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Non-auditory Effects of Noise in the Classroom: Teachers

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In the last edition of Canadian Audiologist, I talked about the fact that despite an awareness that high noise levels in classrooms are problematic, there has not been much improvement over the years. The detrimental effects of noise on speech perception for several different populations (e.g., students with hearing loss, English Language Learners, students with learning challenges, etc.) have been well documented. However, we should not forget the other ways in which high noise levels impact student and teacher health and well-being at school. The number of studies on non-auditory effects of noise continues to grow (see Waye & van Kempen, 2021 for a review of occupational and community noise effects). However, there are some interesting differences in the research on non-auditory effects of classroom noise compared to research in other areas (e.g., sleep disturbance or job performance). While there is little literature on the impact of environmental noise on classroom teachers (see Sargent, Gidman, Humphreys, & Utley, 1980), most classroom noise consists of speech and so non-auditory effects of noise may look different in classrooms than in other settings. A second difference is that much of this research has come as a by-product of reducing the impact of the noise (i.e., the implementation of a sound field system or classroom audio distribution system), where anecdotal comments after the installation of these systems have highlighted problems of which people were previously unaware. Of course, research on sound field systems investigates the effects of improving the classroom listening environment by improving

the signal-to-noise ratio, rather than examining the effects of reducing classroom noise. However, we can still find clues there.

Issues that have been extensively studied in other research on the non-auditory effects of noise (such as annoyance, blood pressure changes, health problems, and stress) have received almost no attention for classroom teachers. This may be related to the fact that classroom noise is “relatively” low in comparison to, for example, construction noise, or to the fact that any annoyance factor may be minimized since the noise source is primarily student voices. In fact, in one study by Kristiansen et al., (2011), the authors noted that “Noise disturbance attributed to traffic noise and ventilation and machinery in the schools…received very low disturbance ratings from most of the respondents” and found that students talking was the most prevalent and most annoying type of noise. In addition, this study indicated that approximately 82% of the teachers reported being exposed to disturbing noise for at least ¼ of the workday and that annoyance reports regarding noise were highly correlated with reverberation times in classrooms.

Teacher vocal fatigue and absenteeism can be considered an indirect effect of classroom noise, but they are important nonetheless. Teachers are unquestionably at higher risk for vocal problems than other professionals (Mattiske et al., 1998; Smith et al., 1998; Verdolini, & Ramig, 2001; Vertanen-Greis et al., 2020). Research on teacher absenteeism due to vocal problems suggests that vocal problems may be the most common reason for teacher absenteeism (Medeiros, & Vieira, 2019; Nerriere et al., 2009). The societal cost of voice problems in teachers alone may be about $2.5 billion annually in the US (Rosow et al., 2016). While some of the vocal problems in teachers are attributable simply to the amount of talking they do during the school day, high noise levels exacerbate this problem because of the need to project one’s voice over the noise, not just occasionally to get students’ attention, but on an ongoing basis throughout the day (Smith et al., Chen et al., 2010; Vincent, 2008).

Vocal effort is related to individual factors such as fatigue and environmental factors such as listener-speaker difference and background noise (Pelegrin-Garcia & Brunskog, 2012). Several studies have theorized that physical education teachers and kindergarten teachers are at the highest risk because they teach in the highest noise levels and have more vocal strain (Safarti, 1989; Unger & Bastain, 1981). Unsurprisingly, research has noted that voice power levels are related to room size and reverberation time, such that the same vocal effort will result in lower voice power levels and poorer speech intelligibility in a highly reverberant room (such as a gym) than in a smaller, less reverberant classroom (Astolfi et al., 2012; Banks et al., 2017; Bradley, 1986; Pelegrín-García et al., 2011). Bottalico et al. (2016) measured teacher vocal effort and vocal comfort under various acoustical conditions (including varying room size, reverberation time, and background noise consisting of children’s speech babble). They found that vocal effort decreased when measures were implemented to improve the acoustical environment. They concluded that speakers change their vocal effort in response to auditory feedback of their own voices under different acoustical conditions. Mattiske et al. (1998) discussed strategies for preventing and treating vocal problems in teachers and reported that there is surprisingly little research on vocal use and vocal hygiene training programs for teachers.

What is more surprising to me, though, is the very meagre body of research on the effects of simply improving the acoustical environment of the classroom so that teachers do not have to strain their voices, although Roy at al., (2002) found that sound-field amplification had a more significant impact on vocal strain than did teacher hygiene training programs and that teachers

using voice amplification reported less voice handicap and voice disorder severity, corroborated by objective acoustic analysis. Sapienza, Crandell & Curtis (1999) found that teachers used less vocal effort with a sound field amplification system, while Jonsdottir et al. (2002), in a study of teachers and students from both elementary school and college/university classrooms, noted that without amplification, 70% of teachers reported throat discomfort before trial of sound field amplification. This decreased to 27% after sound-field installation.

The COVID-19 pandemic has offered us an interesting perspective on this approach to addressing vocal problems by improving the acoustical environment. Sheela & Kiran (2021), in a systematic review of the effects of masks on vocal production during the pandemic, reported that masks result in an increased vocal effort, vocal fatigue, discomfort, and perceived voice problems. However, there has been a *decrease* in reported vocal problems among teachers during the pandemic with remote learning (Patjas et al., 2020; Besser et al., 2021), which is theorized to be due to decreased background noise levels. In the next edition of Canadian Audiologist, I will focus on the non-auditory effects of noise on students (such as cognitive processing, academic achievement, literacy scores, and behaviour).

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