains have evolved to process sound. We are not evolved to understand conversations in which every voice comes from one location; mono audio causes us to lose subtle audio cues, making it nearly impossible to distinguish one voice from another. When you're too busy trying to figure out who has spoken and exactly what they said, there is little brain power left over to evaluate the idea conveyed through speech.

In this day and age, with technology on our side, there is no excuse to accept anything less than stellar audio quality in your conferencing provider. Even if not immediately noticeable, the effects of poor audio quality on your mental state are profound. High-quality audio means easier communication and enhanced collaboration, along with reduced stress and increased cognitive performance. So why would you settle for anything less than the best?

PGi's Dedication to High-Quality Audio

With high-quality audio comes efficient communication and a whole host of cognitive benefits that improve your ability to learn, collaborate and brainstorm with your peers. High-quality audio is undoubtedly crucial to productivity and growth in the workplace. That is why we have always made audio quality a top priority at PGi.



Together, iMeet® and Dolby Voice® are intertwining the science of perception with world-class audio engineering to create a top-notch VoIP experience that works with how our brain processes sound, not against it. The end result? Better communication and ideation all around.

PGi has long provided our customers with a premium audio, video and web conferencing experience, an experience that is largely predicated upon our dedication to equipping our collaboration software with the latest audio technology on the market.

Our customers know to expect the best from our collaboration software and, in keeping with our dedication to quality, we have recently integrated Dolby Voice® into our VoIP platform for our iMeet® collaboration solution. Together, iMeet and Dolby Voice are intertwining the science of perception with world-class audio engineering to create a top-notch VoIP experience that works with how our brain processes sound, not against it. The end result? Better communication and ideation all around.

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