

EVIDENCE FOR AUTISM SPECTRUM DISORDERS AND ENVIRONMENTAL DESIGN

RELEVANT CADRE RESEARCH

- Title:** Sensory wellbeing for adolescents with developmental disabilities: Creating (and testing) a sensory wellbeing hub
- Funds:** American Society of Interior Designers, Lane Tech Alumni Association
- Period:** June 2017 to January 2019
- Collaborators:** Lane Tech College Prep High School, Sean Ahlquist (Univ. of Michigan), Ouva, Mohawk Industries
- Findings:** After constructing a wellbeing hub for adolescents with autism spectrum disorders (ASD) in a Chicago public high school, students' self reported wellbeing-in-school showed a trend of improvement, and students with ASD reported better emotional wellbeing between the first two semesters. These results imply a gradual increase in efficacy of the hub over time. Within the hub, students most often utilized sensory interventions offering compression, lower sound levels, and/or tactile and proprioceptive elements. Sensory intervention usage in the hub differed between students with ASD and those without ASD. As individual students' characteristics and hub usage varied significantly, a single-case analysis—that is, analyzing data per person instead of using aggregated data—was found to be useful in informing caregivers and educators of how to support individual students' unique sensory needs.

RESEARCH ARTICLES

Autism Spectrum Disorders and Sensory Processing

AUTISM SPECTRUM DISORDERS

Baio J, Wiggins L, Christensen DL, et al. (2018). "Prevalence of autism spectrum disorder among children aged 8 Years — Autism and Developmental Disabilities Monitoring Network, 11 Sites, United

States, 2014." *Morbidity and Mortality Weekly Report (MMWR) Surveillance Summaries* **67** (SS-6):1-23. doi: 10.15585/mmwr.ss6706a1

[Excerpted from pages 1-2] ... The Autism and Developmental Disabilities Monitoring (ADDM) Network is an active surveillance system that provides estimates of the prevalence of autism spectrum disorder (ASD) among children aged 8 years whose parents or guardians reside within 11 ADDM sites in the United States (Arizona, Arkansas, Colorado, Georgia, Maryland, Minnesota, Missouri, New Jersey, North Carolina, Tennessee, and Wisconsin). ... For 2014, the overall prevalence of ASD among the 11 ADDM sites was 16.8 per 1,000 (one in 59) children aged 8 years. Overall ASD prevalence estimates varied among sites, from 13.1–29.3 per 1,000 children aged 8 years. ASD prevalence estimates also varied by sex and race/ethnicity. Males were four times more likely than females to be identified with ASD. Prevalence estimates were higher for non-Hispanic white (henceforth, white) children compared with non-Hispanic black (henceforth, black) children, and both groups were more likely to be identified with ASD compared with Hispanic children. Among the nine sites with sufficient data on intellectual ability, 31% of children with ASD were classified in the range of intellectual disability (intelligence quotient [IQ] <70), 25% were in the borderline range (IQ 71–85), and 44% had IQ scores in the average to above average range (i.e., IQ >85). The distribution of intellectual ability varied by sex and race/ethnicity. ... The overall ASD prevalence estimate of 16.8 per 1,000 children aged 8 years in 2014 is higher than previously reported estimates from the ADDM Network. Because the ADDM sites do not provide a representative sample of the entire United States, the combined prevalence estimates presented in this report cannot be generalized to all children aged 8 years in the United States. ... With prevalence of ASD ranging from 13.1 to 29.3 per 1,000 children aged 8 years in different communities throughout the United States, the need for behavioral, educational, residential, and occupational services remains high, as does the need for increased research on both genetic and nongenetic risk factors for ASD.

Wei, X., et al. (2015). "Transition to adulthood: Employment, education, and disengagement in individuals with autism spectrum disorders." *Emerging Adulthood* **3**(1): 37-45.

Relatively little is known about the pathways youth with autism spectrum disorders (ASDs) take in the transition to adulthood in terms of employment and postsecondary education (PSE). Applying life course sequence analysis to a nationally representative sample of youth with ASDs (N = 120), this study clustered various longitudinal sequences into three typical transition groups in the 6 years after high school exit: primarily focused on PSE (57.4%), continuously or increasingly disengaged (i.e., not employed nor in PSE, 29.0%), and primarily focused on employment (13.6%). All three groups experienced unique struggles in the transition to adulthood. We found variations in disproportionate transition patterns by gender, family income, functional cognitive skills, and conversational skills. Policy implications are discussed.

White, S. W., et al. (2009). "Anxiety in children and adolescents with autism spectrum disorders." *Clinical Psychology Review* **29**(3): 216-229.

Anxiety and poor stress management are common concerns in clinical samples of children with autism spectrum disorders (ASD). Anxiety may worsen during adolescence, as young people face an increasingly complex social milieu and often become more aware of their differences and interpersonal difficulties. This review summarizes the state of research on the prevalence, phenomenology, and treatment of anxiety in youth with autism and related conditions such as Asperger's disorder. Using search words autism, Asperger(s), or pervasive developmental disorder and anxiety or anxious to find reports published between 1990 and 2008, this review identified 40 papers. The results of the review suggest that anxiety, whether measured categorically or dimensionally, is indeed common in children and adolescents with autism spectrum disorders and may be a source of additional morbidity. The assessment of

anxiety disorders in ASD should be conducted using multiple informants and modalities, as children with ASD often do not display age-typical symptoms of anxiety. To date, relatively few controlled intervention studies using well-characterized samples have been conducted despite preliminary evidence for efficacy of select pharmacological and psychosocial approaches. Recommendations for future applied research are presented and clinical implications are explored.

WHO (2017, April). "Autism spectrum disorders." [Media Centre](http://www.who.int/mediacentre/factsheets/autism-spectrum-disorders/en/). Retrieved August 9, 2017 from <http://www.who.int/mediacentre/factsheets/autism-spectrum-disorders/en/>.

Key facts:

- 1 in 160 children has an autism spectrum disorder (ASD).
- ASDs begin in childhood and tend to persist into adolescence and adulthood.
- While some people with ASD can live independently, others have severe disabilities and require life-long care and support.
- Evidence-based psychosocial interventions, such as behavioural treatment and parent skills training programmes, can reduce difficulties in communication and social behaviour, with a positive impact on wellbeing and quality of life for persons with ASD and their caregivers.
- Interventions for people with ASD need to be accompanied by broader actions for making physical, social and attitudinal environments more accessible, inclusive and supportive.
- Worldwide, people with ASD are often subject to stigma, discrimination and human rights violations. Globally, access to services and support for people with ASD is inadequate.

ASD refers to a range of conditions characterised by some degree of impaired social behaviour, communication and language, and a narrow range of interests and activities that are both unique to the individual and carried out repetitively.

ASDs begin in childhood and tend to persist into adolescence and adulthood. In most cases the conditions are apparent during the first 5 years of life.

Individuals with ASD often present other co-occurring conditions, including epilepsy, depression, anxiety and attention deficit hyperactivity disorder (ADHD). The level of intellectual functioning in individuals with ASDs is extremely variable, extending from profound impairment to superior levels.

SENSORY PROCESSING

Crane, L., et al. (2009). "Sensory processing in adults with autism spectrum disorders." *Autism* **13**(3): 215-228.

Unusual sensory processing has been widely reported in autism spectrum disorders (ASDs); however, the majority of research in this area has focused on children. The present study assessed sensory processing in adults with ASD using the Adult/Adolescent Sensory Profile (AASP)¹, a 60-item self-report questionnaire assessing levels of sensory processing in everyday life. Results demonstrated that sensory abnormalities were prevalent in ASD, with 94.4 percent of the ASD sample reporting extreme levels of sensory processing on at least one sensory quadrant of the AASP. Furthermore, analysis of the patterns of sensory processing impairments revealed striking within-group variability in the ASD group, suggesting that individuals with ASD could experience very different, yet similarly severe, sensory processing abnormalities. These results suggest that unusual sensory processing in

¹ The Adult/Adolescent Sensory Profile (AASP) is based on Dunn's model of sensory processing described in Dunn's (1997) article included in this document.

ASD extends across the lifespan and have implications regarding both the treatment and the diagnosis of ASD in adulthood.

Dunn, W. (1997). "The impact of sensory processing abilities on the daily lives of young children and their families: A conceptual model." Infants and young children **9**: 23-35.

The article describes a proposed model for considering sensory processing an important factor in young children's performance. The author reviews constructs from neuroscience and behavioral science to propose how the transaction among these constructs may provide a framework for understanding various patterns of behavior and for developing methods for handling young children's sensory processing needs in a functional and supportive manner. The author reviews data from a series of studies on the Sensory Profile, a family-report measure of a child's responses to sensory experiences during daily life, to illustrate the utility and possible quantitative support for the proposed model components in young children with and without disabilities.

Edelson, S. M., et al. (1999). "Behavioral and physiological effects of deep pressure on children with autism: A pilot study evaluating the efficacy of Grandin's Hug Machine." American Journal of Occupational Therapy **53**(2): 145-152.

Objective: One symptom common to many persons with autism is a high arousal or anxiety level. This study investigated the effects of deep pressure on arousal and anxiety reduction in autism with Grandin's Hug Machine, a device that allows self-administration of lateral body pressure.

Method: Twelve children with autism were randomly assigned to either an experimental group (receiving deep pressure) or a placebo group (not receiving deep pressure but in the disengaged Hug Machine²). All children received two 20-min sessions a week over a 6-week period. Arousal was measured behaviorally with the Conners Parent Rating Scale and physiologically with galvanic skin response (GSR) readings.

Results: Behavioral results indicated a significant reduction in tension and a marginally significant reduction in anxiety for children who received the deep pressure compared with the children who did not. Additionally, children in the experimental group, whose GSR measures decreased, on average, after deep pressure, were somewhat more likely to have higher GSR arousal a priori.

Conclusion: These preliminary findings support the hypothesis that deep pressure may have a calming effect for persons with autism, especially those with high levels of arousal or anxiety.

Fernández-Andrés, M. I., et al. (2015). "A comparative study of sensory processing in children with and without autism spectrum disorder in the home and classroom environments." Research in Developmental Disabilities **38**: 202-212.

Sensory processing and higher integrative functions impairments are highly prevalent in children with ASD. Context should be considered in analyzing the sensory profile and higher integrative functions. The main objective of this study is to compare sensory processing, social participation and praxis in a group of 79 children (65 males and 14 females) from 5 to 8 years of age (M=6.09) divided into two groups: ASD Group (n=41) and Comparison Group (n=38). The Sensory Processing Measure (SPM) was used to evaluate the sensory profile of the children: parents reported information about their children's characteristics in the home environment, and teachers reported information about the same characteristics in the classroom environment. The ASD Group obtained scores that indicate higher levels of dysfunction on all the assessed measures in both environments, with the greatest differences

² See Grandin (1992) listed in this document.

obtained on the social participation and praxis variables. The most affected sensory modalities in the ASD Group were hearing and touch. Only in the ASD Group were significant differences found between the information reported by parents and what was reported by teachers: specifically, the teachers reported greater dysfunction than the parents in social participation ($p=.000$), touch ($p=.003$) and praxis ($p=.010$). These results suggest that the context-specific qualities found in children with ASD point out the need to receive information from both parents and teachers during the sensory profile assessment process, and use context-specific assessments.

Foxe, J. J., et al. (2015). "Severe Multisensory Speech Integration Deficits in High-Functioning School-Aged Children with Autism Spectrum Disorder (ASD) and Their Resolution During Early Adolescence." Cerebral Cortex **25**(2): 298-312.

Under noisy listening conditions, visualizing a speaker's articulations substantially improves speech intelligibility. This multisensory speech integration ability is crucial to effective communication, and the appropriate development of this capacity greatly impacts a child's ability to successfully navigate educational and social settings. Research shows that multisensory integration abilities continue developing late into childhood. The primary aim here was to track the development of these abilities in children with autism, since multisensory deficits are increasingly recognized as a component of the autism spectrum disorder (ASD) phenotype. The abilities of high-functioning ASD children ($n = 84$) to integrate seen and heard speech were assessed cross-sectionally, while environmental noise levels were systematically manipulated, comparing them with age-matched neurotypical children ($n = 142$). Severe integration deficits were uncovered in ASD, which were increasingly pronounced as background noise increased. These deficits were evident in school-aged ASD children (5–12 year olds), but were fully ameliorated in ASD children entering adolescence (13–15 year olds). The severity of multisensory deficits uncovered has important implications for educators and clinicians working in ASD. We consider the observation that the multisensory speech system recovers substantially in adolescence as an indication that it is likely amenable to intervention during earlier childhood, with potentially profound implications for the development of social communication abilities in ASD children.

Grandin, T. (1992). "Calming effects of deep touch pressure in patients with autistic disorder, college students, and animals." Journal of child and adolescent psychopharmacology **2**(1): 63-72.

Many people with autistic disorder have problems with oversensitivity to both touch and sound. The author (an autistic person) developed a device that delivers deep touch pressure to help her learn to tolerate touching and to reduce anxiety and nervousness. The "squeeze machine" applies lateral, inwardly directed pressure to both lateral aspects of a person's entire body, by compressing the user between two foam-padded panels. Clinical observations and several studies suggest that deep touch pressure is therapeutically beneficial for both children with autistic disorder and probably children with attention-deficit hyperactivity disorder. Only minor and occasional adverse effects have been noted. Data are reported that show a similar calming effect in nonreferred college students. A review of the animal literature reveals that animals have similar calming reactions, and also suggests possible additional physiological effects of deep touch pressure. At present, there are increasing anecdotal reports of the clinical value of the squeeze machine, including suggestions that it can be used to reduce required doses of psychostimulant medications. More clinical studies are needed to evaluate the potential role of this seemingly beneficial form of "physiological" stimulation.

Howe, F. E. J. and S. D. Stagg (2016). "How sensory experiences affect adolescents with an autistic spectrum condition within the classroom." Journal of Autism and Developmental Disorders **46**: 1656-1668.

Sensory processing difficulties are consistently reported amongst individuals with an autistic spectrum condition (ASC); these have a significant impact on daily functioning. Evidence in this area comes from observer reports and first-hand accounts; both have limitations. The current study used the Adolescent/Adult Sensory Profile (AASP; Brown and Dunn in The Adolescent/Adult Sensory Profile: self questionnaire. Pearson), and a qualitative questionnaire to investigate sensory issues in school children with ASC. The AASP found that the participants' mean scores were outside normal parameters. Participants reported difficulties in at least one sensory domain, with hearing affecting them the most. Content analysis revealed sensory sensitivity to affect the participant's learning and that sensory experiences were largely negative. Results suggest that schools need to create sensory profiles for each individual with ASC.

Joosten, A. V. and A. C. Bundy (2010). "Sensory processing and stereotypical and repetitive behaviour in children with autism and intellectual disability." *Australian Occupational Therapy Journal* **57**(6): 366-372.

Background: Sensory processing disorders have been linked to stereotypical behaviours in children with intellectual disability (ID) and autism spectrum disorders (ASD) and to anxiety in children with ASD. In earlier phases of this study with the same participants, we found that those with both ASD and ID were more motivated than those with ID alone to engage in stereotypical behaviour to alleviate anxiety. In this phase, we confirmed that children with both ASD and ID and those with ID alone process sensation differently than typically developing children. We asked: Do the sensory processing difficulties of children with ASD and ID differ significantly from those of children with ID alone in a way that would help explain the increased anxiety of the former group?

Method: Parents of children with ASD and ID (n = 29; mean age 9.7 years) and with ID alone (n = 23; mean age 9.5 years) completed a Sensory Profile (SP) to provide information about their children's sensory processing abilities. SP quadrant scores for each group were compared with each other and with the published norms of typically developing children.

Results: Children with ASD and ID and with ID alone processed sensory information differently than typically developing children (P = 0.0001; d = > 2.00). Children with both ASD and ID were significantly more sensitive (P = 0.007; d = 0.70) and avoidant (P < 0.05; d = 0.47) than the children with ID alone. Conclusion: We conclude that increased sensitivity and the tendency to avoid sensation may help explain anxiety in children with autism.

Kanakri, S. M., et al. (2017). "An observational study of classroom acoustical design and repetitive behaviors in children with autism." *Environment and Behavior* **49**(8).

The objective of the present study is to explore the impact of acoustical design on children with autism in school classrooms. Empirical research on this topic will provide information on how interior space features and spatial environment characteristics can be used to support the learning and developmental needs of children with autism. Specifically, the connection between repetitive behaviors and ambient noise levels in school classroom environments was observed in four classrooms. The occurrence of repetitive motor movements, repetitive speech, ear covering, hitting, loud vocalizations, blinking, and verbally complaining in relation to decibel levels were analyzed using Noldus Observer XT software. As hypothesized, a correlation between noise levels and frequency of target behaviors was found; that is, as decibel levels increased, several of the observed behaviors occurred with greater frequency. Further empirical testing is necessary to test a causal relationship between increased ambient noise levels and autism-related behaviors, and sensory discomfort as a mediator of that relationship. Findings are applied to the development of classroom design guidelines.

Leekam, S. R., et al. (2007). "Describing the sensory abnormalities of children and adults with autism." *Journal of Autism and Developmental Disorders* **37**(5): 894-910.

Patterns of sensory abnormalities in children and adults with autism were examined using the Diagnostic Interview for Social and Communication Disorders (DISCO). This interview elicits detailed information about responsiveness to a wide range of sensory stimuli. Study 1 showed that over 90% of children with autism had sensory abnormalities and had sensory symptoms in multiple sensory domains. Group differences between children with autism and clinical comparison children were found in the total number of symptoms and in specific domains of smell/taste and vision. Study 2 confirmed that sensory abnormalities are pervasive and multimodal and persistent across age and ability in children and adults with autism. Age and IQ level affects some sensory symptoms however. Clinical and research implications are discussed.

INDIRECT EFFECTS OF AUTISM AND DEVELOPMENTAL DISABILITIES ON CAREGIVERS' AND EDUCATORS' WELLBEING

Brunsting, N. C., et al. (2014). "Special education teacher burnout: A synthesis of research from 1979 to 2013." Education and Treatment of Children **37**(4): 681-711.

Teacher burnout occurs when teachers undergoing stress for long periods of time experience emotional exhaustion, depersonalization, and lack of personal accomplishment (Maslach, 2003). Outcomes associated with burnout include teacher attrition, teacher health issues, and negative student outcomes. Special educators are at high risk for burnout as their working conditions align with many factors associated with burnout. In this review, we updated the literature on special education teacher working conditions by reviewing studies (N = 23) that (a) included a quantitative measure of burnout and (b) focused on special education teachers as participants. An analysis of the studies reviewed provided a clear base of support for the association between burnout and a range of variables from the individual, classroom, school, and district levels. Bronfenbrenner's (1977) Ecological Model supplied the organizational framework for the range of variables. Teacher experience, student disability, role conflict, role ambiguity, and administrative support were particularly salient factors in special education teacher burnout. Important gaps in the research are discussed, future directions for researchers are outlined, and implications for teachers and other practitioners are provided.

Hastings, R. P. and T. Brown (2002). "Behavior problems of children with autism, parental self-efficacy, and mental health." American Journal on Mental Retardation **107**(3): 222-232.

Self-efficacy has been identified in the general parenting literature as an important variable affecting parent outcomes. In the present study, 26 mothers and 20 fathers of children with autism reported on their self-efficacy, anxiety, and depression. Teachers rated the behavior problems of the children. Regression analyses showed that self-efficacy mediated the effect of child behavior problems on mothers' anxiety and depression, but there was no evidence that it functioned as a mediator for fathers. However, there was evidence that self-efficacy moderated the effect of child behavior problems on fathers' anxiety. No evidence for the moderating effect of self-efficacy was apparent for mothers. Methodological issues and the theoretical and practical implications of these results are discussed.

Stempien, L. R. and R. C. Loeb (2002). "Differences in job satisfaction between general education and special education teachers." Remedial and Special Education **23**(5): 258-267.

The occupational field of special education has been particularly vulnerable to losing its well-trained professional staff. Academic preparation and training of these teachers is costly and time-consuming, and replacing them is difficult. The present study compared the satisfactions and dissatisfactions of teachers of emotionally/behaviorally impaired students in special education, teachers of students in general education, and teachers responsible for both groups of students. Teachers of students in special education programs were found to be the most dissatisfied. Specific stresses and frustrations, both from within and from outside

the classroom, were found to be associated with the dissatisfaction. The difficulties were particularly common in younger, less experienced special education teachers. The implications of these findings are discussed, and recommendations aimed at improving job satisfaction for special education teachers are presented.

Environmental Design for Autism

MULTI-SENSORY ENVIRONMENTS AND AUTISM

Cuvo, A. J., et al. (2001). "Effects of living room, Snoezelen room, and outdoor activities on stereotypic behavior and engagement by adults with profound mental retardation." Research in Developmental Disabilities **22**(3): 183-204.

Two experiments were conducted to test the effect of a room with sensory equipment, or Snoezelen room, on the stereotypic behavior and engagement of adults with profound mental retardation. In Experiment 1, participants were observed in their living room before and after attending the Snoezelen room. Results showed that there tended to be a reduction in stereotypy and increase in engagement when participants went from their living room to the Snoezelen room, and a return of these behaviors to pre-Snoezelen levels in the living room. Positive effects in the Snoezelen room did not carryover to the living room. In Experiment 2, the living and Snoezelen rooms were compared to an outdoor activity condition with the same participants and target behaviors. Results showed that the outdoor condition was superior, the Snoezelen condition intermediate, and the living room least effective in their impact on stereotypic behavior and engagement. Conceptualizations regarding factors that maintain stereotypic behavior and engagement were discussed in the context of the three experimental conditions.

McKee, S. A., et al. (2007). "Effects of a Snoezelen room on the behavior of three autistic clients." Research in Developmental Disabilities **28**(3): 304-316.

The effect of a Snoezelen room on the disruptive and prosocial behavior of three male, autistic inpatients was examined. In an ABAB reversal design, specific disruptive and prosocial behaviors were recorded for each client throughout the four 28-day periods of the study. Results indicated that the three clients had different responses to the room, but no client showed a decrease in disruptive behaviors while in the Snoezelen condition compared to baseline, and one client showed a clear pattern of increased disruptive behavior during the Snoezelen periods. There was a slight tendency for clients to engage in more prosocial behaviors while in Snoezelen. These findings do not support the contention that Snoezelen rooms are effective interventions for aggressive behavior in this client population.

Shapiro, M., et al. (1997). "The efficacy of the "Snoezelen" in the management of children with mental retardation who exhibit maladaptive behaviors." The British Journal of Development Disabilities **43**(85): 140-155.

[Excerpted from pages 153-154] Statement of the problem: The "Snoezelen", a method of treatment which takes place in a specially adapted harmonious sensory environment, is increasingly being used in the treatment of children who are mentally retarded. Although therapists are impressed by the results achieved, empirical data demonstrating the effectiveness of this treatment method are lacking. In the present study, we investigated the effectiveness of this method in inhibiting maladaptive behaviour such as stereotypic self-stimulating behaviour (SSB), and facilitating adaptive behaviour.

Method: The study was an open, controlled, cross-over design. Twenty children (5-10 years old) moderately or severely developmentally disabled who displayed stereotypic behaviours,

received treatment in both the "Snoezelen" (study treatment) and "Playroom" (control treatment) over 4 time periods. During treatment their behaviour was recorded by trained observers, both in writing and by means of a video camera, and their ambulatory heart rate was monitored by means of a portable electrocardiogram recorder (Holter).

Results: Children in the "Snoezelen" showed a significantly greater decrease in the mean number of stereotypic behaviours (1.6 in the "Snoezelen" versus 4.2 in the "Playroom", $p < 0.001$), a significantly greater increase in adaptive behaviours (5.0 in the "Snoezelen" versus 3.3 in the "Playroom", $p < 0.001$), and a significantly greater mean absolute percentage change in heart rate in the "Snoezelen".

Conclusion: The "Snoezelen" is an effective therapeutic setting for short-term reduction of SSB and facilitation of adaptive behaviours in children with moderate to severe mental retardation. Long-term effects need to be studied.

Thompson, C. J. (2011). "Multi-sensory intervention observational research." *International Journal of Special Education* **26**(1): 202-214.

An observational research study based on sensory integration theory was conducted to examine the observed impact of student selected multi-sensory experiences within a multi-sensory intervention center relative to the sustained focus levels of students with special needs. A stratified random sample of 50 students with severe developmental disabilities ages eight to eighteen was selected for observation within a public school environment representing four classifications of students: TMH (Trainable Mentally Handicapped), PMH (Profoundly Mentally Handicapped), students with Autism, and students with Multiple Disabilities. An observation form representing 24 observable behaviors (facial expressions, vocal cues, and body language) defined in the literature was developed and pilot tested for construct validation and reliability purposes. Four trained observers completed inter-rater reliability analysis prior to the study. Observers completed observation forms for individual students for three 20-minute time periods (within the regular classroom, within the multi-sensory center, and after returning to the regular classroom). Sustained focus was measured by combining specific observed types of data reflecting student engagement and on-task behaviors as defined in the literature. Data were analyzed using repeated measures ANOVA. Findings of the study lend strong support for implementing multi-sensory experiences to increase the sustained focus of students with special needs.

ENVIRONMENTAL DESIGN FOR AUTISM

Bhatta, S. R., et al. (2017). "Sensory and emotional perception of wooden surfaces through fingertip touch." *Frontiers in Psychology* **8**: 367.

Previous studies on tactile experiences have investigated a wide range of material surfaces across various skin sites of the human body in self-touch or other touch modes. Here, we investigate whether the sensory and emotional aspects of touch are related when evaluating wooden surfaces using fingertips in the absence of other sensory modalities. Twenty participants evaluated eight different pine and oak wood surfaces, using sensory and emotional touch descriptors, through the lateral motion of active fingertip exploration. The data showed that natural and smooth wood surfaces were perceived more positively in emotional touch than coated surfaces. We highlight the importance of preserving the naturalness of the surface texture in the process of wood-surface treatment so as to improve positive touch experiences, as well as avoid negative ones. We argue that the results may offer possibilities in the design of wood-based interior products with a view to improving consumer touch experiences.

Gaines, K., et al. (2016). *Designing for Autism Spectrum Disorders*, Routledge.

Designing for Autism Spectrum Disorders explains the influence of the natural and man-made environment on individuals with autism spectrum disorders (ASD) and other forms of intellectual/developmental disabilities (IDD). Drawing on the latest research in the fields of environmental psychology and education, the authors show you how architecture and interior spaces can positively influence individuals with neurodiversities by modifying factors such as color, lighting, space organization, textures, acoustics, and ventilation.

Mostafa, M. (2008). "An architecture for autism: Concepts of design intervention for the autistic user." *International Journal of Architectural Research* **2**(1): 189-211.

One in every 150 children is estimated to fall within the autistic spectrum, regardless of socio-cultural and economic aspects, with a 4:1 prevalence of males over females (ADDM, 2007). Architecture, as a profession, is responsible for creating environments that accommodate the needs of all types of users. Special needs individuals should not be exempt from such accommodation. Despite this high incidence of autism, there are yet to be developed architectural design guidelines catering specifically to the scope of autistic needs.

The primary goal of this research is to correct this exclusion by developing a preliminary framework of architectural design guidelines for autism. This will be done through a two phase study. The first phase will determine, through a questionnaire of first hand caregivers of autistic children, the impact of architectural design elements on autistic behaviour, to determine the most influential. The second phase, based on the findings of the first, will test the conclusive highest ranking architectural elements in an intervention study on autistic children in their school environment. Specific behavioural indicators, namely attention span, response time and behavioural temperament, will be tracked to determine each child's progress pre and post intervention, for a control and study group.

This study concludes in outlining the findings of both phases of the study, the first being the determination of the most influential architectural design elements on autistic behaviour, according to the sample surveyed. The second group of findings outlines design strategies for autism in three points. The first is the presentation of a "sensory design matrix" which matches architectural elements with autistic sensory issues and is used to generate suggested design guidelines. The second is the presentation of these hypothetical guidelines, two of which are tested in the presented study. These guidelines are presented as possible interventions for further testing. The third is a group of specific design guidelines resultant from the intervention study. It is hoped that these will provide a basis for the further development of autistic specific design standards, and take us one step further towards more conducive environments for autistic individuals.

Pati, D. and U. Nanda (2011). "Influence of positive distractions on children in two clinic waiting areas." *Health Environments Research & Design Journal* **4**(3): 124-140.³

Objective: To examine the influence of positive distraction on the behavior and activity of children in two clinic waiting areas.

Background: People spend a considerable proportion of time waiting in hospitals. Studies show that the quality of waiting environments influences the perception of quality of care and caregivers, that perception of waiting time is a better indicator of patient satisfaction than actual waiting time, and that the waiting environment contributes to the perception of wait time. In fact, the attractiveness of the physical environment in waiting areas has been shown to be significantly associated with higher perceived quality of care, less anxiety, and higher reported positive interaction with staff. Can positive distractions in waiting areas improve the waiting experience, as indicated by the behavior and activities of children waiting for

³ This study does not focus on autism yet has potential to benefit children with autism.

treatment?

Method: Five distraction conditions were randomly introduced in the waiting area of the dental and cardiac clinics of a major pediatric tertiary care center through a single plasma screen intervention. The attention, behavior, and activities of waiting children were recorded. Data on 158 pediatric patients were collected over 12 days during December 2008 and January 2009.

Results: Data analysis shows that the introduction of distraction conditions was associated with more calm behavior and less fine and gross movement, suggesting significant calming effects associated with the distraction conditions. Data also suggest that positive distraction conditions are significant attention grabbers and could be an important contributor to improving the waiting experience for children in hospitals by improving environmental attractiveness.

Tanabe, A. (2016). "Designing for health: Finding a common environmental language of care for children across the autistic spectrum." *Contract*. **2017 edition**: 33-37. New York.

[Excerpted from page 34] ... As awareness increases, society is adjusting to integrating people with ASD and helping them to access the standard joys and comforts of everyday life. For example, Theater Development Fund (TDF) of New York has organized an Autism Theater Initiative since 2011 to host the "Autism Night" showing of plays and musicals with lower sound volume, lights on in the audience, and the coordinators and "break rooms" available in the lobby. AMC offers a similar special showing for the children's movies. Several major airports offer a simulation program for the passenger with ASD to have a walk-through with the specialist ahead of time, so the environment which is stressful even for the neuro-typical population, would be more tolerable during the actual travel.

... The study of Autism has a relatively short history, and the studies focused on environmental factors are even shorter. ... Also as it is called "spectrum" disorder, the degree of their functioning varies greatly. The complexity of this issue makes it particularly difficult to provide designers with a set of guidelines. ... Still, some of the research for therapy and the educational environment are helpful in gaining insight such as Dr. Magda Mostafa's 2008 study. When we reference these studies, we must understand that the educational environment sometimes intentionally challenges the comfort level of the student in order to acclimate them into the real world. In healthcare setting however, the focus might be shifted more towards making sure there are no factors to trigger panic, meltdowns, or self-destructive behavior. These children are often in the hospital for non-neurological treatment and are already in pain or discomfort, and are definitely in a fearful, stressful situation. While the parents of a neuro-typical child might try to pamper the child to soothe them, our focus on the design solution for the autistic patients should be paid towards how to avoid sensory stressors from environment, and should the panic happen how the architecture and the operational protocol can assist alleviating the condition, and how the families and caregivers can find the assistance readily available.

OTHER RESOURCES

Autism Society. <http://www.autism-society.org/>

Autism Speaks. <https://www.autismspeaks.org/>

National Autism Association. <http://nationalautismassociation.org/>

Kijeong Jeon: Environmental design for special needs. <http://www.kijeongjeon.com>

Sean Ahlquist. <https://taubmancollege.umich.edu/faculty/directory/sean-ahlquist>