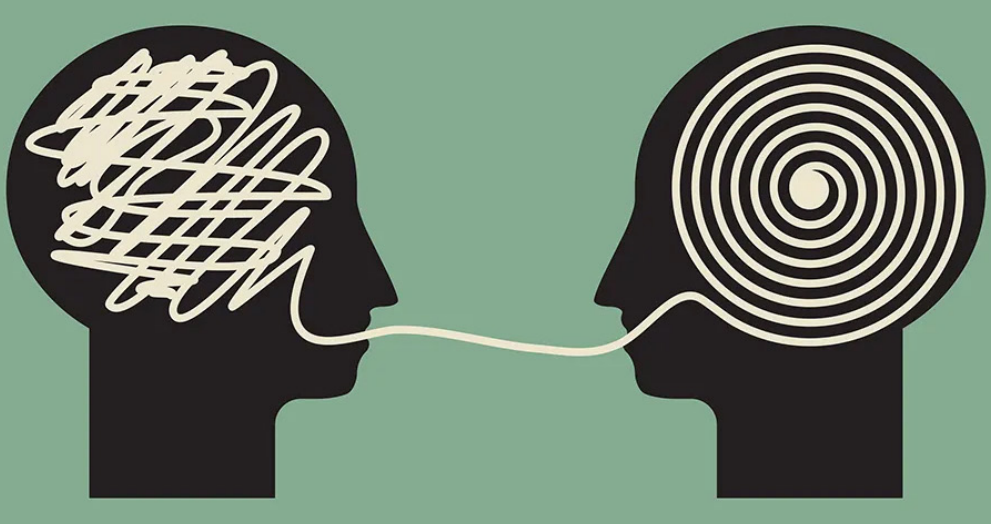

How To Improve Intelligibility in Houses of Worship

BY GRAHAM HENDRY

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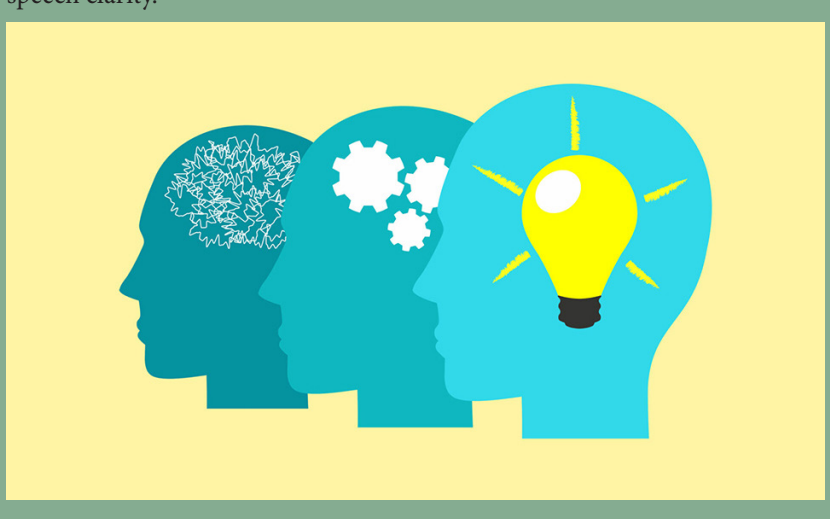
Improving speech intelligibility in houses of worship presents sound professionals with significant challenges, this being the single most crucial factor in the congregation's engagement. Worship services often rely on clear speech for sermons, prayers, and announcements, directly influencing the congregation's ability to connect with the message. However, many houses of worship are built with architecture that prioritizes aesthetics and capacity over acoustics, often resulting in excessive reverberation and poor sound clarity, which can significantly hinder this connection. Art and audio both need to be an uncompromising priority in traditional church architecture. Indeed, the message flows from both.

These spaces often have high ceilings, hard surfaces (stone, glass, wood), and long reverberation times, which mask spoken words, making them difficult to understand. Sound reflects off these hard surfaces, resulting in multiple arrival times at the listener. This is known as indirect sound and is the main contributor to the contamination of intelligible speech. Larger rooms with vaulted ceilings and expansive walls, such as those typified in many traditional sanctuaries, create more opportunities for sound to reflect and cause excessive reverberation. To a lesser extent, ambient noise from HVAC systems, street traffic, or people moving can also interfere with speech clarity.



Understanding Speech Intelligibility

Simply put, speech intelligibility is the percentage of speech a listener can understand or comprehend. Intelligibility is affected by the volume level and quality of the speech signal, the type and level of background noise, room reverberation, and more. The requirements for good intelligibility are straightforward — the sound system must have adequate bandwidth, proper signal-to-noise and direct-to-reverberant ratios, and be devoid of interfering reflections. Without these considerations, the reverberant sound will mask the speech syllables if the direct sound is weak, and the reverberant sound dominates.

Speech intelligibility can be specified in advance, designed through simulation tools, and objectively measured with an accuracy as good as that achieved using a panel of "live" listeners. The Speech Transmission Index (STI) was developed to quantify speech intelligibility in various acoustic conditions. STI measures the transmission quality of the speech signal, considering factors like background noise, reverberation time, and distortion.

ACOUSTIC PANELING IN LIFE CHURCH, SEATLLE. • PHOTO COURTESY OF PRIMACOUSTICS

Using Acoustic Treatments

An effective way to improve speech intelligibility is to use acoustic treatments to control reverberation and echo. Acoustic treatments absorb sound, reducing the number of reflections and ensuring that sound reaches the listener more directly. Acoustic treatments take many forms and have varying degrees of effectiveness, including panels, drapery, and carpeting.

If room treatment is a consideration, then it would be advisable to engage a consultant with the relevant expertise in the field of acoustics. Understanding a room's acoustic signature and being able to measure and interpret it is paramount and not for the novice.

Installing acoustic panels in strategic locations is an effective way to reduce reverberation time. Commercially available sound-absorbing materials can be mounted on walls and ceilings. It's important to consider the strategic placement of these panels to maximize their effectiveness. Introducing materials with effective absorption coefficients, such as carpets, can also help absorb sound. Similarly, using upholstered seating rather than wooden pews can reduce the overall reflectivity of the space.

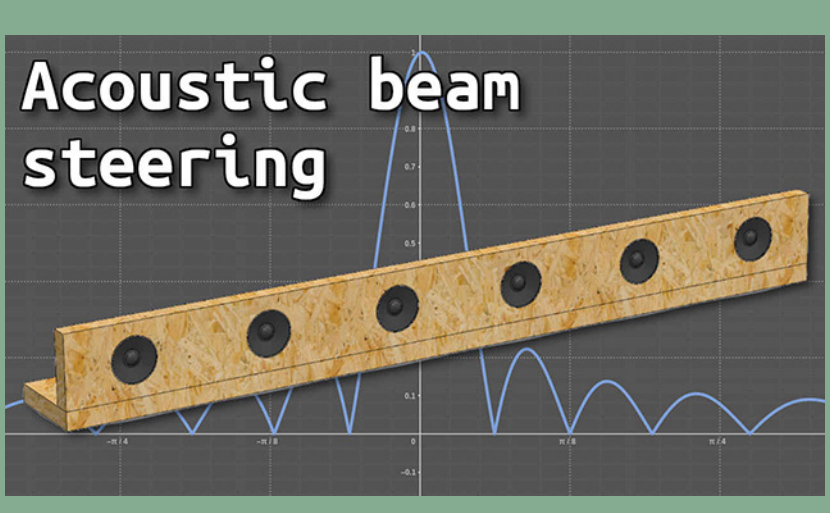
Acoustic treatments in traditional houses of worship are rarely implemented, and for good reason. While effective, such treatments are costly and aesthetically damaging. Often, that final consideration keeps a house of worship from making the change. An ornately designed church is unlikely to willingly compromise one of its most timeless and beautiful aspects.

Optimizing the Sound System

If applying acoustic treatment is prohibitive, loudspeaker selection becomes an even more important consideration. Expertly designing, installing, and tuning a sound system is critical for ensuring that spoken word is heard clearly throughout the house of worship. Optimal results are obtained when the system designer is integrally involved in the sound system commissioning. An experienced designer will have in mind how they intend to measure the system to achieve full optimization with quality test equipment. With the many excellent tools and techniques available today, the system must ultimately still sound good perceptibly. For that, the final piece of test equipment is your ears.

Loudspeakers should be positioned to provide even sound coverage without overemphasizing any areas. However, many houses of worship have architectural constraints on where loudspeakers can be placed, so an excellent solution to address speech intelligibility challenges is digitally steerable loudspeaker technology. Digitally steerable loudspeakers allow for precise control of where sound is placed. It also allows for the listening experience to be tailored in a way that loses no level of quality over the intended coverage area, a big advantage over traditional distributed systems. This is made possible with a combination of amplification, DSP, FIR filters, EQ, and delay — all programmed using software.

The most common sound source found in houses of worship is the speaking and singing voice. Because spoken word is such a critical aspect of the service, special attention should be given to microphone selection and placement, which often requires wearing the microphone for best results. Time spent on training in effective microphone techniques should never go unlooked.



Digital Beam Steering Explained

Digital beam steering allows the user to focus acoustical output on a specified listening area without mechanically aiming the loudspeaker. Each transducer has its own DSP and amplifier channel. Unique and proprietary algorithms result in the ability to tailor beams via software in very granular increments, allowing acute steering capability where the user desires.

By directing sound towards the audience and away from other surfaces that may cause reflections, digitally steerable loudspeakers deliver highly intelligible speech and natural music reproduction. In many cases, digitally steered products are the only way to achieve the required levels of speech intelligibility in large reverberant spaces like traditional houses of worship. Eliminating the need to physically tilt the loudspeakers means that digitally beam-steered loudspeakers can often be mounted directly to the wall, hung plumb, or even flush inside the wall.

Digitally steerable loudspeakers offer several advantages over conventional constant voltage distributed systems. They can reduce a system's overall costs by covering significantly larger areas with improved intelligibility using fewer, easier-to-install loudspeakers. These loudspeakers also incorporate full diagnostics and monitoring, substantially reducing installation and maintenance costs.

Elevating the Worship Experience

Words carry immense importance in houses of worship, and speech intelligibility significantly impacts the congregation's ability to immerse themselves in the worship experience. If they struggle to hear or understand clearly, it takes them out of the worship atmosphere and causes audio fatigue. From acoustic treatments to digital arrays to optimal loudspeaker placement, congregations have many options to improve audio clarity. Investing in these improvements can deepen engagement, foster better communication, and enrich the worship experience for all. T

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