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Noise and autism spectrum disorder in children: An exploratory survey

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ABSTRACT

Background: With more students being educated in schools for Autism Spectrum Disorder (ASD) than ever before, architects and interior designers need to consider the environmental features that may be modified to enhance the academic and social success of autistic students in school.

Aim: This study explored existing empirical research on the impact of noise on children with ASD and provides recommendations regarding design features that can contribute to noise reduction.

Methods and procedures: A survey, which addressed the impact of architectural design elements on autism-related behavior, was developed for teachers of children with ASD and distributed to three schools.

Outcomes and results: Most teachers found noise control to be an important issue for students with autism and many observed children using ear defenders. In terms of managing issues related to noise, most teachers agreed that thick or soundproof walls and carpet in the classroom were the most important issues for children with ASD.

Conclusions: Suggested future research should address architectural considerations for building an acoustically friendly environment for children with autism, identifying patterns of problematic behaviors in response to acoustical features of the built environment of the classroom setting, and ways to manage maladaptive behaviors in acoustically unfriendly environments.

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What this paper adds

This paper investigates how educators believe the acoustical environment can be modified to influence behavior of students with autism. Empirical evidence on how students with autism respond sensitively to lighting, sound, acoustics,

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tactile sensations, scents, and other environmental factors is highlighted, in addition to the relationship between sound and unwanted behaviors from caregivers' perspectives.

The study demonstrates that noise pollution may be associated with children with ASD engaging in intrusive behaviors, such as covering their ears, as an attempt to regulate sound. Teachers who work with these children agreed that noise control is an important issue concerning the instruction of children with autism, which is aligned with past research. While teachers believed that the use of wooden tables, chairs, and panels may be of benefit, most were ambivalent regarding thick or soundproof walls and carpet as methods of managing noise in the classroom. This highlights a need to provide educators with better information about noise pollution in the classroom, specifically the relationship between acoustic modifications and noise pollution.

While prior research suggests that children with ASD engage in intrusive behaviors to regulate noise that negatively impacts health, there is limited empirical research on specific design modifications to help manage noise in a classroom setting. Recommendations based on the current study include further research on the impact of carpet, soundproofing for walls and ceilings, and wood tables and chairs, in addition to analyzing patterns of sensory response and problematic behaviors in children with ASD at school.

1. Introduction

Noise may be defined as “the unpleasant sounds which distract the human being physically and physiologically and cause environmental pollution by destroying environmental properties” (Melnick, 1979; p. 721). Elevated levels of noise in a person's environment have a significant negative impact on their health and result in both physiological and psychological outcomes (Atmaca, Peker, & Altin, 2005). A variety of physiological effects resulting from excess noise can interfere with task performance such as startle response, freezing, muscle tension, and an increased risk of aggressive behavior (Suter, 1989). In addition, noise can prompt increased blood pressure; accelerated heartbeat, trigger muscle reflexes, and sleep disturbances. In extreme cases, prolonged exposure to loud noise at greater than 85 dB can result in hearing loss. Psychological effects are often more prevalent than physiological effects, and can be exhibited in several ways including irritation, anxiety, anger, restlessness, and trouble perceiving and concentrating (Atmaca et al., 2005). The relationship between stress and elevated levels of noise can thus be significant.

Halpern (1995) defines stress as, “that which imposes demands for adjustment upon an individual” (p. 28). Stressors in the environment may be sources of disturbance such as heat, chemical pollutants, and noise. These stressors can trigger a physiological reaction, which causes the sympathetic nervous system to exhibit a fight or flight response. Noise is negatively appraised when it is an unwanted or bothersome sound; however the appraisal of a sound as noise is subjective, and dependent on the internal state of the individual. Different individuals may exhibit unique responses to the same auditory stimuli. For example, elderly individuals often vocalize complaints about noise despite in general possessing objectively poorer hearing. This suggests that the sensitivity of a person's hearing does not solely predict the subjective appraisal of sound as noise. Halpern (1995) hypothesized that if a sound is appraised as noise, it then induces annoyance and can thus cause an individual to experience stress.

Findings on the extent to which noise appraisal is dependent on age vary (Van Kamp & Davies, 2013). For example, previous literature has shown that the exposure–annoyance curve of schoolchildren (aged 9–11 years) for aircraft noise, overall, has the same pattern as in adults. However, in the case of German children aged between 8 and 14 years, children were annoyed by road traffic noise at home less frequently than adults (Van Kamp and Davies, 2013). Thus, noise may be found to increase physiological and psychological distress, but individual experiences and perceptions of noise vary.

1.1. Noise across various environments

According to Van Kamp and Davies (2013), “an area or place is defined as noise sensitive if noise interferes with the normal activities associated with the area's use” (p. 153). Noise sensitive environments may be residential, educational, and recreational areas. Research regarding acoustic layouts of classrooms has shown that one major source of noise within the classroom is noise that occurs from nearby classrooms. This type of noise reduces speech intelligibility and privacy. Noise also, increases distractions, which can decrease attention (Shield, Greenland, & Dockrell, 2010). Crandell and Smaldino (2000) suggested four main acoustical variables interfere with perception in classrooms: reverberation time of the room, level of background noise, relationship between the level of the teacher's voice and the level of the background noise, and the distance between the teacher and the child. Background noise played a large role within this framework, and included noises generated externally of the building, noises generated internally of the building, and noises generated from within the classroom. One significant contributor to the level of background noise within classrooms that was often noted was heating, ventilating, and air-conditioning systems (Woolner & Hall, 2010).

Ljung et al. (2009) Ljung, Sörqvist, and Hygee (2009) concluded that road traffic noise heard from within classrooms impaired reading speed and basic mathematics, but had no significant effect on reading comprehension or on mathematical reasoning. Other research conducted in France with 10-year-old children found that noise exposure while at school was significantly associated with measures of fatigue, headaches, and higher cortisol levels, all indicators of the children's stress reactions (Van Kamp and Davies, 2013). Shield and Dockrell (2008) investigated the effects of inside and outside noise

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