NOISE REDUCTION IN EARLY CHILDHOOD CENTERS

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Early Childhood Centers

The ability of a child to achieve to his/her maximum potential in a typical early childhood setting is diminished by the presence of a hearing loss. Even with early identification, intervention, and appropriate amplification, learning will be impeded in noisy centers. On Prince Edward Island, poor acoustic environments create significant barriers to the developmental progress of preschool children. Initially, early intervention with parents of infants and toddlers with hearing loss occurs in their homes. An auditory verbal therapist guides parents in using strategies that maximize their child's use of hearing in learning spoken language through *listening* rather than *watching*. Generally, the acoustic conditions of the homes are controllable and favorable to listening. Parents sit next to the child and speak close to the microphone of the child's hearing aid or cochlear implant at a regular volume. Background noise is minimized. The parent's speech is melodic, rhythmic, expressive and repetitive. Parents use a variety of techniques called *acoustic highlighting* to enhance the audibility of a spoken message.

Transitions to many island day care centers and kindergarten classes provide serious challenges for clear speech perception for all children. However, a poor acoustic environment will be devastating to the speech, language, and auditory skills development of children with fluctuating or permanent hearing loss. A study of classroom ambient noise levels in 33 Florida elementary classrooms found that occupied kindergarten classes were the noisiest (Rosenberg, 1999). These kindergarten classrooms were located within the elementary school buildings. Prince Edward Island early childhood centers are privately owned and operate in community centers, church basements, and modified residential buildings. Often several small activity groups are being led concurrently in an open concept facility. For easy cleaning and to minimize allergies, hard surface flooring and walls are standard. Draperies are avoided as well. However, the abundance of hard surface areas results in increased reverberation.

Ceiling height and angle, the room size, shape, and design, and continuous noise sources need to be evaluated in determining the listening conditions of early childhood centers. If room acoustics are not addressed and appropriate modifications are not implemented, research studies of school age children have identified deficits in student achievement, behavior, attention, persistence, cardiovascular health, and reading achievement (Anderson, 2001). Poor acoustical conditions diminish potential learning, language, and social development for everyone, but will especially inhibit the auditory brain development of children with any degree of hearing loss----and on any given day 1/4 to 1/3 of the children in preschool centers may be experiencing an educationally significant hearing loss in at least one ear (Flexer, 1995).

Because school boards own and maintain their buildings, they have the ability to make modifications and improvements for listening. Most early childhood center owners are renting space within a community facility and operate on severely limited budgets. These environments require creative strategies to improve the acoustics for young children. Additionally, Prince Edward Island's government supports *inclusionary practice*, which holds that all students are entitled to equitable access to learning, achievement and the pursuit of excellence in their education. The practice of inclusion incorporates basic values that promote participation, friendship and belonging. This policy increases the responsibility to evaluate early childhood centers and to make all learning environments for children acoustically accessible for everyone. Legislation of acoustical standards for classrooms is currently under consideration by the United States Access Board. Standards would apply to new school construction and renovations, but " real change in classroom acoustics is more likely if the affects of acoustic interference on behavior and learning were more widely recognized by architects, educators, educational administration, school board members, and legislators" (Anderson, 1999). Educators are often unaware of the link between noise and children's performance.

Prince Edward Island's government also has a strong commitment to literacy development---and the building blocks of reading and writing, the phonemes, need to be richly available for the normal development of phonological awareness. Background noise levels can mask speech sounds. 90% of the speech sounds that carry the meaning of language are consonants. The low intensity, high frequency consonant sounds such as s, t, and f are particularly important for intelligibility. These often mark tense, plurality, and possessives in spoken language and are obliterated by higher intensity background noise. It

is not sufficient for spoken messages to be merely *audible*. They must be *intelligible* for auditory discrimination and phonological awareness, the basis for literacy success, to develop correctly (Lundberg, 1988). Excessive reverberation changes the quality of the speech signal and causes an acoustic smearing or distortion of speech sounds. Adult listeners have the advantage of decades of listening experience and language usage knowledge. Their auditory cortex is completely myelenized and developed. Adults are able to make sense of incomplete or distorted auditory input using auditory closure. For children, whose auditory cortex is not fully myelenized until age fifteen, the outcome is decreased auditory discrimination and an inability to accurately perceive when speech sounds begin and end. This has huge implications for accurate speech, vocabulary and language development, the foundation of reading and spelling success (Robertson, 2000).

Children with hearing loss may have difficulty with speech recognition in ideal conditions. If they are at a distance from the teacher, speech intensity may be reduced until sounds are inaudible. The greater the level of background noise and reverberation in the room, the closer these students must be to the speaker. Seating in classrooms is more readily managed than in early childhood centers. Young listeners are required to expend greater *listening effort* in settings with poor acoustics and fatigue more quickly. The poorer the listening conditions become, the greater the listening effort is required. When younger children experience auditory fatigue, they "tune-out" and miss much of the instructional and social opportunities being offered.

Hearing loss itself creates an additional acoustic filter effect on top of the degradation and distortion of the speech signal caused by the physical conditions of the acoustic environment. Hearing aids amplify all sound from both within and outside of the listening area. Hearing aids often increase the hearing and listening difficulties instead of improving them in adverse acoustic conditions. Use of personal and sound field FM systems to improve the signal-to-noise ratio in both early childhood centers and school classrooms gives children who are deaf or hard of hearing a chance to access clear, precise speech input from educators. FM system use will always give the advantage of reducing the negative impact of distance on spoken language. However, it is even more effective in quiet, controlled acoustic environments. Background noise needs to be managed and reduced.

Noise causes listeners to pay attention to the most critical or attention-grabbing aspects of a situation and to ignore more subtle, less immediately relevant cues. Preschoolers are very susceptible to visual and auditory distraction and will lose concentration frequently in the presence of background noise. They completely miss, oversimplify, or make erroneous assumptions about complex social relationships and the rules for interpersonal conduct. Learning and behavior outcomes are diminished. Learning to follow directions and increasing sequential auditory memory depends on concentration, the ability to maintain attention, and complex verbal processing.

Adverse conditions also create irritating, annoying noise that children with an auditory sensitivity will actively seek to avoid. Visual and kinesthetic learners are going to be at a serious disadvantage under noisy conditions. Overcrowding in classrooms creates additional noise as well. Today's teaching styles encourage cooperative, interactive, small group activities. An undesirable outcome is that several small groups conversing simultaneously just create more background speech babble that reverberates, smearing and distorting the verbal messages.

Prince Edward Island has just begun its second year of publicly funded kindergarten. It is a wonderful benefit to Island children to have programs accessible in their communities taught by early childhood educators. The Department of Education is one partner in the process of developing a standard curriculum and defining the standards for teacher training and qualifications. Health codes and building codes exist to make sure our children are in healthy, safe environments. Acoustical standards will additionally assist in evaluations of preschool settings so young children all experience listening comfort and an enhanced accessibility to spoken language, critical conditions necessary for auditory brain development.

Noise level data collected from a sample of kindergartens will be reported during this session.

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