Brio of Johnston A WesleyLife Community for Healthy Living



Special Supplement to the 2022 SAGE Post-Occupancy Evaluation White Paper

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2022 SAGE Post-Occupancy Evaluation



The 2022 SAGE POE team relaxes with some of Brio's four-legged residents

The Society for the Advancement of Gerontological Environments (SAGE) has been conducting post-occupancy evaluations (POEs) since the late 1990s. In 2022, a POE was conducted at Brio of Johnston, a WesleyLife Community for Healthy Living in Johnston, Iowa. A particular focus of the 2022 POE was an evaluation of the acoustics of the community. The SAGE POE team included Mandy Kachur, an acoustics engineer, to conduct tests and evaluate this aspect of the built environment.

Access the 2022 SAGE Post-Occupancy Evaluation White Paper and view a recording of the SAGE webinar, "Notes from the Field: A SAGE Post-Occupancy Evaluation of Brio of Johnston" <u>here.</u> You will also be able to access past POE resources dating back to 2016.

Cover photo: Brio, A WesleyLife Community for Healthy Living Firm: Pope Design Group Photographer: Nate Johnson Studio

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2018 FGI Guidelines

This acoustics evaluation utilized the 2018 edition of the Facilities Guidelines Institute (FGI) Guidelines for Design and Construction of Residential Health, Care, and Support Facilities as the reference for performance evaluation. These facilities assessed were designed before this edition, so this document is more of an examination of what is working and what is not for the residents and staff compared to the 2018 Guidelines.

- Room acoustics
- Airborne sound insulation
- Noise control of mechanical systems

Additionally, we assessed the HVAC sound levels in multiple residential units. Other FGI performance guidelines, such as exterior noise infiltration, airborne sound insulation of the residential spaces, and floor/ceiling impact noise, were not evaluated.

SAGE POEs aren't all fun and games! The POE team inflates balloons for acoustics testing.

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Architectural Acoustic Concepts Applicable to this Assessment

Room Acoustics

The lingering of sound in a space is referred to as reverberation and affects the ability to effectively communicate. Excessive reverberation negatively impacts speech intelligibility and allows sound to build-up. For example, if a person talks too quickly in a reverberant room, part of the lingering previous syllable will be heard at the same time as the next syllable. Targets for the reverberation time, which is the scientific measure of the sound decay, are generally based on the type of communicated information (i.e., speech or music) and the required clarity of the sound.

However, speech intelligibility also depends on how loud the speech is compared to the background sound level. Consider the comparison of the vocal and listening effort required for a conversation during a quiet meal at a fancy restaurant versus yelling at a bar to be heard over loud music. In engineering terms, we describe this as the sound level of the talker (i.e., the signal) compared to the sound level of the background (i.e., the noise), or the signal-to-noise ratio (SNR). The larger the SNR is, the better conditions are for listening.

continued





Room Acoustics continued

In the special case of dining spaces, which is important for resident socialization in long-term care settings, the signal-to-noise ratio is affected by the following.¹

- Amount of sound absorptive material in room
- Ceiling height/room volume
- Number of people talking in room
 - Table size directly affects this with the ideal size being four seats per table
 - SNR will start high when the room is relatively empty and quieter, and decrease as the room fills with more talkers and gets louder
- Distance between talker and intended listener
 - Again, this is influenced by table size with tables seating two to four people being ideal
- Seating density and the distance between tables

Reverberation is typically controlled by incorporating sound absorbing materials into a room, but reverberation is also affected by the room volume. Reverberation time is an engineering measure useful for calculating the amount of sound absorbing materials needed to control the sound. Shorter reverberation times improve speech intelligibility.





Airborne Sound Isolation

Good sound isolating construction between spaces reduces the transmission of airborne sound, thus minimizing disturbance and/or protecting speech privacy. Typical examples of airborne sound include people talking and sound from televisions or loudspeakers. Quantifying the effectiveness of reducing this type of sound between rooms in the design stage is described by the Sound Transmission Class (STC) of walls, and floor-ceiling assemblies. The higher the STC, the better the partition is at blocking sound.



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When measuring the field performance, the Apparent Sound Transmission Class (ASTC) or Noise Insulation Class (NIC) is used. These measures are often three to eight rating points below the design STC due to acoustical leaks, flanking paths around the partition, and workmanship issues in the field.

Noise Control of Mechanical Systems

Noise from building mechanical systems can make it difficult to hear in a space. Background sound from HVAC systems is quantified by a family of frequency curves called Noise Criteria (NC) curves. This rating system is preferred over an average decibel level because it contains information about the frequency content of the sound as well as the sound level in each of these frequency bands. The target NC rating for a space is selected by the need for speech intelligibility or privacy. For example, a meeting room should have a low NC rating so that the speech level is well above the background sound (high SNR), but in an open office where distraction and speech privacy can be a problem, the NC rating should be higher to cover (i.e., mask) speech.

Acoustics Considerations for the Hearing Impaired

Approximately one in three people in the US between the ages of 65 and 74 has hearing loss, and nearly half of those older than 75 have difficulty hearing.^{2,3}This makes it more difficult for these individuals to understand speech and respond to signals and alarms in noisy or reverberant environments.

While hearing aids generally benefit individuals in quieter environments, some devices amplify all sound and not just the desired sound, thus not solving the issue of speech-in-noise comprehension. Furthermore, approximately 30% of adults who have been prescribed hearing aids use them, making it important for the background sound level to be low.⁴





Additionally, some older adults do not have voices powerful enough to overcome elevated background noise, making it more difficult for them to join dinner conversations because their companions cannot hear them well.

Reduced ability to hear speech-in-noise is a quality of life issue. It limits enjoyment, communication, and well-being of the hearing impaired person. It also increases stress and social isolation, leading to negative physiological and psychological health outcomes.

A further complication occurs for the hearing-impaired in rooms with long reverberation times. In fact, reverberation time design targets for rooms used by the hearing impaired should be significantly shorter than the standard accepted design ranges for normal hearing persons.⁵ However, more research needs to be done to prescribe what this difference should be.

Acoustics Evaluation at Brio of Johnston

The resident experience at another Pope Design Group/WesleyLife community, which is Hearthstone in Pella, Iowa, informed the acoustics design for the dining rooms at Brio. In particular, the assisted living dining room at Hearthstone was overly reverberant, making it difficult for the occupants to converse with their dining companions. To create a more supportive environment at Brio, WesleyLife invested in acoustical treatment for the community spaces that are heavily used, and Pope Design Group incorporated this vision into the design. Clear gains were accomplished, as this POE will show, though further improvement could be made in some areas.

The POE team tested multiple spaces for room acoustics, sound isolation, and mechanical noise. We concentrated on acoustical issues that residents raised during a group discussion. Residents and staff are generally satisfied with the community acoustics, but dining room noise, reverberation in the lobby, living unit HVAC noise, footfall/impact noise from the above living unit, and noise from the corridor coming through the living unit doors were the most common complaints. This assessment concentrates on dining room acoustics, conference room acoustics, and HVAC noise since these were the easiest to test in the limited time the POE team had onsite.

The FGI Guidelines address many more acoustical aspects than were examined during this POE, but in our limited time, we could not fully assess all the design guidelines. Therefore, this summary only highlights a few issues brought to our attention and should not construed to be a comprehensive design guide for acoustics.



Hearthstone, a WesleyLife Community for Healthy Living. Gilbertson Photography, LLC.

Room Acoustics - Skilled Nursing Dining Area

GOAL

An environment that sounds residential in addition to looking residential.

DESIGN

At Hearthstone, gypsum board ceilings lengthened the reverberation time and created a slightly harsh aural environment. At Brio, reverberation was reduced by installing stipple painted acoustical panels that have a drywall appearance yet perform well acoustically. They are located on the ceiling above two areas of dining seating.



Hearthstone

Brio of Johnston

ANALYSIS

Per FGI Table 2.5-4, Footnote 5, the 2018 FGI Guidelines call for a minimum 17 square feet (1.58 square meters) of floor area per person at full occupancy and 17 square feet (1.58 sq. m.) of acoustical finishes with a performance of NRC 0.80 or higher. The first requirement strives to keep the density of the seating low enough to prevent excessive sound build-up and to reduce the direct sound carry-over from table to table. The second requirement keeps the reverberation time in check, which helps with speech intelligibility and background sound reduction.

Depending on whether the carpeted corridors and lounge spaces are included in the calculation, the FGI area targets were met or slightly shy.



Room Acoustics - Skilled Nursing Dining Area continued

While reverberation time is not cited as a design parameter in the FGI Guidelines, it is helpful to examine the effect on it by adding sound absorption. When comparing the skilled nursing dining areas at Hearthstone and Brio, a 10% reduction in reverberation time was obtained by introducing more acoustical materials in the space, which moves the Brio space closer to the target range typical of the use and size of space. Note that reverberation times lower than the target range are acceptable for this type of space.



Dining - Skilled Nursing

RESULT

While residents were not polled for their opinion on this space, the room acoustics at Brio were successfully improved when compared to the older community of Hearthstone.

THOUGHTS

The ceiling is often the most convenient location for acoustical materials. It offers a large surface that is less susceptible to damage and soiling. Stipple painted acoustical panels and the relatively recent introduction of "acoustical plasters" or "acoustical drywall ceilings" that utilize a hanging grid system maintain a gypsum board appearance while providing the needed sound absorbing materials to create a space that is acoustically more functional for residents.

Reverberation control must be purposefully designed in large volume spaces. "Institutional" has a sound in addition to a look, and harsh, reverberant spaces should be avoided to allow ease of communication and acoustical comfort.

OD CEILING

Room Acoustics - Assisted and Independent Living Dining Area

GOAL

Reduce sound build-up in dining spaces and increase speech intelligibility.

DESIGN

These contiguous dining spaces are separated by partial height dividers in the form of fireplaces and a small area of seating that has a lower ceiling height than the two adjacent areas (see below). The two-story space has acoustical wall panels and carpet, though the ceiling and walls are gypsum board with windows. The vaulted space has carpet with a hard-surfaced wood ceiling and gypsum board walls with windows.







Room Acoustics - Assisted and Independent Living Dining Area continued

RESIDENT INPUT

A focus group of independent and assisted living residents complained about the sound build-up in the twostory dining area, where multiple people said it was difficult to hear conversations. Those who needed a quieter space with better speech intelligibility tended to eat in the vaulted area, though not everyone agreed that this space was ideal.



POE Focus Group

ANALYSIS

These two spaces meet the FGI floor area per seat criterion for good acoustics but fall well short of the recommended 17 square feet of high-performance acoustical materials per person, having only 9 to 11 square feet per person instead of the listed 17 square feet per person. Both dining areas are carpeted, which reduces footfall and chair dragging sound, but typical commercial carpets perform about a twenty-five percent as well as a 1-inch-thick acoustical panels. Consequently, only one quarter of the carpet area was included in the calculation while the full area of acoustical panels was used.

Interestingly, the large bulkhead formed by the low ceiling between the two-story and vaulted spaces, plus the partial fireplace barrier and distance created by the narrow seating area provide enough of an acoustical barrier for these two volumes to have unique reverberation time measurements. This is not always the case for two adjacent spaces that do not have a full partition separating them.



Room Acoustics - Assisted and Independent Living Dining Area continued



Referring to the measured reverberation time for further insight into the behavior of both rooms, the reverberation in the vaulted ceiling seating area is 16% shorter than the two-story space. This is a clearly noticeable difference, as evidenced by the behavior of the residents. Both Brio spaces perform better than the Hearthstone dining space that set this design initiative into motion but fall short of the preferred reverberation time target range for a room of this size and use.

In keeping with expectations, the average sound level measured in the two-story space was 4 dBA louder than the vaulted space during a dinner with roughly 75% occupancy in both spaces, though the two-story area has a slightly higher seating density. This difference is enough to be noticed by occupants.

RESULT

Residents with difficulty hearing speech-in-noise seek out the quieter and less reverberant vaulted ceiling area of the dining room.



Room Acoustics - Assisted and Independent Living Dining Area continued

THOUGHTS

Both spaces would benefit from additional sound absorbing materials. Stipple painted ceiling panels or acoustical plaster can be installed in the two story space to meet the FGI Guidelines while retaining a gypsum board appearance. To avoid altering the aesthetics of the wood vaulted ceiling, acoustical panels can be mounted to the upper side walls in this space to bring its ratio of treatment area per person in line with the FGI Guidelines.

If the project budget does not support acoustical treatments throughout the dining spaces, consider designing at least a portion of dining area with better acoustics, similar to the situation at Brio, so that residents can move to the quieter seating sections as needed.



Assisted and Independent Living Dining Area

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Room Acoustics - Lobbies Used for Meetings



Brio Lobby



Hearthstone Lobby/Community Room Gilbertson Photography LLC

GOAL

Use of the lobby as a meeting space in either community was not anticipated, and therefore no particular acoustical goals were envisioned.

DESIGN

Acoustically hard surfaces are typically used in lobbies, such as gypsum board, glass, and hard flooring. This is the case in both facilities. The Brio lobby volume is larger than Hearthstone's lobby, and thus we would expect it to have a longer reverberation time for the same materials.

ANALYSIS

The reverberation time trends longer for large spaces with hard, sound reflecting surfaces. If a lobby will be used for meetings, the reverberation time target for a large multipurpose room would be appropriate. Both WesleyLife lobbies have reverberation times well above the ideal target range for meeting spaces but are typical of large lobbies and atriums that do not have speech communication needs.

RESULT

Hearthstone uses their lobby more frequently than Brio for meetings, and staff said that the reverberation is troublesome for speech intelligibility for the residents. When the Brio lobby is used for meetings, staff members have also noticed speech intelligibility issues.



Room Acoustics - Lobbies Used for Meetings continued



THOUGHTS

If the construction budget cannot support acoustical treatment in the lobby, consider leaving wall and/or ceiling area free for installation of sound absorbing materials at a later date should the unforeseen uses of the space require better speech intelligibility and acoustical comfort.

Sound Isolation - Brio Meeting Rooms

GOAL

Provide enclosed meeting spaces that can be used for private gatherings while retaining an aural connection to adjacent spaces to keep a sense of community.

DESIGN

The Club Lounge can be closed off from the Bistro Seating and Lobby by a pair of double-wide barn doors for private gatherings or the doors can open widely to allow a visual connection between these adjacent spaces. The Community Room has a glass wall to provide a visual connection to the hallway. Caulking the butt joints between glass panes was not specified because the joint material would be visible and that was judged to negatively affect the aesthetics.





Sound Isolation - Brio Meeting Rooms continued

ANALYSIS

Sound transmission testing produced very low Noise Isolation Class (NIC) ratings of NIC 17 and NIC 20 for the Club Lounge doors, which allows for speech to be fully understood across the partition and extraneous sounds to easily transmit into the meeting room. These test results are typical for unsealed doors. The glass wall with unsealed butt joints produced a similar result at NIC 16. While each of these spaces can be used as closed meeting rooms, they are not acoustically private or free from outside distraction.

RESULT

While the lack of seals on the Club Lounge doors accomplishes the goal of aural connection, extraneous sound transmitting into the room could be distracting to some meeting attendees. A similar situation occurs with the Community Room glass wall, though presumably unintentional, because of the decision to prioritize the glass wall aesthetics. AL/IL residents and staff had no comments about the Club Lounge but mentioned sound transmission from the corridor and adjacent Lobby into the Community Room as a concern.

THOUGHTS

The aural connectedness versus sound distraction trade-off should be considered in the design process. Should the sound isolation in the Community Room remain a concern, installing acoustical door seals and caulking the gaps in the glass would likely improve the partition NIC by 10 to 15 points. This would reduce the transmitted sound by half to a third.

Mechanical Noise - Brio Meeting Rooms

GOAL

The FGI Guidelines and ASHRAE Handbook – HVAC Applications⁶ documents have defined recommendations for good speech intelligibility in meeting rooms.

DESIGN

No design information for the mechanical systems was provided.

ANALYSIS

All of the main meeting rooms shown in the graph have HVAC noise that is significantly higher than the target range based on both the FGI Guidelines and ASHRAE. The low frequency noise is due to fan noise and the upper frequency noise is due to diffuser or damper noise.





Mechanical Noise - Brio Meeting Rooms continued

RESULT

With these levels of sound, the presenter is more difficult to hear and understand for a meeting attendee. The measured levels are comparable to an electronic sound masking system, whose purpose is to decrease speech intelligibility. This is undesirable for a conference room acoustic environment.

THOUGHTS

Several strategies can be applied to improve the acoustic quality of spaces. These include specifying quiet mechanical units, incorporating duct silencers or internal acoustically lined ductwork, adhere to ASHRAE recommended duct air velocities. locating terminal units outside of noisesensitive spaces, and selecting diffusers and grills for low noise generation. It is important to note that the FGI appendix material mentions that historically background sound level criteria have been formulated for populations with normal hearing and not the hearing impaired. Where possible, consider setting the target background sound level 5 NC points or 5 dBA lower than the recommended levels in the FGI main body and ASHRAE references.



Brio Club Room



Brio Community Room



Brio Silo

Mechanical Noise - Brio Residential Living Units

GOAL

Acoustical comfort and minimizing disturbance are primary goals when designing HVAC systems that serve individual units. In a residential unit, a loud HVAC system can disturb sleep, mask conversational speech between individuals, and make it difficult to hear the television, alarms, and signals.

DESIGN

The Brio VTAC units are housed in mechanical closets. The supply is fully ducted with the return air transferring through a louver in the door.





ANALYSIS

The loudest model HVAC units operating in both heating and cooling modes were well above the target range in the rooms where the mechanical closet was located. While this is less than ideal when the closet was in the living room, it was unhealthy when it was located in the bedroom due to sleep disruption. Other model HVAC units were not this loud and were closer to the target range. However, their operation was still clearly noticeable since the ambient level is guite low in the living units, which makes the cycling of the unit more apparent when it turns on. For the example shown, the HVAC sound is roughly twice to four times as loud as the background sound, depending on the frequency.

One-bedroom independent living apartment



Mechanical Noise - Brio Residential Living Units continued



RESULT

A resident complained that the unit located in her bedroom wakes her up at night. This is not healthy since sleep disturbance can lead to disorientation, possibly contributing to falls.⁷ The best way to solve this issue is to purchase quiet HVAC units and not locate the mechanical closet in the bedroom. Also avoid short duct runs between the HVAC unit and the bedroom.

THOUGHTS

Select quiet HVAC units and locate them in a less noise sensitive area than the bedroom. Long duct runs to the quietest spaces will help reduce the sound propagation through the ductwork. If the units have a mechanical closet, offset the door louver or transfer duct away from the unit inlet.

References

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⁵ M. David Egan, Architectural Acoustics, New York, The McGraw-Hill Companies, Inc., 1988, p. 64.

⁶ 2019 ASHRAE Handbook - HVAC Applications, Chapter 49 Noise and Vibration Control, p. 49.3.

⁷ Katie L. Stone, PhD, Terri L. Blackwell, MA, Sonia Ancoli-Israel, PhD, Jane A. Cauley, DrPH, Susan Redline, MD, MPH, Lynn M. Marshall, ScD, Kristine E. Ensrud, MD, Sleep Disturbances and Increased Risk of Falls in Older Community-Dwelling Men: The Outcomes of Sleep Disorders in Older Men (MrOS Sleep) Study, J Am Geriatr Soc. 2014 Feb; 62(2): 299-305.

Helpful Links



<u>SAGE Webinar Recording:</u> Notes from the Field: A SAGE Post-Occupancy Evaluation of Brio of Johnston Presented 11/16/22 2022 SAGE POE White Paper Access all SAGE POE white papers and resources dating back to 2016

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2022 SAGE Post-Occupancy Evaluation White Paper

Prepared by Arry Carpenter, AIA, LEED AP Principal, SFCS Architects

Click below to learn more about all the organizations involved in the 2022 SAGE POE.







WesleyLife



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